Appendix 2-1: Annual Permit Report for the Picayune Strand Restoration Project, Phase 1 – Prairie Canal Backfill and Road Removal Component

Permit Report (May 1, 2011–April 30, 2012)
Permit Number: 0221670

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Contributors: Violeta Ciuca and Nimmy Jeyakumar

SUMMARY

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

The Prairie Canal Backfill and Road Removal component, which was Phase 1 of the Picayune Strand Restoration Project, was completed in 2007, and post-construction monitoring is being conducted under Permit Modification 0221670-008-EM. Results from hydrologic monitoring are provided in this report for Water Year 2012 (WY2012) (May 1, 2011–April 30, 2012). Water quality is no longer monitored within the Phase 1 footprint because the plugging of Prairie Canal has eliminated permanent surface water sites for water quality sampling. Exotic vegetation mapping and control for WY2012 is reported within this annual report. The final report for Year 4 (WY2011) post-restoration vegetation monitoring report is also provided.

Work has also been completed on other phases of the Picayune Strand Restoration Project. This work is permitted under the United States Army Corps of Engineers (USACE) Picayune Strand Restoration Project – Road Removal Project Permit SAJ 2005-6598. Permits 0288313-001 and 0288313-003 have also been issued to the USACE by the FDEP for the Merritt and Faka Union canals phases, respectively, of the project, and construction has commenced for both phases. Planning for the Miller Canal phase is currently under way, with a target date for

[1] Contributed as a SFWMD contractor during the draft SFER production cycle.

awarding the contract for construction near the end of Fiscal Year 2013. Baseline monitoring has been completed for all phases. Post-construction monitoring for these phases has not yet begun.

Table 1. Key permit-related information.

Project Name:	Picayune Strand Restoration Project, Phase 1 – Prairie Canal Backfill and Road Removal Component
Permit Number:	0221670
Issue and Expiration Dates: Permit #: 0221670 (original) Permit #: 0221670-008-EM (mod)	Issued: 10/28/2005; Expires: 10/28/2010 Issued: 6/11/2010; Expires: 6/10/2015
Project Phase:	Post-Construction
Permit Specific Condition Requiring Annual Report:	17
Relevant Period of Record:	May 1, 2011–April 30, 2012
Report Generator:	Kimberly Chuirazzi kchuiraz@sfwmd.gov 561-682-2425
Permit Coordinator:	Nirmala Jeyakumar njeyaku@sfwmd.gov 561-682-6471

Table 2. Attachments included with this report.

Attachment	Title
A	Specific Conditions and Cross-References
B	Hydrologic Data
C	Picayune Strand Restoration Project Restored Footprint Exotics Mapping and Control Coordination, Annual Summary Effectiveness Assessment Report
D	Year 4 Post-Restoration Vegetation Monitoring of Prairie Canal and Control Transects – Picayune Strand Restoration PSRP Vegetation Monitoring 2011 Final Report

INTRODUCTION

PROJECT DESCRIPTION

The Prairie Canal Backfill and Road Removal Project was the first phase of the Picayune Strand Restoration Project. The Picayune Strand Restoration Project is a Comprehensive Everglades Restoration Plan (CERP) project with the objective to restore hydrological and ecological function of the region by establishing pre-development sheetflows and hydroperiods. The first phase of this larger restoration effort consisted of the elimination of channelized flow in the Prairie Canal.

PROJECT LOCATION

The project is located in the eastern portion of the Picayune Strand Restoration Project area (**Figure** 1), which is located in an area previously known as Southern Golden Gate Estates. The Prairie Canal and roads to be removed are located in Sections 1, 2, 11, 12, 13, 14, 23, 24, 25, 26, 35, and 36 of Township 50 South Range 28 East; and Sections 1, 2, 11, 12, 13, 14, 23, 24, 25, 26, and 35 of Township 51 South Range 28 East. The filled canal forms the border between the two areas.

PROJECT OBJECTIVE

The objectives of the project are (1) restoration of the historic hydrologic regime including overland sheetflow, and historic water levels and durations (hydroperiods) through the backfilling of Prairie Canal and degradation of roads east of Merritt Canal; (2) recolonization of the construction footprint by native vegetation by controlling the invasion of exotic and nuisance vegetation; and (3) the restoration of historic plant and animal communities.

PROJECT HISTORY

The first phase of this larger restoration effort consisted of the elimination of channelized flow within Prairie Canal. To accomplish this, numerous earthen plugs were constructed along the seven miles of the canal. Also, all 65 miles of roads east of Merritt Canal (**Figure 2**), except portions containing cultural sites, were demolished and degraded or filled to ground level. The area is located directly to the west of Fakahatchee Strand Preserve State Park. Source material for the canal plugs and swale blocks consisted of spoils that came from the original canal and swale excavations, as well as the demolition and degradation of the berms and roads. More fill was available in the northern portion of the canal so more of the canal was filled in this area while plugs were used to fill the southern portion of the canal.

Work began in 2004 on the portion of the canal and roads north of 79th Street. Hydrologic effects were apparent in this area beginning in the 2005 rainy season. Plugging of the canal and road demolition was completed on March 4, 2007, and effects began to be seen in 2007 in the area south of 79th Street. These effects are discussed in more detail in the *Hydrologic Improvements* section of this report.

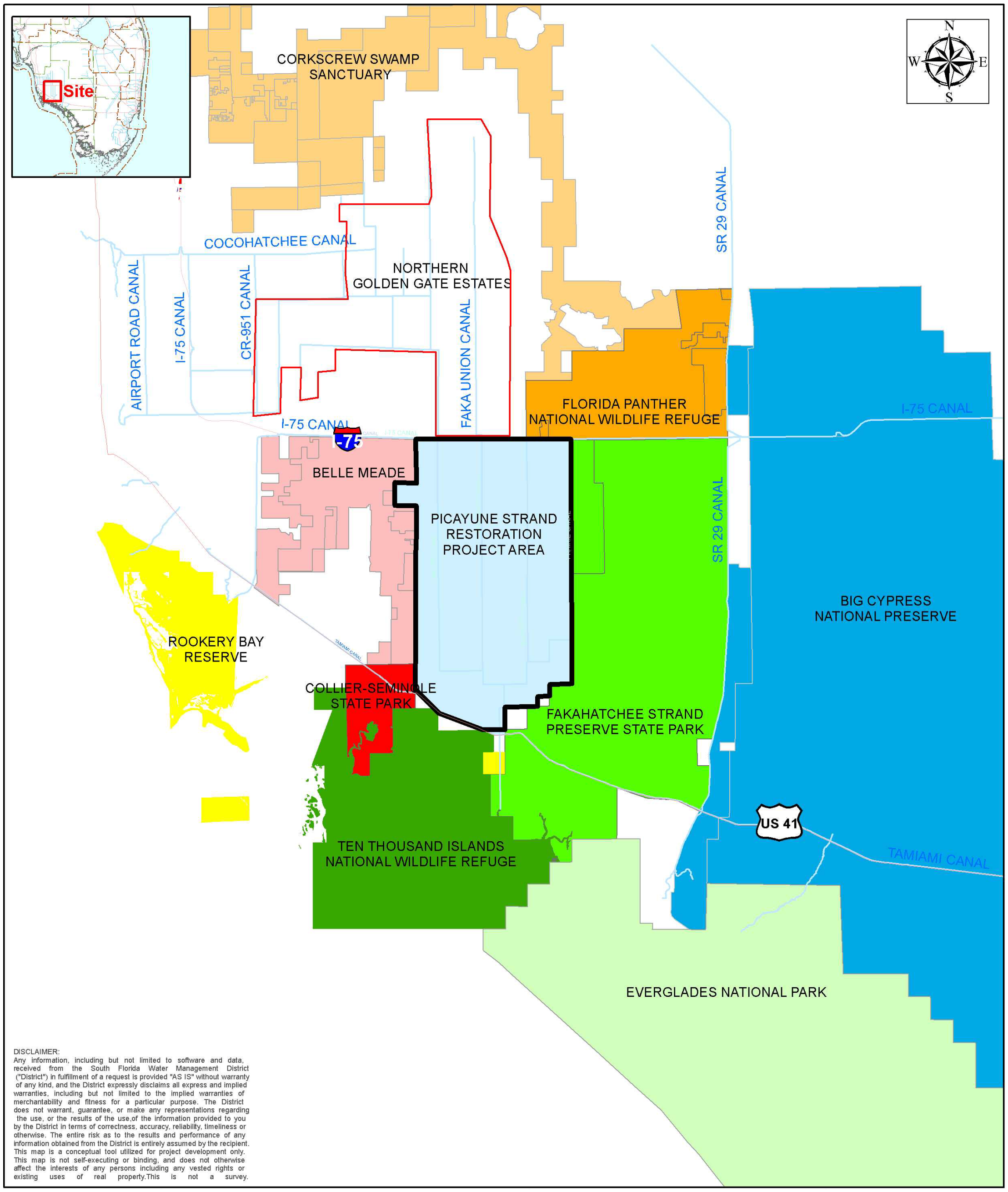


Figure 1. Picayune Strand Restoration Project area and surrounding areas. [Note: Area labeled as Corkscrew Swamp Sanctuary is the Corkscrew Regional Ecosystem Watershed (CREW); Corkscrew Swamp Sanctuary is within the CREW.]

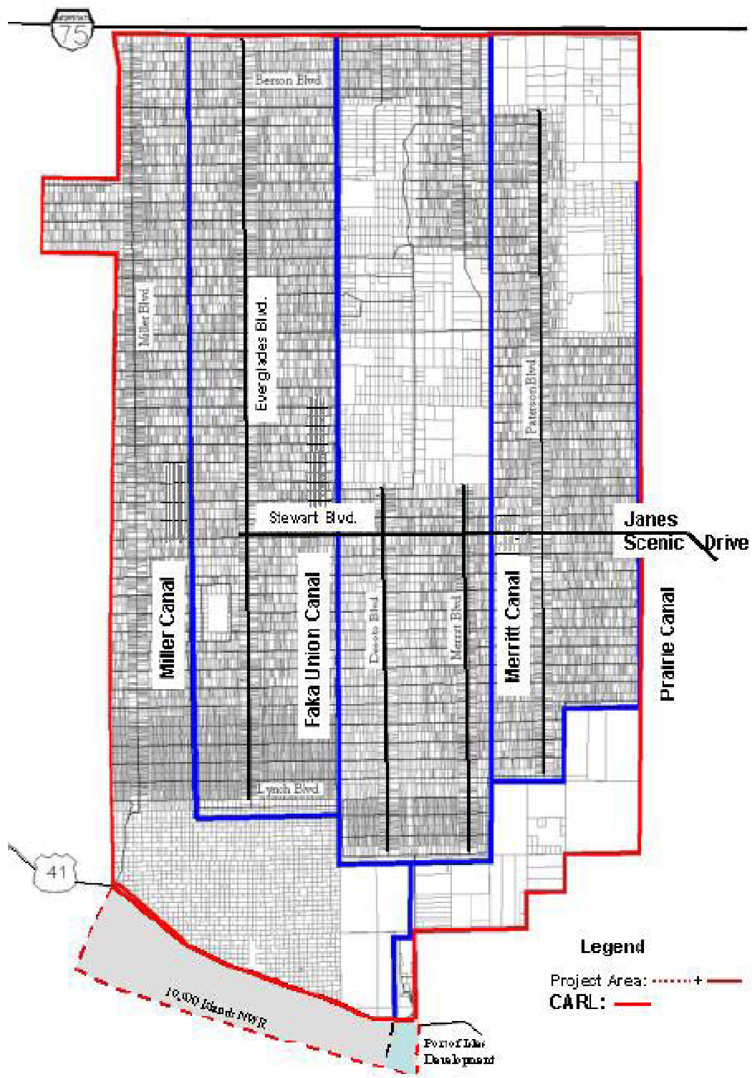


Figure 2. Picayune Strand Restoration Project area showing subdivision infrastructure prior to canal filling and road degradation.

PERMIT HISTORY

Permit number 0221670-001-GL was issued to the South Florida Water Management District (SFWMD) for the Prairie Canal Backfill and Road Removal Project on October 28, 2005. Specific condition 9 of the permit modifications, beginning with 0221670-004-GL, requires water level and water quality monitoring be conducted in accordance with the Prairie Canal Restoration Fish and Wildlife Resource Monitoring, Vegetation Monitoring and Construction Protocol Plan, dated October 14, 2002, and amended based on a letter from Kenneth Ammon, SFWMD, dated September 14, 2005. Specific condition 17 of permit modification 0221670-004-GL requires the submittal of an annual report detailing the progress of the project for five years after the completion of construction. The annual report must include a discussion of results obtained from the monitoring plan mentioned earlier in the paragraph. Modification 0221670-008-EM was issued on June 11, 2010, to modify the post-construction monitoring protocol for this project. At this time, per specific condition 9, the Modified Prairie Canal Monitoring Plan (Version 2) replaced the previous monitoring plan.

MONITORING AND REPORTING HISTORY

Past reporting for this project has been included in Volume I, Appendix 7A-2 of the *2008 South Florida Environmental Report* (SFER), 2009 SFER, and 2010 SFER, and in Volume III, Appendix 2-1 of the 2011 SFER and 2012 SFER.

PROJECT STATUS

Monitoring continues for Phase 1, per the requirements in Permit Modification 0221670-008-EM, dated June 11, 2010. Groundwater levels will be measured and reported at the seven stations listed in **Table 4** through 2050. Water quality is no longer monitored within the Phase 1 footprint because plugging of Prairie Canal has eliminated permanent surface water sites for water quality sampling. Once the pump stations currently under construction are operational, water quality will be measured as it enters and leaves the Picayune Strand Restoration Project area. Vegetation at three 2-kilometer transects crossing the upper, middle, and lower portions of Prairie Canal must be monitored annually for two years following construction, and then every three years for six more years (years 1, 2, 4, 7, and 10) at the end of the growing season. Year 4 monitoring was conducted in WY2011. Assessment and treatment of exotic vegetation continues. Once a species has been completely eradicated (has 0.0% coverage for three consecutive years at specific locations), it will be removed from the list of exotics to be monitored by the SFWMD at those locations. Exotic vegetation management will continue to take place throughout the Picayune Strand Restoration Project area through the Florida Forest Service (formerly the Division of Forestry) Land Management Program, but it will not be reported in annual reports.

Work has also been completed on other phases of the Picayune Strand Restoration Project. Permits 0288313-001 and 0288313-003 have been issued by the FDEP to the USACE for the Merritt and Faka Union canals phases, respectively, of the project, and construction has commenced for both phases. Clearing and leveling of logging trams east of Miller Canal is now complete, with the exception of some containing cultural sites. Roads in the Merritt Canal phase have been removed, with the exception of some north of the pump station, those needed to complete work on the pump station and its associated levees, and some portions containing cultural sites. Road removal is currently under way in the Faka Union Canal phase. Future work on the Merritt and Faka Union canals phases includes the filling of the north–south portion of the Merritt and Faka Union canals, and completion of the pump stations. Planning for the Miller Canal phase is currently under way, with a target date for awarding the contract near the end of Fiscal Year 2013.

Aquatic fauna monitoring for the Merritt Canal phase will begin in the first wet season following the first full year after the canal has been filled. Monitoring for vegetation will begin after the first full growing season (March through September) after the canal is filled. Vegetation and aquatic fauna will initially only be sampled at plots near monitoring wells next to or east of the Merritt Canal, as water levels further west will still be affected by Faka Union Canal drawdowns. These monitoring events are not scheduled until after Merritt Canal is filled because no detectable benefits are expected to be realized until after the canal filling is completed and water levels have had a chance to assume a natural hydrologic cycle. For other parameters, monitoring will commence after all three pumps are operational, the entire Picayune Strand Restoration Project is complete, and one full wet season has passed.

WATER QUALITY MONITORING

Because the Prairie Canal has been backfilled, water was not flowing at any of the water quality stations during WY2012, and monitoring was not conducted. Consequently, there is no water quality data to report.

HYDROLOGIC MONITORING

WEATHER

Daily rainfall and evapotranspiration (ETp) data were retrieved from the SFWMD's DBHYDRO database for a weather station (SGGEWX) in the project area (See **Attachment B**). The historical annual average rainfall in the Southwest Rain Area is 54.12 inches (**Table 3**) (2013 SFER – Volume I, Chapter 2). The Picayune Strand area received 55.84 inches during WY2012 (**Table 3**) indicating that this was an above-average rainfall period for the area. WY2012 rainfall was 12.99 inches higher than WY2011. The annual ETp for WY2012 was 50.43 inches compared to 56.26 inches in WY2011, a dry year (**Table 3**). For most months, ETp was higher than rainfall (**Table 3** and **Figure 3**). June and October 2011 were the wettest months. From November 2011 to January 2012, the area was dry, with ETp far higher than rainfall. This was a La Niña year, and during these events in South Florida, dry season rainfall is often below average. WY2012 dry season rainfall was 8.68 inches, 55 percent of the historical average. Daily rainfall is depicted in **Figure 4** and daily ETp for WY2012 is shown in **Figure 5**. Data used for these analyses are provided in **Attachment B**.

Table 3. Water Year 2012 (WY2012) (May 1, 2011–April 30, 2012), historical average monthly rainfall, and WY2012 evapotranspiration (ETp).

Months	Rainfall (inches)		ETp (inches)
	WY2012	Historical Average	WY2012
May	2.21	4.03	3.68
June	11.72	9.13	4.73
July	7.58	8.73	4.59
August	8.18	8.26	4.28
September	9.6	8.20	4.19
October	10.08	4.05	3.65
November	0.17	1.55	3.71
December	0.1	1.43	3.27
January	0.24	1.92	3.85
February	1.21	2.15	3.65
March	1.41	2.46	5.24
April	3.34	2.21	5.58
TOTAL	**55.84**	**54.12**	**50.43**

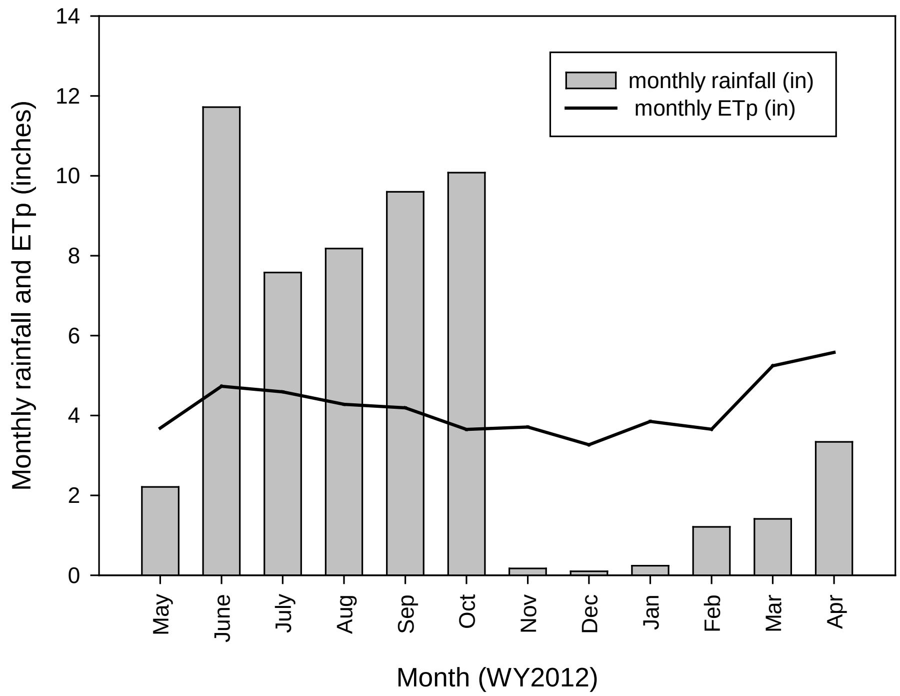


Figure 3. Monthly rainfall and ETp at the Picayune Strand Restoration Project for Water Year 2012.

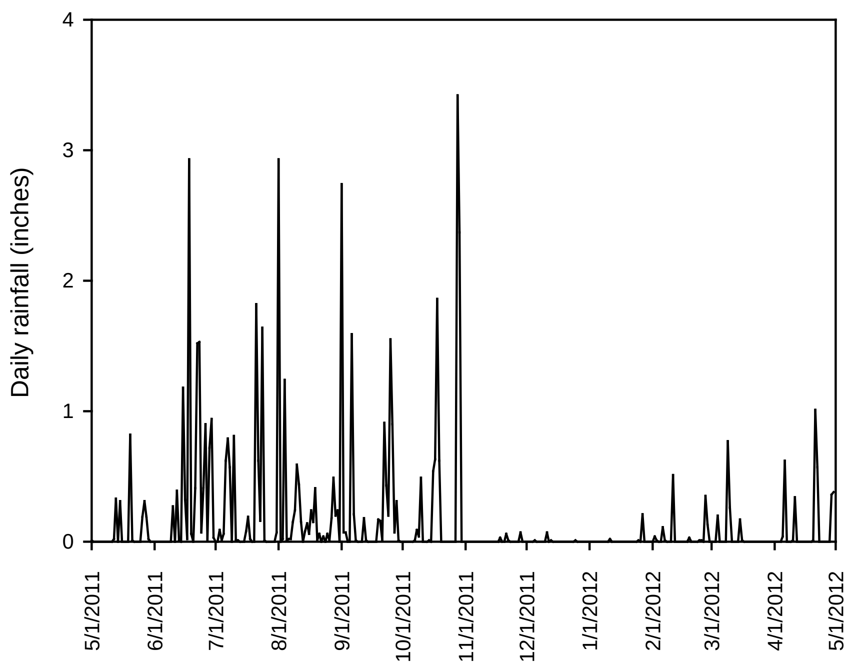


Figure 4. Daily rainfall in the Picayune Strand Restoration Project area for WY2012.

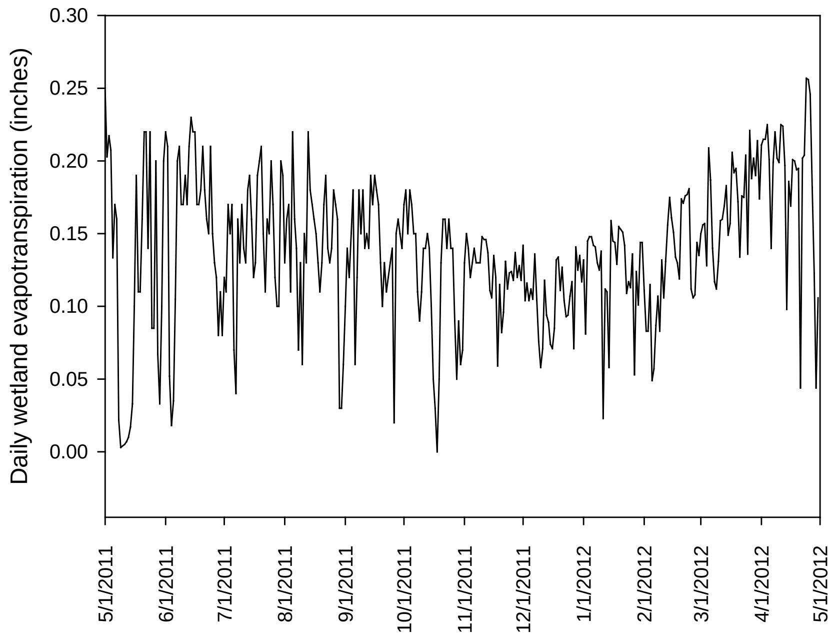


Figure 5. Daily evapotranspiration in the Picayune Strand Restoration Project area for WY2012.

GROUNDWATER LEVELS

For this phase of the project (Prairie Canal Backfilling and Road Removal), groundwater level is monitored at seven stations to the east of Merritt Canal, which are shown in **Figure 6** along with the rest of the Picayune Strand Restoration Project stations. The stations sampled are SGT1W5, SGT2W5, SGT2W6, SGT3W5, SGT3W6, SGT3W7, and SGT4W6. Information about these seven sites is presented in **Table 4**. These stations have been renamed since the permit was issued. The former names are provided in the table. **Figures 7** through **13** show water levels and depth at each of the seven stations for WY2012. Declines in groundwater levels reflect the extreme drought condition in the region. Data used for these analyses are provided in Attachment B.

Table 4. Water quality and groundwater level monitoring stations coordinates and database Dbkeys.

Latitude	Longitude	Status	DBHYDRO Station Name	Former Station Name	DBHYDRO Dbkey
260835.68	812811.048	Existing	SGT1W5	SGGE5SW	PT049
260635.995	812834.49	Existing	SGT2W5	SGGE10SW	PT059
260535.218	812739.212	Existing	SGT2W6	SGGE11SW	PT061
260319.78	812956.813	Existing	SGT3W5	SGGE16SW	PT069
260227.5	812747.2	Existing	SGT3W6	SGGE23SW	PT071
260252.501	812628.314	Existing	SGT3W7	SGGE17SW	PT073
260138.427	812842.013	Existing	SGT4W6	SGGE22SW	PT087

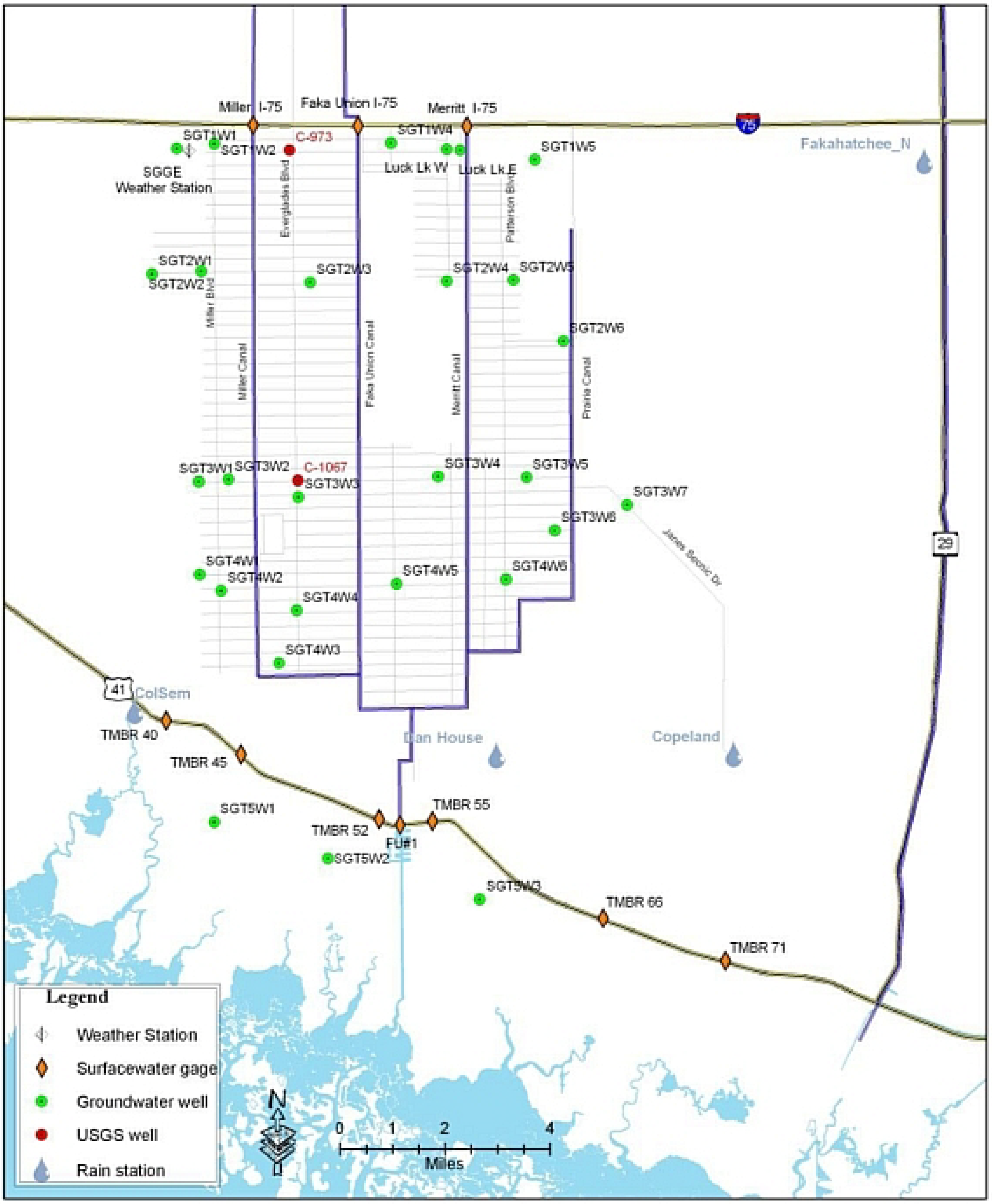


Figure 6. Water quality and hydrologic sampling stations in the Picayune Strand Restoration Project. Stations reported for this phase of the project are the seven to the east of Merritt Canal: SGT1W5, SGT2W5, SGT2W6, SGT3W5, SGT3W6, SGT3W7, and SGT4W6.

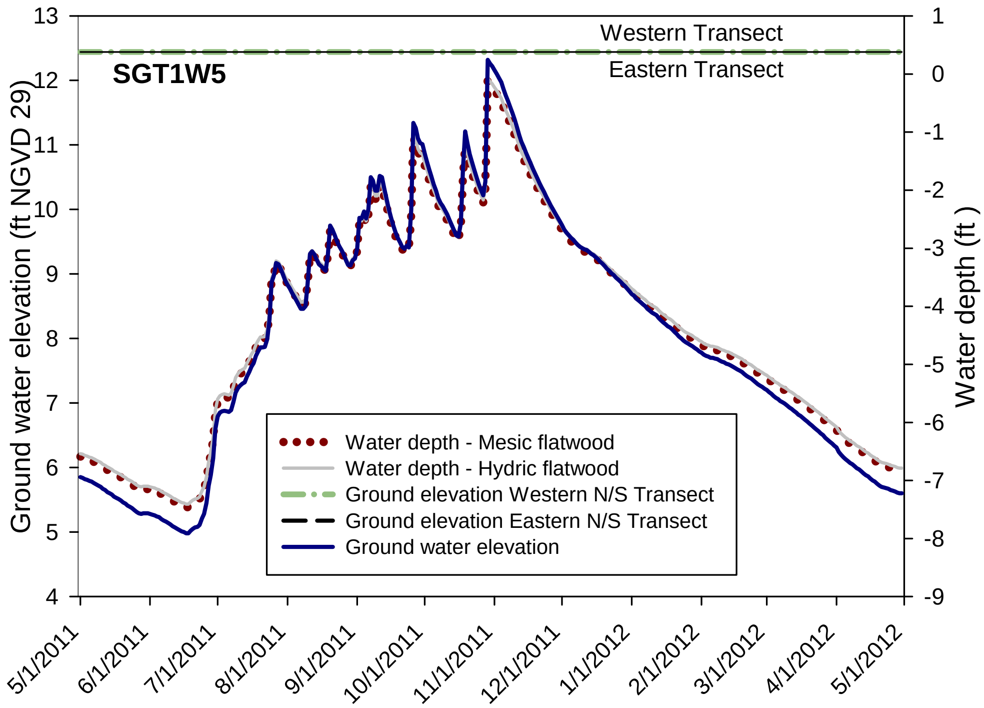


Figure 7. Ground elevation, groundwater elevation, and water depth for well SGT1W5 for WY2012.

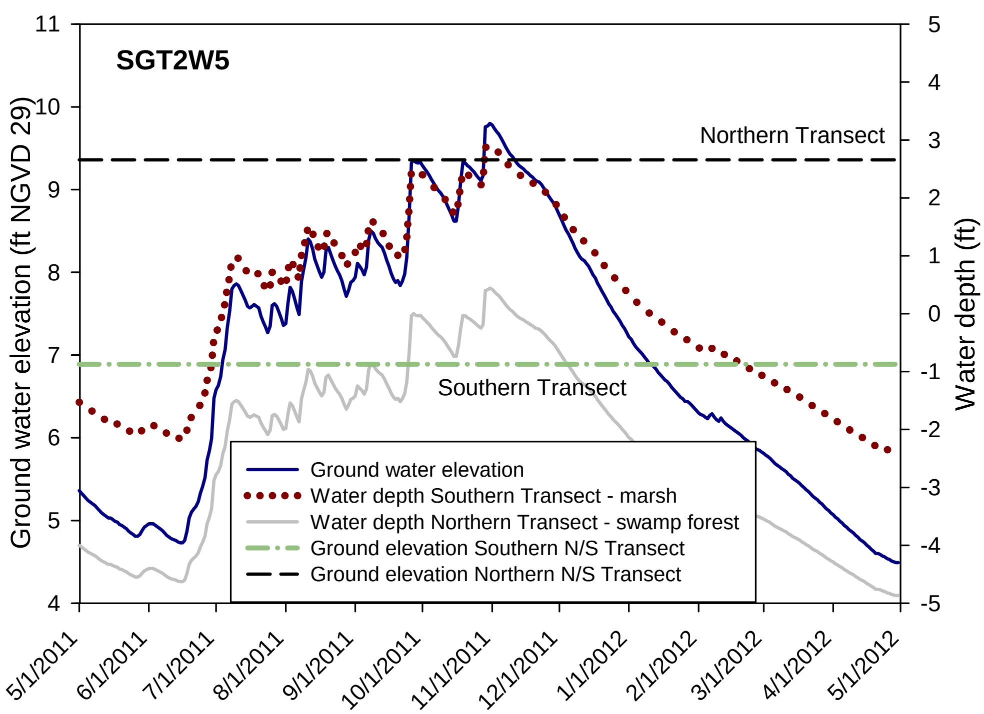


Figure 8. Ground elevation, groundwater elevation, and water depth for well SGT2W5 for WY2012.

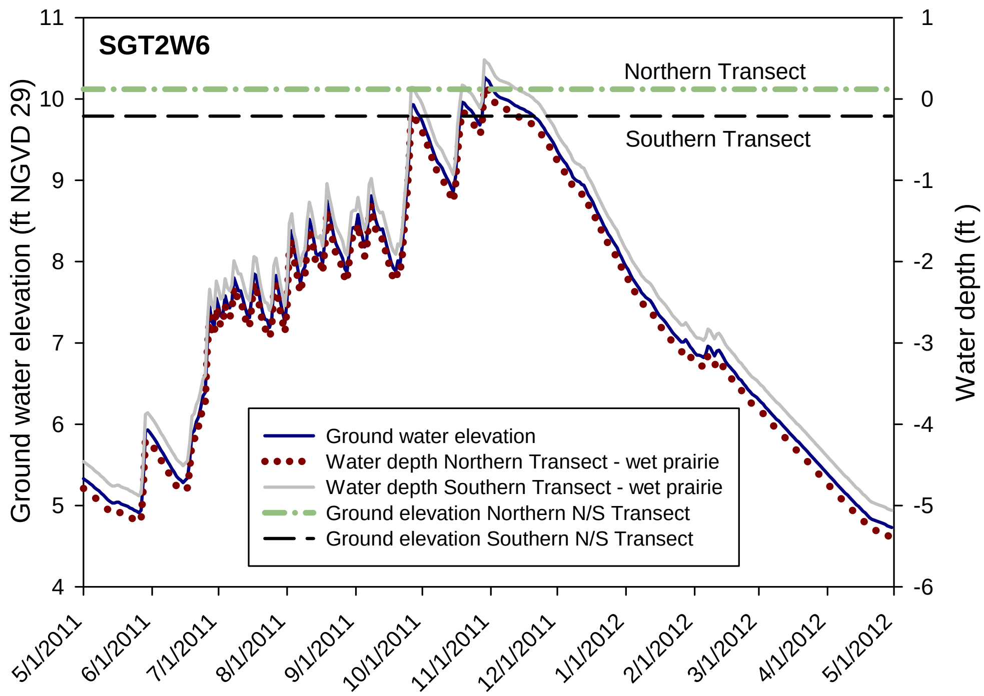


Figure 9. Ground elevation, groundwater elevation, and water depth for well SGT2W6 for WY2012.

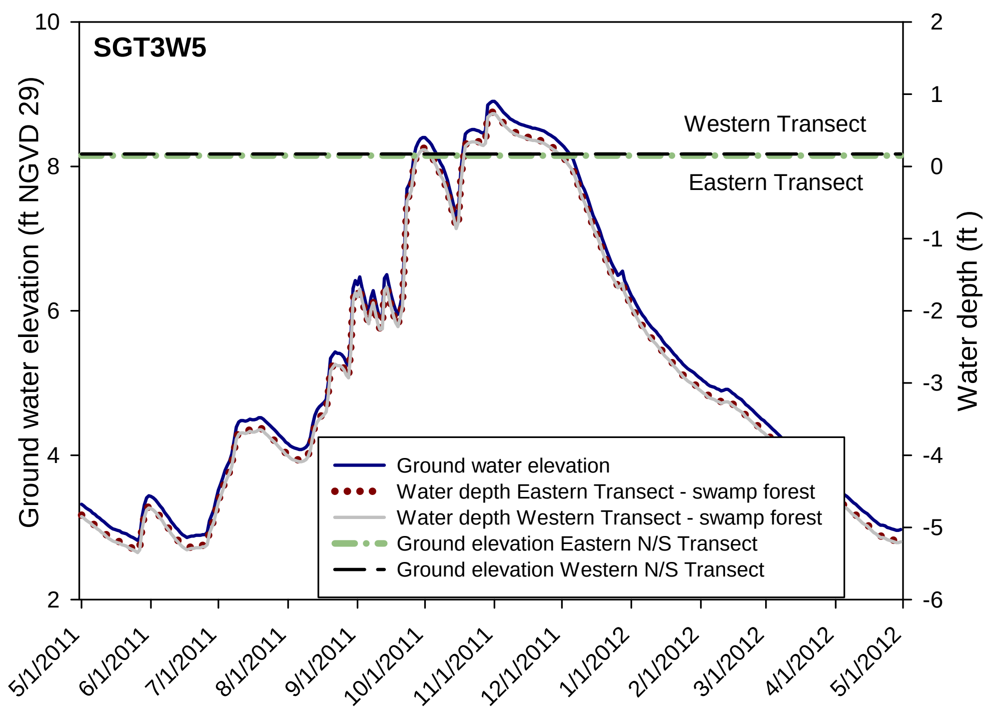


Figure 10. Ground elevation, groundwater elevation, and water depth for well SGT3W5 for WY2012.

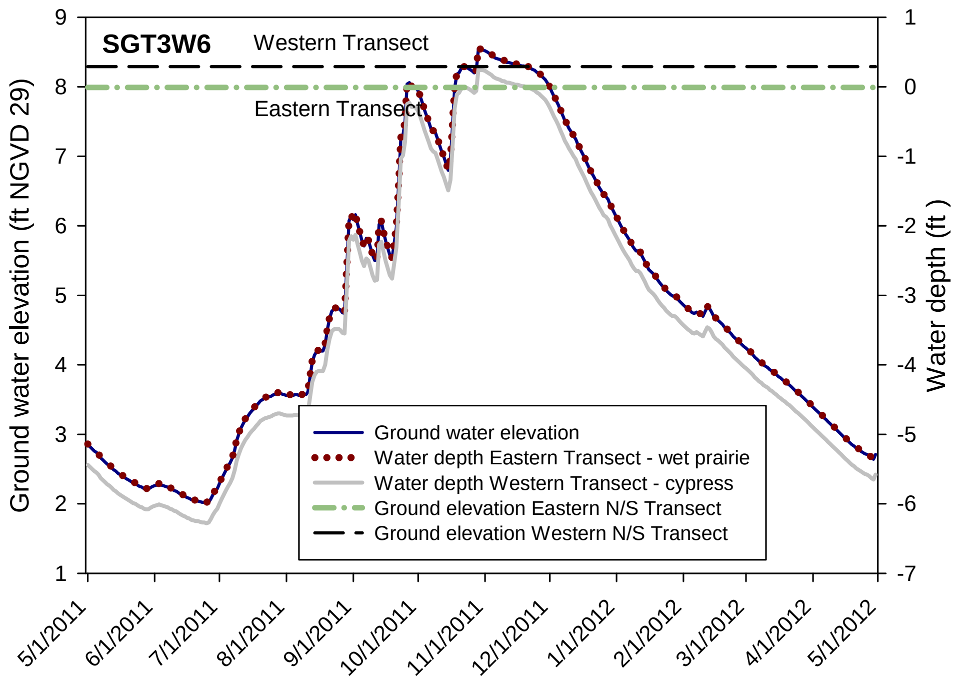


Figure 11. Ground elevation, groundwater elevation, and water depth for well SGT3W6 for WY2012.

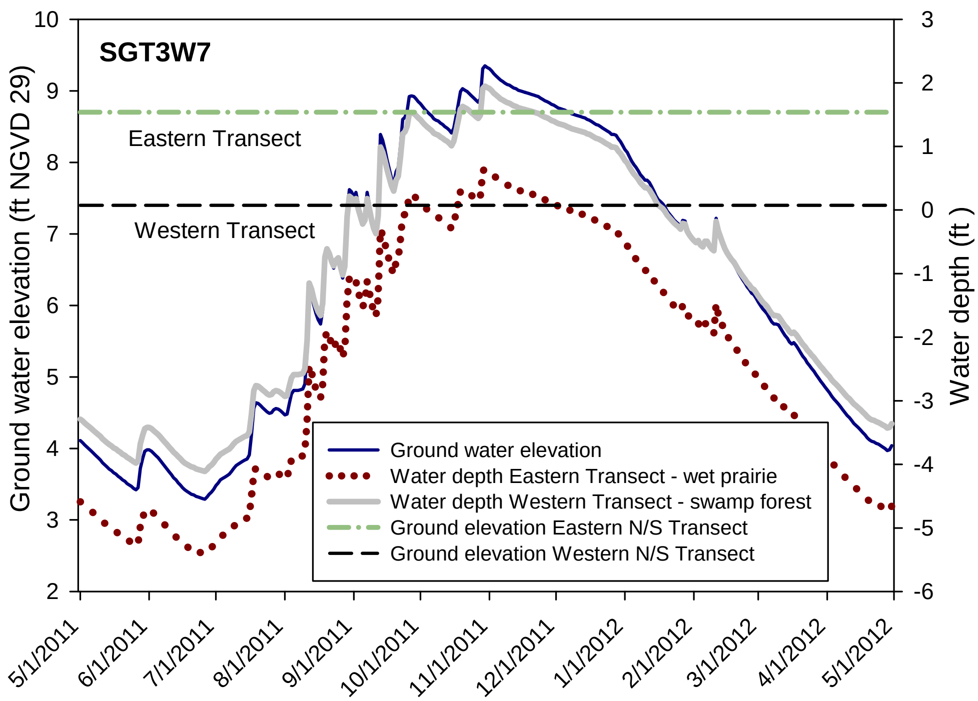
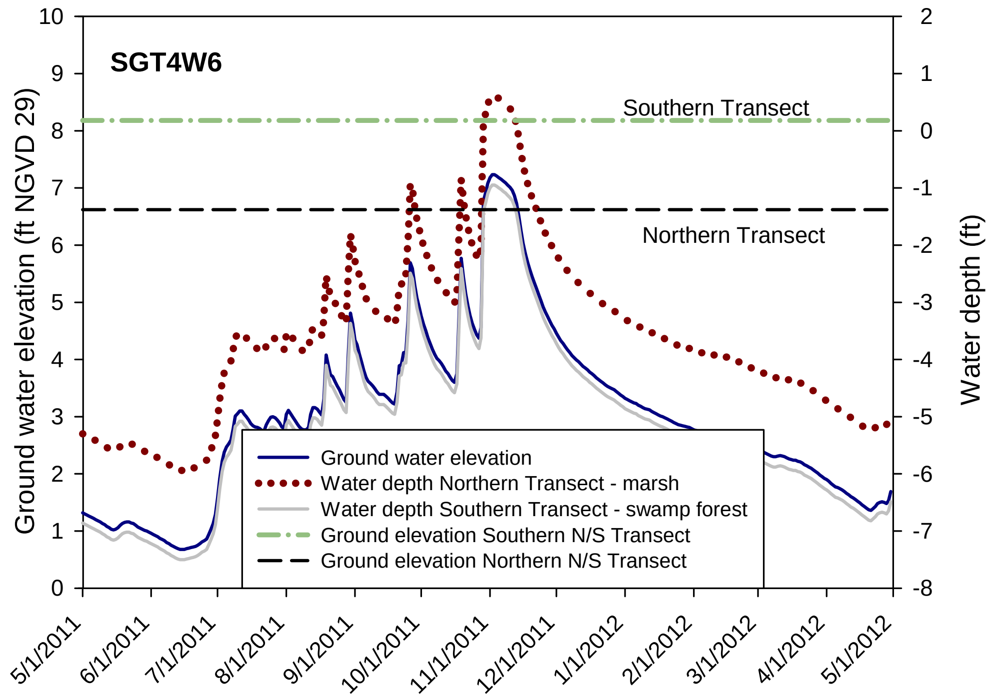


Figure 12. Ground elevation, groundwater elevation, and water depth for well SGT3W7 for WY2012.



Key: ft – feet; NGVD 29 – National Geodetic Vertical Datum of 1929; N/S – north–south.

Figure 13. Ground elevation, groundwater elevation, and water depth for well SGT4W6 for WY2012.

A reference on the natural system's hydrologic regime (hydroperiods and water depths) for the various plant communities of Picayune Strand is shown in **Table 5** (Duever, 2008).

Table 5. Hydrologic regimes of major Southwest Florida plant communities.

Southwest Florida Plant Communities	Hydroperiod (months)	Seasonal Water Level (inches)	
		Wet	Dry (1,10)*
Xeric Flatwood	0	≤-24	-60, -90
Mesic Flatwood, Mesic Hammock	≤1	≤2	-46, -76
Hydric Flatwood, Hydric Hammock	1 - 2	2 - 6	-30, -60
Wet Prairie, Dwarf Cypress	2 - 6	6 - 12	-24, -54
Marsh	6 - 10	12 - 24	-6, -46
Cypress	6 - 8	12 - 18	-16, -46
Swamp Forest	8 - 10	18 - 24	-6, -36
Open Water	>10	≥24	< 24, -6
Tidal Marsh, Mangrove, Beach	Tidal	Tidal	Tidal

* 1 = average year low water , 10 = 1-in-10 year drought

HYDROLOGIC IMPROVEMENT

Water levels measured at 24 groundwater wells placed along two transects within Fakahatchee Strand Preserve State Park (**Figure 14**) are compared to show changes in hydrologic condition before and after Prairie Canal was filled. These transects are designated as Fakahatchee North Transect and Fakahatchee South Transect.

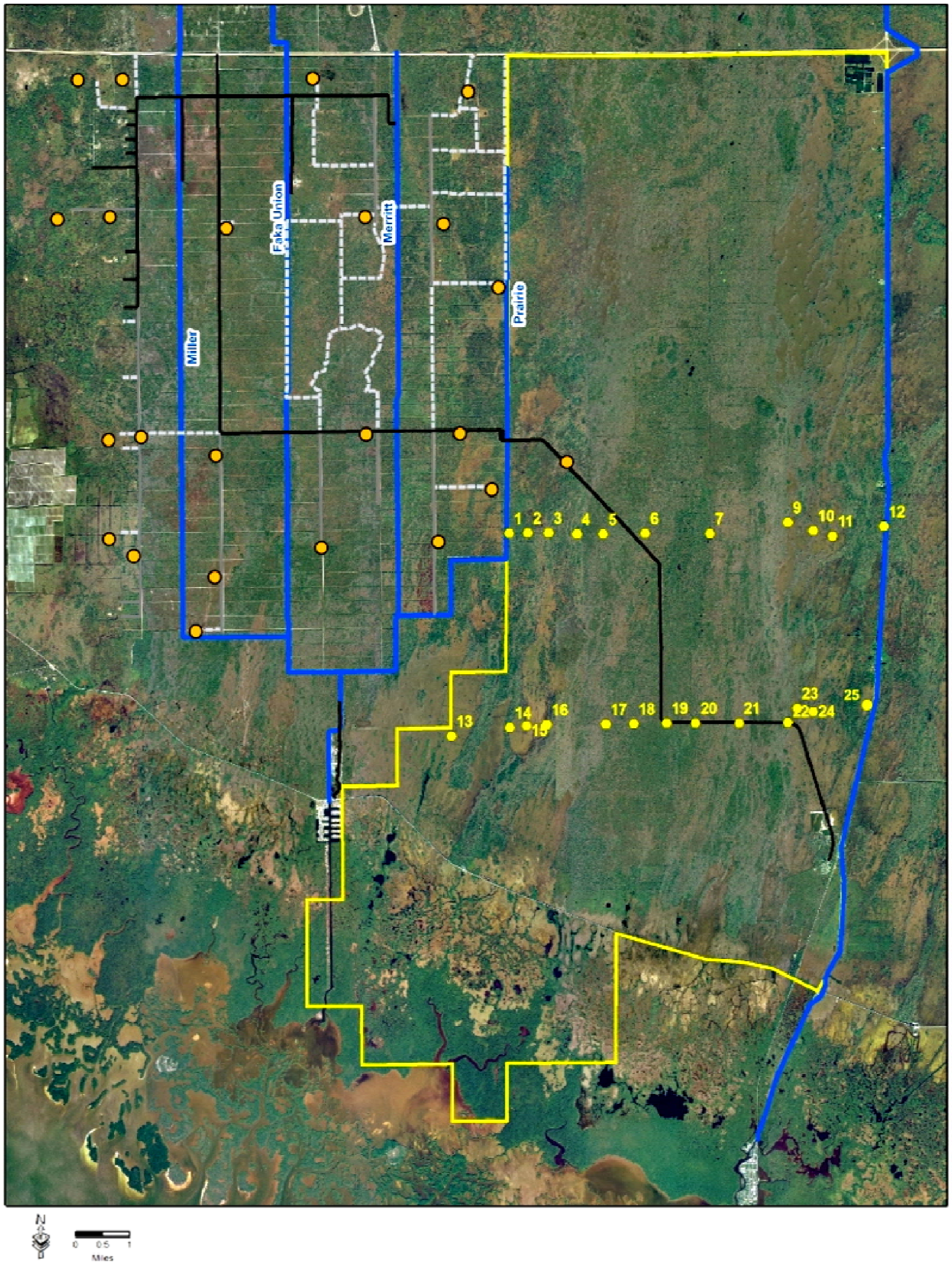


Figure 14. Groundwater wells within Fakahatchee Strand Preserve State Park (yellow dots indicate groundwater wells in Fakahatchee Strand Preserve State Park; orange dots indicate other groundwater wells).

The hydrologic effects of restoration efforts can be seen by comparing the drawdowns experienced in WY2003 for the North (**Figure 15**) and South (**Figure 16**) Transects to those in WY2012 (**Figure 17** and **Figure 18**). Because WY2012 had a much drier spring than WY2003, post-restoration water levels appear worse than those before restoration. If Prairie Canal had not been filled in, and roads and levees removed, WY2012 water levels would have been much lower.

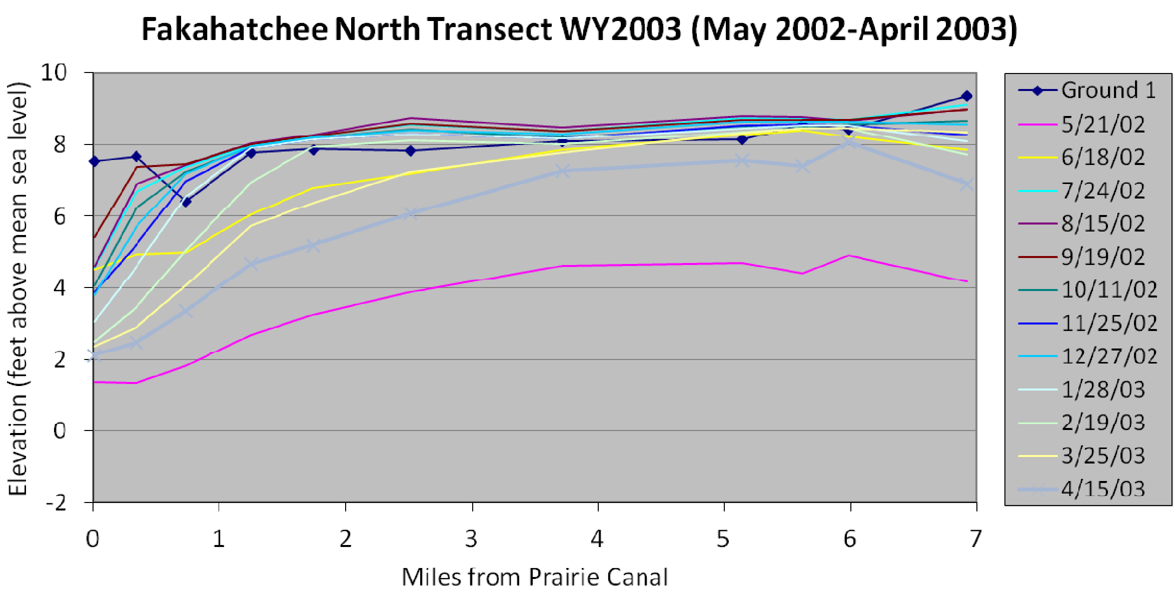


Figure 15. WY2003 monthly water profiles (May 2002–April 2003) for Fakahatchee Strand Preserve State Park North Transect.

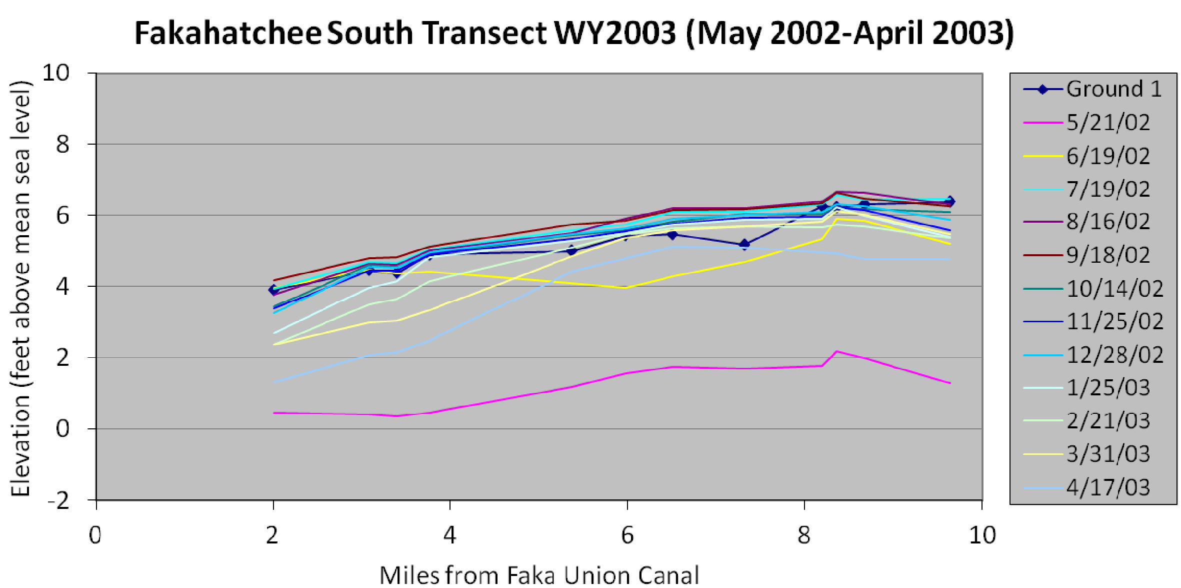


Figure 16. WY2003 monthly water profiles (May 2002–April 2003) for Fakahatchee Strand Preserve State Park South Transect.

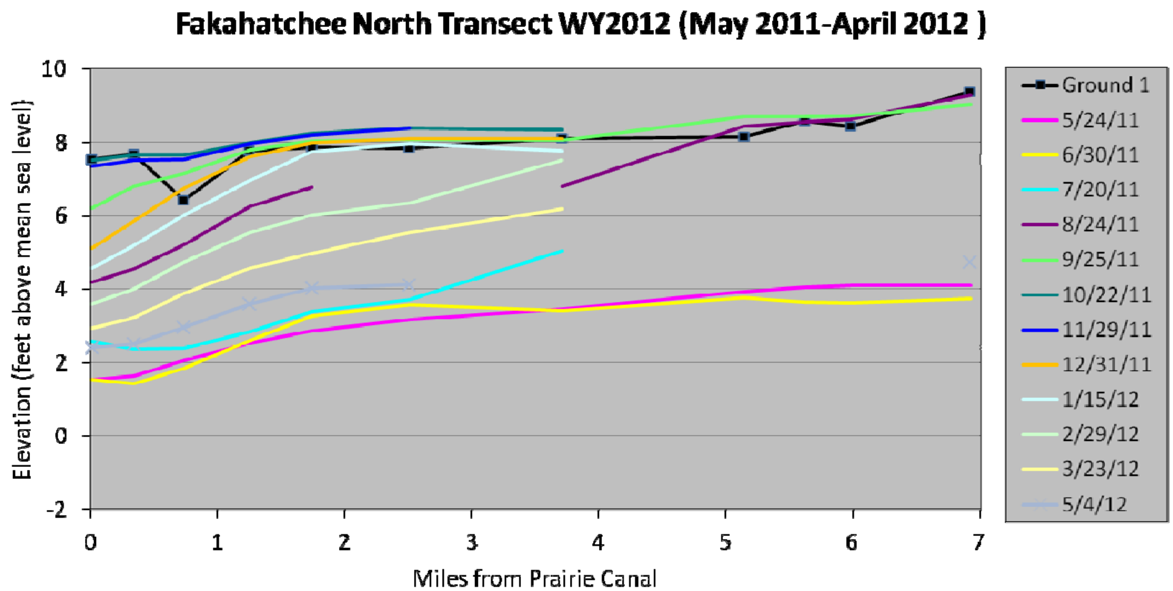


Figure 17. WY2012 monthly water profiles (May 2011–April 2012) for Fakahatchee Strand Preserve State Park North Transect.

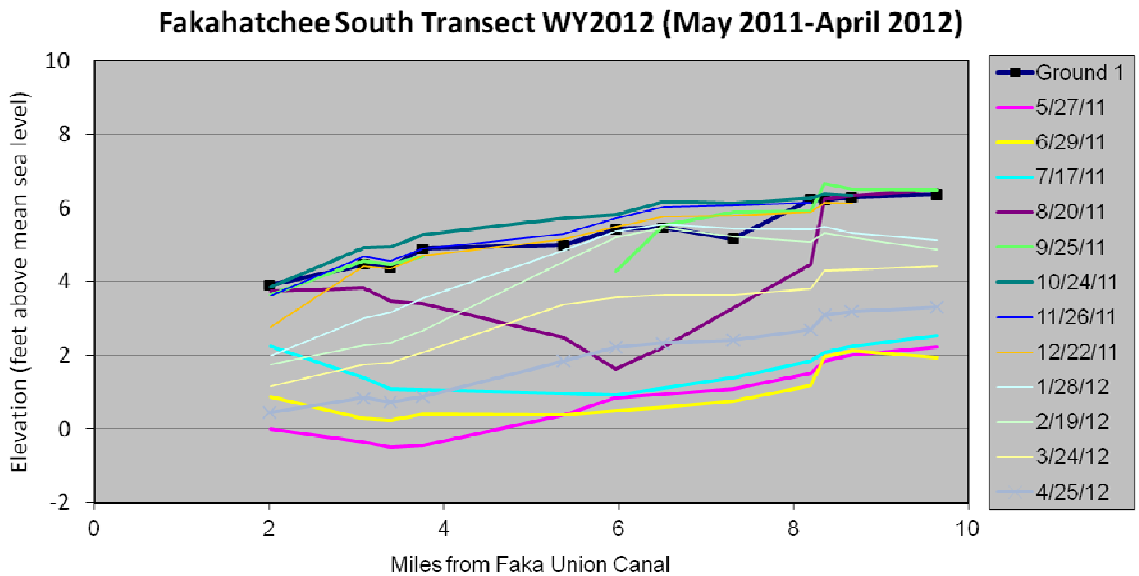


Figure 18. WY2012 monthly water profiles (May 2011–April 2012) for Fakahatchee Strand Preserve State Park South Transect.

Even with WY2012 being exceptionally dry, water levels of those groundwater wells closest to the canal were lower than those more than five miles away from the canal, compared to pre-restoration levels. The difference in water levels between the west and east end of each transect should lessen even more once Merritt Canal is filled.

Nothing additional has changed within the project area that would be expected to produce additional improvement in the hydrology. Additional improvement is expected once Merritt Canal and the east–west canals at the south end of Prairie Canal have been filled. However, the condition and character of the plant communities can be expected to improve steadily for decades under the current level of restored hydrology, as upland species die from higher water levels and longer hydroperiods, and more flood-tolerant species recolonize the sites and become established.

EXOTICS MAPPING AND CONTROL

Mapping of exotic and nuisance vegetation continued in WY2012 within the footprint of the filled Prairie Canal, the cleared road and house demolition footprints east of Merritt Canal, and the soil inversion sites off Miller Boulevard. Exotic control efforts were also conducted during the water year. These mapping and control efforts are documented in the *Picayune Strand Restoration Project Restored Footprint Exotics Mapping and Control Coordination, Annual Summary Effectiveness Assessment Report*, prepared by Environmental Resources Management under contract to the SFWMD (Attachment C).

VEGETATION TRANSECT MONITORING

Year 4 post-restoration vegetation monitoring of Prairie Canal and control transects was conducted in WY2011. The draft report was provided in last year's annual report. The final report for year 4 post-restoration vegetation monitoring, which was not available at the time the 2012 SFER was published, is now provided as Attachment D. Vegetation monitoring will not be required again until year 7 (WY2014).

WILDLIFE MONITORING

Aquatic fauna monitoring for the Merritt Canal phase will begin in the first wet season following the first full year after the canal has been filled. Aquatic fauna will initially only be sampled at plots near monitoring wells next to or east of the Merritt Canal, as water levels further west will still be affected by Faka Union Canal drawdowns. These monitoring events are not scheduled until after Merritt Canal is filled, because no detectable benefits are expected to be realized until after the canal filling is completed and water levels have had a chance to assume a natural hydrologic cycle. For the other wildlife and estuarine parameters, monitoring will commence after all three pumps are operational, the entire Picayune Strand Restoration Project is complete, and one full wet season has passed.

WORKS CITED

Duever, M. 2008. The Pre-Restoration Status of Wetlands Within and Near Picayune Strand. South Florida Water Management District, West Palm Beach, FL.

Attachment A: Specific Conditions and Cross-References

Table A-1. Specific conditions, actions taken, and cross-references presented for the Picayune Strand Restoration Project, Phase 1 – Prairie Canal Backfill and Road Removal Component (CERPRA Permit #: 0221670) in this report.

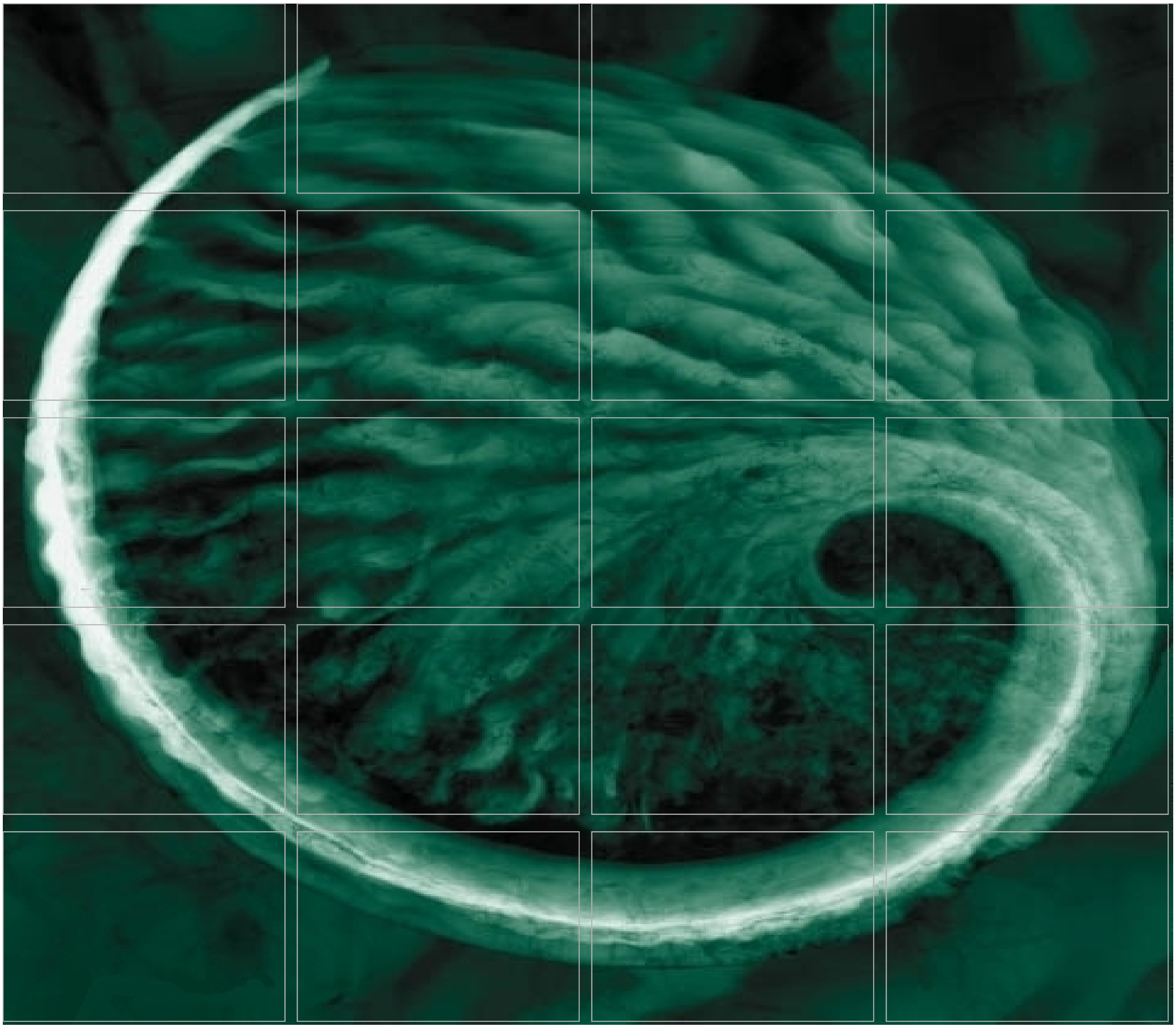
Specific Condition	Description	Applicable Phase	Action Taken	Reported in the 2013 SFER in: *(All references are to Volume III, unless noted)*			
				Narrative (page #'s)	Figure	Table	Attachment
8	Water Quality	Pre-construction and during construction until Prairie Canal is fully filled/plugged	Because Prairie Canal has been backfilled, water was not flowing at any of the water quality stations during WY2012, so monitoring was not conducted.	7			
8	Weather: Rainfall and Evapotranspiration at Station SGGEWX	Post-construction	Continuous automatic weather recordings were collected.	7 - 9	3 - 5	3	B
8	Water Levels at 7 Stations: SGT1W5 (formerly SGGE5SW) SGT2W5 (formerly SGGE10SW) SGT2W6 (formerly SGGE11SW) SGT3W5 (formerly SGGE16SW) SGT3W6 (formerly SGGE23SW) SGT3W7 (formerly SGGE17SW) SGT4W6 (formerly SGGE22SW)	Pre- and post-construction	Continuous water level recordings were collected.	9 - 14	6 - 13	3	B
16	Vegetation Transects	Pre- and post-construction	Vegetation monitoring is no longer required every year. It will not be required again until WY2014 (Year 7 post-construction).	18			D
16	Wildlife Monitoring	Pre- and post-construction	Wildlife monitoring is no longer required.	18		4	
17	Project Status	All	Project status is provided.	6	7		
17	Hydrologic Improvement	Pre- and post-construction	Water levels were monitored in 24 groundwater wells monthly in Fakahatchee Strand. Water level was continuously recorded in 26 groundwater wells within the project area.	15 - 18	8		B
17	Exotic Footprint Mapping and Control	Post-construction	Invasive native and exotic species were mapped and controlled along the construction footprints.	18	9		C

Attachment B: Hydrologic Data

This project information is required by Specific Condition 8 of the Picayune Strand Restoration Project, Phase 1 – Prairie Canal Backfill and Road Removal Component permit (0221670), and is available upon request.

Attachment C: Picayune Strand Restoration Project Restored Footprint Exotics Mapping and Control Coordination, Annual Summary Effectiveness Assessment Report

This report, dated September 30, 2012, was provided to the South Florida Water Management District by Environmental Resources Management under Work Order #4600001953-WO3.



Picayune Strand Restoration Project Restored Footprint Exotics Mapping and Control Coordination–*Annual Summary Effectiveness Assessment Report (September 2012)*

Work Order No. 4600001953-WO3

September 30, 2012

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South Florida Water Management District

Picayune Strand Restoration Project Restored Footprint Exotics Mapping and Control Coordination

Annual Summary Effectiveness Assessment Report (September 2012)

Work Order No. 4600001953-WO3

September 30, 2012

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1.0 INTRODUCTION

Environmental Resources Management-Southeast, Inc. (ERM) was retained by the South Florida Water Management District (SFWMD) to provide Biological/Ecological Monitoring, Assessments, Consultation, and Coordination Services under Contract No. 4600001953, dated June 30, 2010. Work Order No. 4600001953-WO3, between the SFWMD and ERM, was issued for Exotic and Nuisance Native Vegetation Control Coordination and Vegetation Monitoring for the Picayune Strand Restoration Project. At the request of the SFWMD, this work is being performed by ERM and our subcontractor, The Institute for Regional Conservation (IRC), which has been providing such services related to the Picayune Strand Restoration since approximately 2008.

The scope of work included in the subject Work Order includes mapping exotic and nuisance vegetation within the footprint of the filled Prairie Canal, the cleared road and house demolition footprints east of Merritt Canal, and the soil inversion sites off of Miller Boulevard. The scope of work also included the coordination of exotic control efforts conducted by Applied Aquatic Management, Inc. (AAM), which is operating under a separate contract with the SFWMD.

ERM's Work Order was executed by the SFWMD on March 1, 2011; however, the documentation of vegetation monitoring and exotic control efforts reported under the subject work order dates back to February 1, 2011. This Annual Summary Effectiveness Report for FY2012documents project work from November 8, 2011 to September 7, 2012, which marks the completion of re-treatments of the demolition sites of the Prairie Canal phase. Because of a delay in the availability of funds from the SFMWD during the past fiscal year, FY2012 funds will be utilized into FY2013, beginning with treatment of fall flowering grasses.

This Annual Effectiveness Summary Report for fiscal year 2012 documents the scope and effectiveness of control treatment efforts by the District's contractor through our assessment of exotic and invasive species cover data since the previous year's treatments. Therefore, the coverage data presented in this report were collected in FY 2012 to detail the areas treated by the field crews; however, changes in conditions noted in the field and discussed herein are based upon comparison of the FY 2012 data vs. post-treatment conditions documented in FY 2011, as summarized in the 2011 Annual Effectiveness Summary Report (ERM 2011).

2.0 METHODS

ERM's subcontractor, IRC, surveyed and mapped exotics by vegetation type and provided the data directly to the exotic control contractors funded by the SFWMD and ACOE. Providing data directly to the contractor represented the most cost-effective method for data transfer. IRC also conducted follow-up surveys to assess effectiveness of treatments. Two geodatabases were utilized: one to record field data and the other to delineate exotic infestations by vegetation types and track treatments.

2.1 FIELD DATA COLLECTION AND GEODATABASE

Initial and subsequent annual field surveys were conducted of the contract area to determine invasive species cover at full recovery post-treatment (i.e., just prior to the next treatment) to direct new control efforts and evaluate the success of previous treatments. Ground-truthing methodology consisted primarily of vehicle (or bicycle) surveys along the removed road footprints, with foot surveys conducted in native vegetation types around old home sites and in areas adjacent to the footprints. Field ground-truthing focused heavily on known and suspected areas of exotic plant species infestations in the priority areas set by SFWMD. Suspected areas of exotic plant species infestations were based on similar aerial photograph signatures. These efforts followed general construction schedules for PSRP, relating mostly to time-since-construction/land clearing activities. Therefore, surveys are essentially based on stratified random sampling, covering as many signatures as possible in the field.

Field data were recorded in the IRC_Master_GDB.mdb geodatabase (ArcView 9.3 personal geodatabase), based on the FNAI Florida Invasive Plants Geodatabase project (http://fnai.org/invasivespecies.cfm), with modifications. Taxonomy for all plant species in the geodatabase follows Wunderlin and Hansen (2011). All Florida Exotic Pest Plant Council (FLEPPC) Category I and II species were recorded in the field, as they were in the FNAI methods (FLEPPC 2011) (http://www.fleppc.org/list/list.htm). Modifications included the expansion of the scope of species mapped, including native nuisance species and some non-FLEPPC-listed exotic species. Additional exotic species, not yet listed by FLEPPC, which have been noted to exhibit invasive behavior in Collier County, included West Indian Pennisetum (*Pennisetum polystachion*) and signal grass (*Urochloa arrecta*). Additionally, species that may or may not exhibit invasive behavior, such as smutgrass (*Sporobolus indicus* var. *pyramidalis*) was mapped, among others. This species, along with several other less common species, covered nearly all roadsides prior to clearing in Picayune. These species will be monitored to determine if they begin to become establish in the "undisturbed" adjacent areas in a manner that would be considered "invasive". Persistent landscape species at home sites also were mapped, whether they were FLEPPC-listed or not, in the event these species become a problem in the future. Moreover, two native species with the potential for nuisance behavior also were mapped: cattail (*Typha domingensis*) and common reed (*Phragmites australis*).

Another important departure from the FNAI methodology was the incorporation of survey track logs (polyline feature class) with percent cover of dominant exotic species along the track route to strengthen the data set for production of polygon maps. Lastly, additional vegetation type data and additional point data were collected beyond the original FNAI geodatabase scope.

Hand held Trimble Geo-Explorer and Thales Mobile Mapper GPS units were utilized in the field for data collection. Both units have ArcPad software and were utilized primarily with one polyline feature class (discussed above) with custom designed data fields (drop-down menus for vegetation type and exotic plant species density/cover codes exported from the geodatabase (IRC_Master_GDB.mdb)). Five point feature classes were utilized to further document other exotic species, rare plants, rare or exotic animals, other points of interest, and fixed point photographs. Both GPS units allow for the use of digital aerial photography while in the field to help ensure location of signatures in question.

Polyline data were collected by streaming data by distance (5m). When more precise vertices were needed (<5m) they were added to the polylines manually while streaming. Each time a new vegetation type or the same vegetation type with distinctly different exotic species canopy coverage was entered in the field, a new line segment was initiated. Streaming continued until either vegetation type or exotic species canopy coverage changed, at which time the segment was ended, and the fields of the associated database were populated accordingly. When even more precision was needed, such as narrow (<5m wide), but distinct vegetation types, manual points (using the 30 point averaging feature) were taken to assist when digitizing. Besides vegetation type and canopy coverage of exotics, a comments field also was often utilized to describe co-dominants to assist in final habitat type determinations for the polygon map. These data were entered in the IRC_Master_GDB.mdb geodatabase in the "field_survey_tracklog" feature class.

While conducting initial surveys of road footprints within the Merritt phase and logging trams in Prairie Canal phase, a temporary feature class was created to add fields with drop-down menus to record data for exotics and vegetation types visible in areas immediately outside (adjacent) of the footprints. These data primarily consisted of vegetation type and Brazilian-pepper (*Schinus terebinthifolius*) cover, depending on visibility from the trails in the center of the cleared road footprints. These data will be processed and added to the 'field_survey_tracklog' feature class, with adjacent habitat data converted to text in the comment field.

Exotic species with less extensive coverage were recorded into a point feature class closely following the FNAI methodology. For example, common species such as Brazilian--pepper were generally recorded using the polyline method, although points were sometimes also taken for these species when isolated individuals occurred in otherwise non-infested areas. Uncommon exotic species, or those with distinct patches (i.e., not evenly distributed within a vegetation type), were primarily recorded as points, including all locations of cogongrass (*Imperata cylindrica*) and old world climbing fern (*Lygodium microphyllum*). All species noted in the field were incorporated into the polygon map following fieldwork.

Observations of threatened or endangered plant species were recorded using the GPS, as well as notes on abundance, phenology, and host plant (for epiphytes). State of Florida-listed orchids and bromeliads were the most commonly recorded species, none of which were Federally-listed species. Areas with a high probability of rare plant occurrence were not given preference for ground-truthing. Instead, rare plants were observed by chance, while focusing on the primary goal of traversing as many exotic plant species-infested habitat types as possible. These data were entered in the IRC_Master_GDB.mdb geodatabase in the "rare_plant_pts" feature class.

Occasionally, when near the center of a characteristic vegetation type, exotic plant species infestation, or other ecologically significant landscape feature, a fixed-point photograph location was established. These locations were not marked in the field; however, a GPS point was collected and stored in the "Photo_pts" feature class in the IRC_Master_GDB.mdb geodatabase. Photographs were taken starting facing towards the north, then shooting adjacent areas in a clock-wise pattern. Any interesting plants or features were also photographed with a zoom lens. Most photographs were taken in portrait orientation due to the thick vegetation, and additional photographs of the canopy were taken occasionally. Photographs from each fixed point were stored in a separate directory and provided in digital format to the SFWMD.

An additional point feature class was maintained for observations of any other interesting landscape features. This included plant species not previously known from PSRP (but not considered rare in South Florida), as well as other features, such as abandoned camps, junk piles, etc. Also, vegetation type features needing more precision than streaming with the polyline were recorded into this feature class. The referenced polyline averages 30 location coordinates, instead of simply the first location coordinates, as used in the polyline streaming method. This is often the case for small unique vegetation types in areas of poor GPS signal, such as dense canopy areas with high, multipath error. These data were recorded in the "Misc_pts" feature class in the IRC_Master_GDB.mdb geodatabase.

Finally, animal signs or direct observations of rare or exotic animals were occasionally recorded as point data. This generally included visual observations of individuals, burrows, nests or signs of any significant finds within PSRP boundaries. These data were stored in the "rare_animal_pts" feature class in the IRC_Master_GDB.mdb geodatabase.

2.2 *POLYGON GEODATABASE*

A polygon geodatabase, PSRP_vegetation_GDB.mdb, was utilized to synthesize exotics survey data from the IRC_Master_GDB.mdb geodatabase in a final format. Annual updates of exotic species cover recorded in this geodatabase reflect full-recovery, post-treatment (i.e., immediately before next treatment) exotic species cover values. The polygon map was digitized manually, starting originally with existing data from NRCS vegetation map (Burch et al. 1997) and past maps done by Mike Barry, as a Division of Forestry employee in 2002-2004. These data were used as a base and modified as ground-truthing progressed section by section. Existing and historical (1940) vegetation types were recorded along with exotics cover data, where possible.

The polygon geodatabase is an on-going work-in–progress, which can be enhanced over time and made more current, with the addition of new ground-truthing data and editing the polygons. Ground-truthed areas can be viewed as "complete" data, while other areas remain in "draft" data format, until additional data are collected. "Draft" areas have been based on aerial photo-interpretation and extrapolation/interpolation of the closest ground-truthing data. For example, this fiscal year, data taken from road footprints was extrapolated to signatures between roads for the Merritt phase. A 'Yes/No' field was included for all polygons, indicating if the polygon had been ground-truthed; however, it is important to note that only a portion of the larger polygons with 'Yes' values may have been actually ground-truthed. This is because the Yes/No field is populated after hand-digitizing polygons by selecting polygon records that intersect the field survey track log. If the track log enters a large area of similar signature, it was assumed to be the same, until shown differently with additional field data.

A variety of existing data resources went into the production of the polygon vegetation geodatabase. Aerial photography utilized for this project ranged from infrared to true color, from 1995 to 2012. Black and white photography from the 1940s was utilized for historical vegetation types. As mentioned above, actual GIS data from broader-scale mapping efforts done by NRCS (Burch et al. 1997), prior to the subject project, served as a base for the development of a more detailed, ground-truthed map. In addition, elevation data processed from 2007 LiDAR data were utilized to delineate polygons. These relatively recent elevation data have greatly increased the accuracy of the polygons. Finally, aerial sketch mapping data received from SFWMD in 2011 also were utilized to populate exotic cover fields.

All of the data in the ground-truthing feature classes (points and polyline) were incorporated manually into the polygon geo-database. Large polygons generated from existing NRCS layers and Florida Department of Forestry (FDOF) polygons formed the base layer. Subsequently, polygons in ground-truthed areas were further modified, following aerial photograph signatures identified by the field survey track log feature class. Multiple years of aerial photography were examined to assist with signature recognition. The 2007 LiDAR data also were utilized when digitizing polygons to discern differences where aerial signatures were ambiguous.

Fields in the attribute table of the polygon feature class were populated for vegetation types for current conditions, for1940's or "pre-drainage" conditions, and for percent cover of exotic species. Field notes from comment fields in the field geodatabase were entered into the polygon attribute table when applicable. All point feature classes also were examined while digitizing to help identify and populate data fields.

Vegetation types followed the Comprehensive Everglades Restoration Plan (CERP) codes (Rutchey et al. 2006); see:

http://science.nature.nps.gov/im/units/sfcn/docs/Vegetation%20Classification%20-%20v6.15.09.xls.

Any vegetation types encountered in PSRP during field work, but not found in the referenced report, will be proposed for addition to the classification system. If acceptable to the SFWMD, the vegetation types will be entered into the system, if of significant coverage. Other vegetation classification systems were secondarily designated using crosswalks created for the purpose of automatically populating data fields from the CERP codes. FNAI Natural communities were provided along with CERP habitat types for each habitat type polygon, following the FNAI natural communities' guidelines (see:

http://www.fnai.org/NaturalCommGuide.cfm).

Florida Land Use Cover and Forms (FLUCFCS) also were utilized, based on FDOT definitions (FDOT 2009), but these general codes were not updated following recent evaluation of the system by Florida Fish and Wildlife Conservation Commission (Kawula 2009). NRCS (Burch et al. 1997) vegetation types also were re-populated using the crosswalk. The NRCS crosswalk was utilized originally to populate general (level 2 or 3) CERP fields in the base layer of the polygon geodatabase, but recent mapping efforts are at a much more detailed scale, even without ground-truthing data.

Existing ground-truthing data were incorporated into the polygon map for a specific area by hand digitizing polygons around signatures crossed and identified by polylines from the field survey track log feature class. Subsequently, digitizing continued outward (extrapolation) from the ground truthed areas. Therefore, the attribute table was populated with values based on aerial photograph signature interpretation and LiDAR data according to similarity to the closest ground-truthed polygons. Exotic species coverage data also were entered into the attribute table according to general similarity and proximity to ground-truthed signatures.

A Yes/No field in the geodatabase identifies which polygons intersect with ground-truthing point or polyline data. As noted earlier, not all areas of all polygons were ground-truthed; therefore, when interpreting areas actually ground-truthed, the line data should be viewed overlaying the polygon map. Some signatures in areas not ground-truthed (i.e., extrapolated areas) also may have employed lower precision habitat type classifications of the South Florida vegetation classification system, if signatures were less than obvious. As a result, these areas should be identified as important for future ground-truthing efforts when resources are available. Finally, when digitizing and populating the fields of the attribute table in areas not yet ground-truthed, areas with signatures that were difficult to discern often included comments such as "Needs Ground-truthing", or may mention alternative classification system values that may be applicable.

2.3 *COORDINATION OF EXOTIC CONTROL CONTRACTORS*

IRC was available for onsite orientation of the exotic control contractor upon the initiation of each control effort. IRC was also available as needed for interpretation of maps, plant identification, discussion of priorities, or adjustment of control methodologies during treatments. Survey data in the form of maps and point data were loaded into the contractor's Garmin GPS units to ensure the treatment of all known locations of invasive exotics.

Contractor progress was tracked by collecting GPS units utilized by the contractor. Any new locations of invasive exotics found by the contractors were also added to the geodatabases. Using the crew's weekly GPS track logs also allowed IRC to go directly to known infestations that lacked track data to determine if the locations had been overlooked, the location simply lacked signal, or if crew members without GPS units had performed the treatment. Spot assessments were conducted in the field randomly throughout the year to ensure ongoing treatments did not miss such areas while the treatment crews were mobilized. Field work by IRC for spot assessments included taking GPS track logs into the 50-foot buffer areas around the cleared areas to verify the distance treatment had extended into the buffer area and to assess how much was missed or re-sprouting. Emphasis was placed on identifying areas missed by the contractor to allow additional treatment before they demobilized from the area.

2.4 *ASSESMENT OF EFFECTIVENESS OF TREATMENTS*

Bimonthly Status Reports, including status maps, noting exotic and nuisance vegetation treatment areas, have been submitted to the SFWMD. Problems encountered during treatments were discussed, as well as justifications for priorities or actions taken in the field. Lists of exotic and nuisance, vascular, plant species observed within the footprints were prepared using taxonomy following Wunderlin & Hansen (2011). At the end of the fiscal year, final reports have been prepared to summarize treatments and to assess effectiveness of the previous year's treatments.

Annual field surveys were conducted of the contract area to determine invasive species cover at full recovery post-treatment (i.e., just prior to the next treatment) to direct new control efforts and evaluate the success of previous treatments. As much as possible, the field teams re-visited the areas treated in the previous fiscal year. Most of the survey data were collected from February to July; however, starting in fiscal year 2011, initial survey work for new areas occurred in the fall and winter months.

Initial surveys are more time consuming than annual re-visits, making the earlier start necessary.

New data were "cleaned-up" in the geodatabase (IRC_Master_GDB.mdb) and then utilized to update the polygon geodatabase (PSRP_vegetation_GDB.mdb, see section 2.2). Each year's exotics cover values have been maintained in this geodatabase. As treatments have continued over multiple years, values have varied less, as target species typically remain at the same low cover values (i.e., maintenance levels), thereby requiring less work with GIS. However, lower priority species that have not been targeted often require more adjustments.

Comparisons were made and maps produced showing cover by all exotic species combined, by FLEPPC category and by groups of species targeted by control efforts. Combined exotic species cover estimates were made by summing the median values of cover classes (i.e. <1%=0.5, 1-5%=3, etc.) for each polygon by the designated group in an external table linked by the OBJECTID field in the PSRP_Vegetation_GDB.mdb geodatabase. In this manner, maps can be generated by using the OBJECTID field in ArcView, and queries using Access can be utilized for summarizing the extent of infestations by other fields in the geodatabase, such as phase, footprint, and habitat type.

As discussed in past reports, using the groups of summed data in this manner can result in misrepresentations, thus individual species data should be consulted when questions arise. Using total invasive species cover would result in an overestimate, if for example; one or more exotic species was growing beneath another exotic species. Also, if only one or two individuals (<1%) of multiple species are found in a large polygon, the program would default to the next one or two cover classes (1-5% or 5-25%), thereby generating an overestimate. In general, the more invasive species found in a polygon, the higher the probability of overlapping cover, which could result in an overestimate. This is especially the case where both woody and herbaceous species are present and each group can occupy different strata of the same patch of ground.

To develop a summary of the study area, cover class median values (i.e., <1%=0.5, 1-5%=3, etc.) are multiplied by acreages and tallied by the groupings for subsequent analysis. It should be noted that these coverage estimates are based on many independent locations, or records in the geodatabase. The final sums for acreage by cover class have been compared to previous years. If target species values increased, an effort was made to understand why, and recommendations have been made to correct the problem, where possible; in some cases, this lead to discontinuing treatment of specific targets (if current methods were not working and no other alternative methods were possible, given budgets or other factors).

3.0 RESULTS AND RECOMENDATIONS

This report summarizes work completed by ERM and IRC under ERM's contract with the SFWMD and the exotic and native nuisance vegetation control efforts of Applied Aquatic Management, Inc. in Fiscal Year 2012. This report is not timed with the completion of all treatments planned for this fiscal year because additional SFWMD funds became available late in the summer, after receiving <5% of the funding received in previous years at the beginning of the fiscal year. This funding cycle resulted in delays to the treatment schedule. In previous years, the Annual Summary Effectiveness Report has summarized work completed under the budget for the fiscal year. As a result, the manner in which work and field conditions have been documented in this report departs from the approach in prior years.

SFWMD-funded treatments began May 29, 2012 with the re-treatment of Prairie Canal footprints, starting at the southern end and moving northward. Treatments covered high priority road footprints (those not covered by overlap with ACOE funded work) and eventually the demolition sites of the Prairie Canal phase. This first re-treatment was completed on September 7, 2012. This year, foliar treatments have continued to focus on exotic grasses, especially torpedograss (*Panicum repens*) and cogongrass (*Imperata cylindrica*).

Field efforts funded by SFWMD-administered FY2012 funds from FWC, targeting *Melaleuca,* also were completed earlier this fiscal year. *Melaleuca* treatments in the "long blocks", west of Miller between 62nd and 68th Ave. SE, began March 26, 2012 and were completed on May 15, 2012. These treatments were conducted to finish work at the close of the prior fiscal year, which was intended to treat all *Melaleuca* in the PSRP project area.

Work supported by additional FY2012 SFWMD funds (approved late in Fiscal Year 2012) started with initial treatments at demolition sites in the Merritt phase (on-going), and will continue to cover new ground this fall. These areas are higher and drier than other areas; therefore, they are logistically well suited for late summer and fall treatments. Other treatments and cover assessment remain to be completed this fall, which will be funded with the remaining FY 2012 funds. This will include treatment of the soil remediation sites, re-treatment of the grasses at the Merritt demolition sites, and the fall grass re-treatments to be conducted when jaraguá (*Hyparrhenia rufa*) matures in September-October. These treatments will be documented in later reports.

In contrast, treatments of invasive exotics in the recently cleared logging tram footprints in the Prairie Canal phase and the road and tram footprints in the Merritt phase (funded by the ACOE) were completed on schedule for the fiscal year. All of these recently cleared footprints were treated twice, beginning on November 8, 2011 at the T-Canal, and continuing through May 24, 2012.

Work has entailed the continued coordination of on-going treatments (including uploading known locations into crew GPS units and printing maps reflecting the status of the work crew efforts during the prior week) and the associated general logistical assistance. Coordination efforts have included weekly downloads of crew GPS data to record areas treated and to add exotic points to the geodatabase for new infestations discovered by the eradication and monitoring crews. Work also included initial surveys of entire Merritt phase footprints, recently cleared logging trams, miscellaneous areas in Prairie Canal phase, and re-assessing the cover of exotic grasses in the footprints and demolition sites. Processing these data, especially the initial survey data, has included the generation of polygons, which was completed for most of the Merritt phase this fiscal year. Fieldwork also has included re-visits to existing photo points in these areas, as well as the establishment of several new photo points.

Assessment of overall coverage by exotic and nuisance species was performed by comparing 2012 cover to data for the previous year (2011). In general, FLEPPC-listed exotic and nuisance species have been maintained at or below maintenance levels in the Prairie Canal phase footprints and demolition sites, Merritt phase cleared footprints, and some headway has been made in the Merritt phase demolition sites. The cover values presented herein represent pre-treatment levels or full recovery since the treatments completed during the last fiscal year.

3.1 WEATHER AND WATER LEVELS

Weather again affected treatment strategy and field work. This year, we experienced extremes in temperature, as well as below average rainfall, with resulting hydrological patterns. Naples' temperatures and Big Cypress National Preserve rainfall data are presented in Figures 1 and 2. These data were acquired from The South Florida Watershed Journal website http://www.gohydrology.org, linked to:

http://www.fgcu.edu/bcw/swamp/journal/Temp_NaplesDaily.gif; and http://www.fgcu.edu/bcw/swamp/rain/R_BC.gif.

Figure 3 shows water levels onsite in well SGT2W5 at 70thAvenue, just east of Patterson.

Higher temperatures slowed work this year more than cold temperatures. Low temperatures for the region in early January included several hard-freeze nights (January 4 and 5), which were observed on the ground in the PSRP (Figure 1). Treatments were suspended at that time, as additional freeze events associated with cold fronts in January-February were anticipated; however, temperatures stayed just above freezing on most nights. Fortunately freeze effects were much less extensive this year and treatments resumed January 31, 2012.

In March and April, temperatures increased immediately to the 80s and 90s, starting summer-like afternoon highs very early in the year, much like last year. In fact, after the cool conditions at the beginning of the year, during the first half of January, temperatures were largely above average and especially pronounced when the daily low temperatures are compared. The second half of February and all of March showed the greatest departure from typical temperature patterns, being well above average. Temperatures remained well above average through mid-June. Thus, conditions remained hot throughout the entire treatment period, ending in the first week of September.

Owing to the early arrival of warm weather, crew progress was often slowed. The heat index averaged over 100 degrees for the entire treatment period since May. Heat indices regularly exceeded 115 degrees on site and routinely exceeded temperatures recorded concurrently in Naples. This excessive and early heat represented a significant health and safety risk to the work crews and severely limited productivity. Because of the experience of the crew leaders in the field, no heat-related injuries resulted.

Like last year, rainfall this season was below average, especially from November through July (Figure 2). October 2011 rainfall was well above average, after several record rainfall events associated with cold fronts. These events raised water levels for the fall, after an extremely dry summer. This was followed by a period of below average rainfall through August 2012. Rainfall amounts that month were finally above average. In fact, rainfall deficits compiled by NOAA Doppler estimates from January 2012 to September 5, 2012 (http://water.weather.gov/precip/) for the study area and its headwaters show a much greater shortage than similar data from the Naples area (Figure 3). Most of the area experienced a 6- to 12-inch deficit, with one area just upstream of Picayune and Fakahatchee Strand experiencing a deficit greater than 12-inches.

The driest months, again, coincided with above average temperatures, which then contributed to very low water levels. No standing water was noted, even in the cypress habitats, through at least August (Figures 4). Water levels at the Big Cypress National Preserve experienced record dry down in June 2011 for Tamiami Bridge 105 (just to the southeast of our project area) in comparison to data going back at least 20 years (http://www.gohydrology.org). This year, the drought effects were more evident in Okaloacoochee Slough, the Florida Panther National Wildlife Refuge (FPNWR), and Corkscrew Swamp Sanctuary, and record low water levels were experienced for the summer months in Lake Trafford. All of these habitats are upstream of the Picayune (http://www.gohydrology.org).

Staff at the FPNWR have indicated that water levels in borrow pits and ponds along S.R. 29 were the lowest ever observed for this time of year. This is consistent with the personal observations of water levels in the PSRP and west side of Fakahatchee Strand Preserve State Park, since 1991 (by the Project Senior Biologist, Mr. Mike Barry), which indicate the past two years have been the driest years in his experience working in the area. For the second year in a row, Cypress again exhibited early leaf color change. This year, yellowing leaves were observed in late July, as also noted in 2011 (ERM 2011). This unusual condition was likely a result of the combined effects of the heat and drought noted above.

Because low water is necessary for most herbicide treatments, this pattern of reduced rainfall and surface water levels has allowed the field crews to overcome the delays caused by the freeze, the slow work pace dictated by the early and extreme heat, and the unavoidable delay in funding from SFWMD.

3.2 FIRST FOLIAR TREATMENTS WITHIN MERRITT CANAL ROAD AND LOGGING TRAM FOOTPRINTS AND PRAIRIE CANAL LOGGING TRAM FOOTPRINTS

Two separate crews worked to complete initial treatments of recently cleared footprints and adjacent infested areas in Merritt and Prairie Canal phases in fiscal year 2012 (Figures 5 and 6). A total of 2,742 acres was treated (Table 1). This acreage was primarily low coverage by invasive exotics with roughly 400 acres actually infested with cogongrass and torpedograss (combined). Coverage by these species was usually low (<5%), although some patches of greater cover were treated, primarily in the areas adjacent to the Merritt Canal footprints (roughly 15 acres >5% cover) (Table 1).

Treatments were conducted using glyphosate with imazapyr, targeting primarily cogongrass and torpedograss; thus, these species are presented with combined cover values in Table 1. Because jaraguá (*Hyparrhenia rufa*) was flowering and evident, it was also targeted, especially in the first week of treatment when crews started specifically where this grass had been located by IRC survey crews. Where present, this species occurred at a low coverage levels. Also, Burma reed, bermudagrass (*Cynodon dactylon*), vaseygrass (*Paspalum urvillei*), Natalgrass (*Melinis repens*), West Indian Pennisetum, common reed, cattail, and guineagrass (*Panicum maximum*) were partially targeted. Smutgrass (*Sporobolus indicus* var. *pyramidalis*) was not treated and already covered significant acreage in the northern Merritt phase during this first treatment. Smutgrass also was scattered elsewhere throughout the footprints.

Initial foliar treatments of the road footprints in the Merritt phase began November 8, 2011 and continued to January 3, 2012. A freeze occurred in the area on January 4, so spray work was not conducted through January 30, 2012. A map of the treated areas is presented in Figures 5 and 6. A total of 1.358 acres of cleared road footprints, 4 acres of logging tram footprints, 44 acres adjacent to footprints, and 18 acres of demolition sites and their buffers (portions adjacent to road or canal footprints) were treated in the Merritt phase during this time period (Table 1).

A second crew began initial treatments of the tram footprints within the Prairie Canal phase on February 21, 2012, and these efforts were completed on March 30, 2012. Crews included re-treatment of cogongrass and torpedograss in many of the cleared road footprints of the Prairie Canal phase because infestations were centered primarily where recently cleared trams intersected previously cleared road footprints. Also, because crews had to use the roads to access some of the trams, it made economic sense to spot re-treat known patches, especially given budget shortfalls at the time with SFWMD. Without re-treatment of those footprints, there was the risk that treated patches would spread and re-establish. This treatment also included the areas cleared last year by the ACOE contractor to install culverts along Stewart, as well as around the tie-back levee and swale, which cuts through the Broken Wing Ranch area in the northern portion of the Prairie Canal phase.

A total of 23 miles of logging tram footprints and an additional 2.7 miles of tie-back levee were treated in the Prairie Canal phase logging trams since February 21, 2012 (Figures 5 and 6). A total of 195 acres of logging tram footprints, 1,044 acres inside road footprints, 45 acres of footprint buffers, and 33.6 acres of demolition sites and their buffers were treated in the Prairie Canal phase (Table 1).

3.3 *SECOND FOLIAR TREATMENTS WITHIN MERRITT CANAL ROAD AND LOGGING TRAM FOOTPRINTS AND PRAIRIE CANAL LOGGING TRAM FOOTPRINTS*

A total of 3,648 acres of footprints and adjacent areas in the Merritt and Prairie Canal phases were treated as a part of the first "re-treatment" of these recently cleared areas (Table 2). A map of the treated area is presented in Figures 7 and 8. Cover by invasive exotics was again generally low, although due to more complete treatment of secondary target species beyond cogongrass and torpedograss, greater acreage of areas with >5% invasive exotics cover could be treated (Table 2).

As with the initial treatment, second foliar treatments were conducted using glyphosate with imazapyr. These efforts targeted primarily cogongrass, torpedograss, and Burma reed, as in the first re-treatment, but also included more complete treatments of bermudagrass, vaseygrass, West Indian Pennisetum, common reed, cattail, guineagrass, and natalgrass (*Melinis repens*), which were sporadically treated. Smutgrass also was treated only sporadically. While Smutgrass covers significant acreage in the northern Merritt phase, it is currently being considered a lower priority, given current resources. It may be necessary to consider a long-term plan for this species, as it has already penetrated previously grazed natural areas around the old home sites in the unblocked areas of the Merritt phase.

A total of 348 additional acres were treated in the Merritt phase, and 558 acres were treated in this treatment effort compared. Crews covered roads not yet completed in the first treatment and penetrated deeper into adjacent areas with hand crews to complete the initial attack on new infestations in Merritt phase. Also, a recently cleared portion of the Merritt Canal edge was treated. In the Prairie Canal phase, crews made efforts to visit all previously treated cogongrass and torpedograss patches along roads, knowing funding restrictions might not allow future treatment, thereby allowing the remaining sprigs to re-colonize the dead patches.

Crews began the first re-treatment of the road and tram footprints in the Merritt phase January 31, 2012, catching all missed patches, as well as more complete treatment of the many patches of cogongrass in the adjacent buffers, using backpack sprayers. This work within the Merritt phase was largely completed by March 22, 2012, although additional acreage along the recently cleared portion of the Merritt Canal was covered from May 7 to May 22, 2012 by a separate crew.

During this period, all of the recently cleared road footprints were re-treated from the south end at the T-canal up to 48th Ave. SE at the north end, between the Merritt and Faka Union canals (Figures 7 and 8). A total of 1,773 acres were covered. Of this, 1,213 acres were infested by the targeted species listed above with combined coverage generally <5% (Table 2). Approximately 127 acres consisted of >5% invasive exotics.

Some buffer areas around extensive cogongrass patches resulted in significantly additional natural area acreage treated by hand crews, using backpack sprayers. These areas primarily included areas north of the unblocked areas in the Merritt phase and especially in the blocks near the Merritt pump station (between 52nd and 58th Ave. SE E of Merritt) where cogongrass essentially occurred throughout the areas between the roads (Figure 8). Other hot spots included 58th Ave. SE to 69th Ave. SE west of Merritt, principally near the edge of the large unblocked areas that were affected by the many home sites.

During the last week of the main treatment efforts in March, crews included the buffer areas to the Faka Union Canal north of the pump station. These areas were primarily re-treatment areas near home sites and areas along the road that were treated last year, although hand crews did expand treatments into the pineland habitats killing areas around the edges of the previously treated cogongrass patches.

Also in the Merritt phase, additional acreage along the recently cleared portion of the Merritt Canal edge was treated from May 7 to May 22, 2012. This included several large, dense cogongrass infestations, which will require many follow-up treatments, which will likely result in a large dead zone, including slash pine mortality. If so, the area will be prone to re-infestation by cogongrass or other invasive exotics for years to come.

A second crew began the first re-treatment of the tram and intersecting road footprints within the Prairie Canal phase on April 2, 2012, and work was completed on May 4, 2012 (Figures 7 and 8). In this treatment effort, crews covered 1,876 acres of primarily low coverage, with 1,233 total infested acres (Table 2). Only 8 acres consisted of infestations >5% cover by the invasive exotic targets listed above. This is, in part, because many of the road footprints were treated while covering the logging trams, and have actually been treated since 2008.

As noted above, because crews had to use the roads to access some of the trams, spot treatments were conducted in many of the road footprints, while crews were in the area. This treatment also included the areas cleared by the ACOE contractor last year during culvert installation along Stewart, as well as around the tie-back levee and swale, which cuts through the Broken Wing Ranch area in the northern portion of the Prairie Canal phase. Moreover, as efforts are underway to remove spoil left in this phase after initial road removal, large areas of recently re-disturbed ground will have to be treated using ACOE funds. By covering the road footprints around the tram areas (which currently have very little exotic plant coverage), we are essentially reducing the amount of work required later.

3.4 *MELALEUCA TREATMENTS IN PSRP, FY 2012*

Melaleuca treatments in the "long blocks" west of Miller, between 62nd and 68th Ave. SE, began March 26, 2012 and were completed on May 15, 2012 (Figure 9). This work was a resumption of the treatment efforts completed in the prior fiscal year (December 9, 2010 to January 28, 2011). The work was intended to treat all Melaleuca in the PSRP project area, in general, beginning in the southern and eastern areas, working towards the Belle Meade where the largest infestations of Melaleuca remain.

Treatments this year began at Miller and 62nd and continued generally towards the southwest where work ended at the close of the prior fiscal year in the block between 66th and 68th Ave. SE. Also, crews treated the lower density areas on the south side of 68th. The cut-stump method was utilized primarily, although frill/girdle treatment was done in a few cases.

A 430-acre footprint was covered in this treatment effort (Table 3). A total of 34 acres consisted of greater than 50% exotic cover. All of these areas were difficult to treat because of a very high density of multiple-stemmed re-sprouts with both living and dead stems. This condition is presumed to have resulted from years of wildfires and recent freezes, followed by droughts knocking back the larger trunks. The actual area treated totaled 41 acres (sum of acreage multiplied by midpoints of cover class values).

The densest patches of multiple-stemmed re-sprouts with heavy insect damage were not treated, leaving these patches for bio-control or future application of velpar. These areas, in which individuals are mostly <1 m tall, take a considerable amount of time to treat using the cut-stump method. Because of the significant time required to treat such areas, they were not treated in an effort to prioritize the treatment of outlier, mature (potential seed-producing) trees.

Furthermore, over the past three years, we have seen a change in these patches resulting in mortality of a large portion of the re-sprouts and an increase in native vegetation, which had been nearly absent previously. All of the Melaleuca-specific bio-control agents are very abundant in these areas. This, coupled with the hard freezes of the past few years and subsequent extreme drought, may have fostered re-sprout mortality by bio-control agents; however, this remains uncertain. We should plan on monitoring these areas, and if changing conditions prove less favorable for bio-control, treatment will be necessary prior to mass seed production.

3.5 FIRST SFWMD FUNDED FOLIAR TREATMENTS IN PSRP, FY 2012

The first SFWMD re-treatment of the Prairie Canal footprint for this fiscal year began on May 29, 2012 and was completed September 7, 2012. Work initially began with two applicators, using a swamp buggy to target high priority areas because of the lack of funding for the effort; however, while treatments were underway, SFWMD acquired more funds and we switched to a combination of swamp buggy and a hand crew around the demolition sites and their buffers to allow more thorough treatment.

A total of 2,110 acres were covered by crews. Of this, 898 infested acres were treated by crews (Table 4). Treatments began at the south end of the Prairie Canal footprint and worked northward through the demolition sites (Figures 10 and 11). Combined cover by invasive exotics was generally low with 835 acres <5% cover and 63 acres >5%. Less than 1 acre was treated with >50% cover. This included some new patches of cogongrass that were found while sweeping through areas with hand crews.

Work began in late May to take advantage of low water, hoping torpedograss, which had been somewhat dormant during the dry season since the freeze, would have emerged, but not flowered. With the budget allocated at that time, we would have completed work in June, prior to the typical rise in water levels. Because of the initial lack of funds, crews did the best they could to cover the known torpedograss hotspots first and then the larger previously treated cogongrass patches, especially around the home sites. When sufficient funds became available to include a hand crew, crews expanded treatment around these patches to carefully and methodically treat all exotic grasses scattered around the demolition sites. As shown in Figure 11, there are smaller areas treated with earlier dates surrounded by later treatment dates. Actually, those patches were treated again, as hand crews walked very methodically in transects from road to road to cover all areas.

As with the previous treatments, this re-treatment was conducted using glyphosate with imazapyr, targeting primarily torpedograss along the Prairie Canal footprint and Stewart (any known torpedograss locations in road footprints) and cogongrass, especially in and around the demolition sites. Other targets also included jaraguá, Burma reed, vaseygrass, West Indian Pennisetum, common reed, cattail, and guineagrass. Natalgrass and bermudagrass were sporadically treated.

Smutgrass (*Sporobolus indicus* var. *pyramidalis*) was largely not treated because of its current extensive coverage. Treatments of Bermudagrass were also discontinued indefinitely in the middle of this effort because past treatments, though appearing effective within a month of treatment, have been ineffective over the longer term, as evidenced by the expansion of this species since the last fiscal year. Vaseygrass was targeted and has also expanded since last year, but appears to be spreading into areas where it was not previously found instead of the same treated locations. It remains at a low cover overall. These data are discussed in Section 3.8, below.

Some new patches of cogongrass were found. Some of these appear to have been missed in recent years (they were not recently established colonies), so cover values at the time of treatment were also populated in last year's cover fields in the geodatabase to accurately show changes in cover from 2011 to 2012, as described in the analysis below.

3.6 SOIL REMEDIATION SITES

Owing to funding restrictions early in the fiscal year, no treatments were scheduled for the soil remediation sites. By the time additional funds were allocated, it was too late to treat these areas as water levels had begun to rise. When the water level recedes in this area and higher priority areas are complete, we will assess cover and coordinate treatment of these sites, probably sometime this fall or early winter.

3.7 BRAZILIAN-PEPPER TREATMENTS AT PSRP

Re-treatment of Brazilian-pepper in the Prairie Canal phase was not conducted this fiscal year, though some were treated as a part of foliar treatments. Assessment of cover for Brazilian-pepper was conducted in the footprints. but to accurately sample the 50-foot buffers, it will be necessary to conduct some sampling on foot. Some data were taken at demolition sites in the Broken Wing Ranch area showing most areas still at maintenance levels (i.e., <5%); however, some of the formerly dense areas had, in fact, grown back to cover levels in the 5-25% category. Re-treatment in high cover areas of the footprints and a more accurate re-assessment of Brazilian-pepper in the 50-foot buffers, and possible treatment, will be important tasks over the next fiscal year. Re-treatments in the 50-foot buffers and demolition site buffers will be a labor-intensive and costly undertaking that will depend on total available budget.

No targeted treatment of Brazilian-pepper was conducted in the Merritt phase footprints or 50-foot buffers. Brazilian-pepper was however systematically surveyed and is updated in the polygon geodatabase. These data will be useful in estimating the cost of treatments of the buffers to help determine if sufficient budget exists for the task at hand.

Using SFWMD funds, initial treatments of Brazilian-pepper and miscellaneous hardwoods at the demolition sites within the Merritt phase began September 10, 2012 where previous treatments had left off at 64th Ave. SE, west of Merritt. These treatments will continue south simultaneously with foliar treatments of grasses. Although we would like to treat exotic grasses first at these home sites, because of frequent afternoon showers, this treatment is being conducted instead because of the lower likelihood of rains washing away hours of work. The status of these treatments will be reported in the next bi-monthly status report.

3.8 OVERALL EXOTIC AND NUISANCE SPECIES COVER

It is important to track percent cover of invasive exotic species from year to year to assess the effectiveness of exotic control efforts. Total cover presented in this report represents sampling and pre-treatment cover for fiscal year 2012 and is compared to pre-treatment cover from 2011. The pre-treatment cover for 2012 thus represents the exotics cover to be treated, and re-treated (what remains alive of the total cover following first treatments), this fiscal year. These data are provided directly to the exotic control contractor, often with commentary on what seems to have been missed or had not been effective the year prior at the specific location to be treated. The direction of change since 2011, as analyzed in more detail in this report, will give additional insight to the overall effectiveness of treatments conducted in 2011 and outlined in the Annual Effectiveness Summary for FY2011 (ERM 2011).

Field Data Collected Fiscal Year 2012

This fiscal year a total of 464 km of polyline data with habitat type and invasive exotic cover were collected and loaded into the field_survey_tracklog feature class of the IRC_Master_GDB.mdb (see Section 2.1) (Table 5). This is more than treble the 142 km of polyline data collected during fiscal year 2011 (ERM 2011).

These data include re-assessment of all previously treated road footprints, recently cleared logging tram footprints, and sampling of demolition sites in the Prairie Canal phase. In the Merritt phase, all recently cleared roads and logging tram footprints were sampled for the first time, including habitat and exotic cover data for the adjacent buffer areas outside the cleared footprints. The new ground covered resulted in the substantial increase in survey effort.

While assessing exotics cover, other data were also incorporated into the polygon map. Maps with notes taken in the field sometimes were utilized when GPS units malfunctioned or in some cases when areas were visited briefly for other tasks. Also, new GPS data from exotic control contractors and notes/discussion with the contractor were utilized. Finally, aerial sketch mapping completed in Fiscal Year 2011 was also utilized in map production.

Many additional locations of invasive exotic species were recorded, totaling 738 new points in FY 2012, out of the existing Picayune Strand State Forest total of 7,518 points (Table 6). These points were taken during the subject field surveys and by exotic control crews using Garmin GPS units downloaded weekly.

A total of 60 invasive exotic species and two native nuisance species were mapped using points, polylines, and polygons in areas treated as a part of PSRP (mostly in Prairie Canal and Merritt phases). Over 100 species have been recorded thus far and incorporated into the geodatabase for the entire State Forest. Only two additional species were added to the geodatabase in FY 2012 for Picayune Strand State Forest, including one in the areas where construction has been completed. This species, which is not necessarily invasive, *Pteris cretica,* was found in a hammock adjacent to a logging tram in the Merritt phase during surveys this fiscal year. The other, an exotic orchid, *Eulophia graminea*, was found at 35 locations west of FakaUnion Canal by FDOF biologist Dexter Sowell and at one location by Alan Buckhalt, an Applied Aquatic employee, while treating melaleuca West of Miller. This orchid was documented in Florida in 2007 and is spreading rapidly in southern counties.

The lack of new invasive exotic species recorded this year is not surprising given that over the past two years the demolition sites within the northern portion of the Merritt phase have already been surveyed. The demolition sites have been the most diverse sources of invasive exotics in PSRP to date. That being said, not all of the demolition sites in the Merritt phase have been surveyed and new species could be encountered at any time.

We are also tracking several additional non-invasive species. A list from the Merritt demolition sites was presented in the FY 2010 report (Barry 2010). A few, including a spiny legume, have not been positively identified as yet, but treatments have thus far been effective on this non-native species. Mike Barry currently has a live potted specimen at his residence for identification purposes; it is healthy, but has not flowered.

As noted in section 2.2 above, these additional field data were incorporated into hand-digitized polygons in the geodatabase, PSRP_Vegetation_GDB.mdb. At the end of last fiscal year, September 30, 2011, there were 23,763 polygons in the geodatabase. At the time, analysis for this year's report was conducted on September 7, 2012. At that time, 28,181 records existed, which means existing polygons were cut into 4,418 additional smaller, more precise mapping units this fiscal year. The majority of these are from the initial survey and mapping efforts within the Merritt phase.

As discussed in Section 2.4 above, comparisons of exotic species cover were made between fiscal years, with this year's report focusing on trends observed since FY 2011 only. As discussed above and in previous reports, consideration of the data must be based on a clear understanding of the potential biases in data groupings.

<u>Prairie Canal Cleared Footprints</u>

Total infested acreage coverage by all exotic and nuisance species combined in the cleared footprints of Prairie Canal phase in 2012 was 1,759, which is roughly the same as the 1,758 acres recorded in 2011, out of a total 1,763 acres analyzed (Table 7) (Figure 12). Total acreage analyzed is less than the acreage analyzed in the final report for FY 2011 because some recently re-graded areas and new features, such as the tie-back levee were not included previously (ERM 2011). Again, the bulk of the infested acreage was low cover, although a significant amount of acreage (1,098 acres) with all exotics pooled was >5% cover that would be target cover for a "maintenance" level. Actual acreage covered by invasive exotic species, by summing acreage multiplied by canopy cover (see section 2.4), is estimated as 252 acres in 2012, barely down from 254 acres in 2011 (Table 8). Total percent cover was estimated at 14.3% in 2012, which is essentially unchanged from the 14.4% estimated in 2011.

These recent values are down only a few tenths of a percentage point from total exotic species combined cover in 2008 (ERM 2011). Although combined cover falls short of achieving the goal of <5%, a maintenance standard, many species included are not FLEPPC-listed and often are not included in land management activities in South Florida. Furthermore, because the control and monitoring efforts commenced with recently disturbed bare ground formerly dominated by invasive exotics and weedy native species (the road and swales prior to clearing), these levels of infestation, and the trend of decreasing or stable cover, can be seen as a restoration success. The treatment efforts to date appear to be preventing complete domination by exotic species, which generally are better suited than natives in colonizing disturbed soils, especially in the upland areas at the north end of the Prairie Canal phase.

Total infested acreage by FLEPPC I species similarly changed little, with a slight increase from 1,759 acres in 2011 to 1,758 in 2012 (Table 7) (Figure 13). However, only 85 acres in 2011, and 95 acres in 2012 were >5% cover out of the 1,763 total acres analyzed, which is much better than total exotics combined, although the increased acreage is not a good sign (Table 7). A slight decrease is observed when actual aerial coverage is calculated, with 53 acres (3.0%) in 2011 down to 47 acres (2.7%) in 2012 (Table 8). Both 2011 and 2012 values are less than the 107 acres (5.9%) estimated in 2008, with much of the decrease attributed to Brazilian-pepper treatments over the first couple of years (ERM 2011). Again these trends suggest we have been successful in preventing mass colonization and apparently maintaining low coverage by these most aggressive weeds.

Highest priority FLEPPC I species remain controlled. Cogongrass, a FLEPPC I species and one of our highest priority targets over the past couple of years, continues trending downward in the cleared footprints, with total infested acres 174 in 2012, which is down from 341 acres in 2011 (Table 7) (Figure 14). All infested acres remain at maintenance levels (<5% cover). Total cover by this species remains at <1% (Table 8). Total infested acreage of torpedograss was similarly low, with 163 acres in 2012 (Table 7) (Figure 15). Total cover also remains <1% in both 2011 and 2012 with total acres of actual coverage dropping from 1.7 acres in 2011 to 1.1 acres in 2012. Though cover remains low, total cover by torpedograss has fluctuated in the footprint since 2008, indicating that without control this species could increase rapidly (ERM 2011).

Brazilian-pepper cover, although not analyzed in depth in this report, remains low and has changed little over the past two years, which may be, in part, due to haphazard treatments in the cleared footprints. More effort will be taken next year to evaluate trends with this species as time since last treatment continues to grow. What little sampling in previously treated areas outside the footprints conducted this fiscal year suggests that some areas are beginning to exceed the 5% cover, getting out of "maintenance" levels.

In the cleared footprints, total FLEPPC II species have changed little, reflecting largely that we have not yet targeted all of these species systematically (Tables 7 and 8) (Figure 16). Some species, such as caesarweed, have been largely ignored in treatments. Also because much of caesarweed distribution is patchy in larger areas of the footprints, the survey methodology is insufficient to detect subtle changes. More effort could be put into both surveying and treating caesarweed, though timing with flowering is important limiting the window of opportunity for effective treatments.

Total infested acres of non-FLEPCC listed Species changed little with 1,734 acres in 2011 to 1,731 acres in 2012, out of the total 1,763 acres, illustrating that nearly all of the cleared footprints have some cover by these non-native species (Table 7) (Figure 17). However, actual cover has increased from 140 acres (7.9%) in 2011 to 148 acres (8.4%) in 2012 (Table 8). A similar increase was observed from 2010 to 2011 (ERM 2011). This trend of increasing coverage suggests that re-evaluation of treatment of certain species may be warranted prior to next fiscal year. These species are, in general, a lower priority because they do not regularly show up outside of heavily disturbed ground.

Several species have been targeted and treatment stepped up in 2011, after noticing their increase in the field (ERM 2011). Specifically, vaseygrass, bermudagrass, common reed, and cattail have been targeted systematically, yet cover by both vaseygrass and bermudagrass continued to increase. Part of the failure to control these species may be difficulty in identifying vaseygrass before it flowers, as well as timing treatments. Nevertheless, crews have been improving their results with early detection. Bermudagrass appears to actually survive treatments, as it seems to return at the same locations; perhaps because it is difficult to kill and it grows back quickly. Regardless, because of budget limitations of the observations of re-growth in the field at the same patches, additional treatments were discontinued in the footprints this year, until we can figure out the problem. Vaseygrass on the other hand, seems to die at treated locations, but continues to show up at low cover (mostly <1%) in new areas, increasing total acreage infested by this species. Allen Buckhalt of AAM also has noticed the increase in this species this year and has put extra effort into treating it in 2012.

Smutgrass has continued to increase in cover primarily in areas where it has been present, although following two consecutive dry years, it may be beginning to actually expand along Patterson south of 88th and especially south of Stewart. Treatments south of Stewart in 2011 were largely in-effective. While treated patches died, a month after spraying during the early part of the dry season, new growth was noted to be expanding outward from the treated areas, and filling in was observed. Again, primarily due to budget and also due to lack of initial success, treatments were discontinued. There is a need to discuss a long-term strategy for this species, as it is possible much of the cleared footprint acreage may remain dominated by this exotic species.

Other species such as tanglehead (*Heteropogon contortus*), buttonweed (*Spermacoce verticillata*), pitted bluestem (*Bothriochloa pertusa)*, and a handful of other species seem to have remained largely unchanged, except in the wettest areas where they have disappeared. All of these species were prevalent in the roads prior to clearing, much like smutgrass. Thalia lovegrass (*Eragrostis atrovirens*) has been showing up in more and more locations, including wet areas such as the Prairie Canal footprint. Although they appear not to be expanding and have not been observed penetrating the adjacent natural areas, these species are not going away either. This is important to note because they have colonized large areas of recently cleared footprints in the Merritt phase just one year following treatment. At least for higher and drier areas, these species may end up preventing colonization by native plant species over the long term, if no action is taken.

<u>Prairie Canal Demolition Sites and Their Buffers</u>

Total infested acreage by combined exotic species in the demolition sites and their buffers in the Prairie Canal phase, which largely refers to the Broken Wing Ranch area, was 1,760 in 2011 and 1,761 in 2012, out of the total 1,786 acres mapped and analyzed (Table 9) (Figure 12). Actual coverage has reduced from 122 acres (6.8%) in 2011 to 87 acres (4.9%) in 2012 (Table 10). This continues the trend of decline observed since treatments begin in 2009 (ERM 2011).

FLEPPC I species also continue trending downward at the Prairie Canal demolition sites, with total infested acreage remaining high at 1,758 acres out of 1,786 acres analyzed (Table 9) (Figure 13). However, actual coverage continues to decrease with 55 acres (3.1%) in 2011 to 50.7 (2.8%) in 2012 (Table 10). This trend has continued since 2009 (ERM 2011).

Cogongrass has continued to be the most important target at the demolition sites and their buffers in the Prairie Canal phase with 379 infested acres in 2011 and 373 acres in 2012, out of the 1,786 acres covered (Table 9) (Figure 14). Actual coverage dropped from 5.9 acres (0.3%) in 2011 to 4.4 acres (0.2%) in 2012 (Table 10). These numbers are higher than estimates presented for 2011 (ERM 2011) because, this year, several additional patches were located and treated while sweeping the area with hand crews. Several of these patches were too large to have spontaneously appeared this fiscal year. Therefore, their current cover was also entered for previous years, thus reflecting an improvement of the overall map. Still, the trend holds that cover by cogongrass has generally decreased by over half at the demolition sites and buffers since treatments began in 2009 (ERM 2011). This trend seems to hold true for the 50-foot buffers along the footprints as well, although not detailed here.

It is also important to mention that several infestations have been reduced to zero, including patches initially treated in 2004. Some of these areas had been treated up to 10 or more times. In contrast, some of the patches treated with hand crews last year were reduced to near zero and may be zero next fiscal year. This seems to be because when patches are treated using backpack sprayers on foot, the edges (usually with thick brush) are more completely treated. Use of ATV or swamp buggy is far more cost effective for initial treatments of large patches, but when trying to "finish off" the infestation in follow-up treatments, observations indicate hand work is more effective. Though not specifically presented here, similar observations were made at cogongrass patches treated multiple times in the 50-foot buffers of the Prairie Canal phase as well.

In addition, areas which burned in the Cobalt fire (May 2011) just after treatment were found to have increased since last year. This fire burned demolition sites and buffers south of 66th along the Prairie Canal footprint (ERM 2011). In most cases, percent cover increased into the 5-25% category where patches had been at maintenance levels (<5%). This reiterates the importance of re-treatment. The fire not only caused a missed treatment, but also added nutrients and increased light, causing a fairly dramatic increase in one year.

Total infested acres of FLEPPC II species at the demolition sites and the buffers was 406 and 407 for 2011 and 2012, respectively (Table 9) (Figure 16). Actual coverage differed, with 57 acres (3.2%) in 2011 and 13 acres (0.7%) in 2012 (Table 10), largely due to an increase in cover by caesarweed (*Urena lobata*) following the cobalt fire in May 2011. Coverage by caesarweed was low 2008 through 2010 and only spiked in 2011 after the fire. We responded last summer with an emergency pre-flowering treatment (ERM 2011).

Although caesarweed was present throughout the area, as is shown by the similar total infested acres, treatments were very effective in reducing cover and controlling the solid patches that had formed. Anecdotal comparisons to other areas, which had burned, but we were unable to treat supports the conclusion that the treatments were successful. Hopefully, these efforts also helped reduce the seed bank in these areas for the next fire.

Total acres of non-listed invasive exotics had increased in 2011 (53 acres) compared to 2008 through 2010 (35-38 acres), probably due to increased light availability at the actual demolition sites where we had treated Brazilian-pepper (ERM 2011). This year we saw further increase with 115 acres in 2012 compared to 53 acres in 2011 out of the total 1,786 acres included in the demolition sites and buffers (Table 9) (Figure 17). Actual cover was 6 acres (0.3%) in 2011 and 15 acres (0.9%) in 2012 (Table 10). The majority of this cover is smutgrass and is actually restricted to the old home sites themselves, though it is also scattered around trails through the demolition site buffers, as well. Smutgrass does not readily penetrate the natural habitats (except when grazed), although it probably will continue to be a problem wherever disturbed ground remains in upland areas. We may not be able to expect native groundcover species to establish at the actual demolition sites without intervention.

<u>Merritt Demolition Sites and Their Buffers</u>

In last year's report we analyzed the roughly 441 acres in the northern-most portion of the unblocked areas in Merritt phase where a number of home sites are present (ERM 2011). In these treated areas, we saw a substantial drop in FLEPPC I species, especially Brazilian-pepper, lead tree (*Leucaena leucocephala*), and cogongrass from 2010 to 2011, while non-listed species remained approximately the same (ERM 2011).

This year, we are lumping the 441 acres, which have been treated twice, into the total 5,258 acres of the entire unblocked area in Merritt phase. The Merritt phase has demolition sites scattered throughout with abandoned trails, borrow pits, camps, trash piles, corals, and disturbed areas connecting the actual home sites. We have continued mapping these sites this fiscal year and have just begun to continue initial treatments of exotics where we left off heading south (these treatments are not addressed in this report). It appears that the areas in the middle of the unblocked sections have fewer disturbed areas and fewer exotics; however, to date, we have spent less time ground-truthing those areas. In general, we expect to continue finding and mapping invasive exotics around these home sites this fiscal year, as we progress with treatments. Therefore, numbers next year will reflect the improvements in mapping and will likely increase. Accordingly, most of these numbers are preliminary and represent a work in progress. Any differences observed between 2011 and 2012 would be attributed to the 441 acres on the northern portion that have been previously treated.

We currently estimate the total infested acres to be 4,546 out of the 5,258 total acres (Table 11). Actual cover of combined exotic and nuisance species mapped thus far totals 618 acres (11.8%) (Table 12) (Figures 18 and

19). Much of the infested acreage mapped to date consists of FLEPPC I species that cover 366 acres (7%) of the area (Table 12). This includes primarily Brazilian-pepper on 286 acres (5.4%) and cogongrass on 57 acres (1.1%) (Table 12) (Figures 20-23). Several very large patches of cogongrass have been mapped, including one 8-acre patch and several 1-5 acres patches. We expect to continue to find cogongrass in areas between these large patches. Nearly all of the large patches are associated with trails or disturbed areas around or linking old home sites. As ground-truthing and mapping continues this fiscal year, we expect these estimates will increase The acreage mapped thus far represents a lot of actual treatment work ahead of us.

Total infested acres by FLEPPC II species was 355 acres (Table 11) with 41 acres (0.8%) of actual coverage (Table 12). Non-listed species includes 653 acres or 195 acres (3.7%) of actual coverage covered (Tables 11 and 12). Smutgrass is the primary non-listed species mapped. It is important to note that the home sites and their surrounding disturbed areas represent the largest expanses of smutgrass in PSRP, which is likely also due, in part, to past cattle grazing in this area, which is known to promote smutgrass growth. These unblocked areas were the most recent areas where active cattle grazing occurred. To promote the re-establishment of native groundcover, intervention may be necessary, at least in the upland areas and all areas north of the tie-back levee.

Merritt Cleared Footprints

A total of 1,694 infested acres out of 1,706 acres total of all exotic and nuisance species combined were mapped in the recently cleared road, logging tram, and some canal edge footprints in the Merritt phase (Table 13) (Figures 18 and 19). Actual coverage by exotics is relatively low at 620 acres (11.8%) (Table 14). FLEPPC II species included 1,165 infested acres (Table 13) or 41 acres (0.8%) of actual coverage (Table 14). Caesarweed in some of the logging trams and road footprints cleared earliest (i.e., cleared in 2010, which had an additional rainy season for caesarweed to recruit) and accounted for the areas of highest percent cover of FLEPPC II species (377 acres >5% cover), while most other areas are low cover (Table 14).

Non-listed species infest 1,593 acres in the recently cleared road, logging tram, and some canal edge footprints in the Merritt phase (Table 13). This includes mostly low cover; however, already there are significant areas dominated by non-listed species, including 308 acres in the range of 5 to 50% cover and 87 acres at >50% cover (Table 14). Actual coverage by non-listed species totaled 195 acres (3.7%). Smutgrass was the most significant species mapped in this group, with at least some scattered nearly throughout, and it has begun to dominate many areas of the footprints north of the unblocked sections. Tanglehead also dominates many footprint areas in nearly solid expanses, including the T-canal areas and the northernmost road footprints both. It is hoped that, after the canals are filled, these species will be eliminated from many areas; however, much of the acreage north of the tieback levee will likely continue to be dominated with these species and possibly increase without treatments. What is particularly problematic is that smutgrass has already become established in the unblocked areas.

<u>Prairie Canal and Merritt Phase Areas Outside Footprints</u>

Although we have estimated exotics coverage between the roads in the Merritt phase (Figure 18-23), and we have treated many patches of cogongrass adjacent to the roads already (Figures 5-8), we have not summarized these data in tables because we consider the data as preliminary. The treated areas immediately adjacent to the footprints, along with the 50-foot buffers in the Prairie Canal phase that need additional re-assessment for re-growth of Brazilian-pepper, will be summarized in the next fiscal year, for at least those areas receiving at least one treatment. We will continue to improve the accuracy of the mapping this next fiscal year, as more ground-truthing data is collected.

3.9 RECOMMENDATIONS

Based on the results of the cover surveys discussed above, the following treatment priorities are suggested for the coming fiscal year. More discussion is expected when actual budgets defined.

If sufficient funding is allocated between ACOE and SFWMD to accomplish these goals, then several tasks will have to be done simultaneously requiring additional crews above and beyond the numbers in past years. Specifically, items 1-2 should be done in the fall of 2012, immediately. Items 3-7 should be completed during the dry season in 2013.

Finally, primary targets would not likely change appreciably from fiscal year 2012. However, if budgets allow, expanding targets to include more species, especially non-listed species, would be appropriate. This would also increase the workload substantially and require even more manpower to complete work in the timeframes presented.

1. (SFWMD FY2012 remaining funds – *in progress*) Continue initial treatments of demolition sites, moving southward through the

unblocked section of the Merritt phase, starting where we left off just north of the abandoned nursery where the new tie-back levee crosses east to west at the FakaUnion Pump station. Priority should be given to invasive grass species over Brazilian-pepper, though all lead tree and miscellaneous hardwoods should be treated immediately to limit their spread. These abandoned home sites provide a large seed source (mostly wind-dispersed grass seeds) for surrounding recently cleared footprints. Exotic grasses infestations previously treated just to the north of the tieback levee also should be retreated. If surveys do not reveal infestations in the middle of the unblocked phase, crews could skip this large area and move to the SE corner where large infestations of cogongrass are already mapped.

2. (Mostly ACOE but some SFWMD funds) Foliar treatments focusing on jaraguá and other priority grasses should again be conducted in September-October 2012. This should at least be done for known locations in the northern areas (79th and northward) in the Prairie Canal phase and all known locations in the Merritt phase.

3. (Mostly SFWMD but recently re-worked areas would be ACOE funds) Foliar treatments of the entire Prairie Canal footprint and all known locations of torpedograss (including Stewart, 79th, 86th, 94th, 98th, and 102nd) should be conducted again this early winter preferably before a freeze event, if water levels are low enough for effective torpedograss control.

4. (SFWMD funds) Cogongrass in the demolition sites and buffers should be re-treated as a part of the entire footprint re-treatments for the Prairie Canal phase. A few small patches not yet treated found by Brazilian-pepper crews late in the season should be treated as well.

5. (ACOE funds) Merritt phase road, logging tram, and cleared canal edge footprints should be re-treated at least one time in the next fiscal year, if not twice. Initial treatments should continue along the recently cleared canal edges where we left of in fiscal year 2012.

6. (SFWMD funds) Merritt Canal phase demolition sites and buffers treated in fiscal years 2010 through 2012 should be retreated, at least for exotic grasses. It would be good to also re-treat Brazilian-pepper and hardwoods, if budget allows.

7. (ACOE funds) Initial treatments of areas recently cleared in the FakaUnion Canal phase (along Everglades Blvd.) should be

conducted focusing on grasses, especially cogongrass, including patches adjacent to the cleared footprints.

8. (SFWMD funds) Retreatment of footprint areas for Brazilian-pepper should be discussed for Prairie Canal phase. Cover by Brazilian-pepper in the 50-foot buffer should also be re-assessed, as the footprints are surveyed. Given budgets may be limited and treating the buffer is costly, Triclopyr treatments in the buffer may be limited anyway.

9. (SFWMD funds) The soil remediation sites should be a high priority for re-assessment of cover and potentially for treatment this winter when water levels recede. Because no treatments were conducted since 2011 torpedograss is likely to have re-grown in many areas. If budget allows, treatment of Bahia lovegrass (*Eragrostis bahiensis*) should be considered also.

4.0 ACKNOWLEDGEMENTS

We want to start by acknowledging the people actually on the ground killing the invasive exotics that we are mapping, because without this hard work our efforts would be pointless. Specifically, for all the early mornings, including often 3 AM starts Mondays for some, and all the long, hot and buggy days, we thank (alphabetically) Alan Buckhalt, Brian Brubaker, Buddy Carter, Mike "el Gallo" Cunningham, Sebastián "el Tio" Marcos, Melico Ruedas, Mulmaro Velasquez, Josh Yates, and all the rest of the labor crew members, who have contributed their own sweat to the success of this restoration project. Thanks to Jerry Renney and Curt Ramsey for continuing to send such knowledgeable and hardworking individuals to Picayune. Curt Ramsey's resolve to keep the crews working this year after the tragic loss of his son, Ricky Ramsey, is awe inspiring and we wish him, his family, and all of his friends a brighter future and we will all remember that no matter what, coming home safe at the end of the day is above all the most important goal in restoration. That being said, we also wish Bill Shane continued recovery from the accident last year and want him to know we have not forgotten. We also wish to thank Maureen Bonness, Beth McCartney, Terry Rushing, and Daniel VanNorman for their contribution to the mapping efforts. Thanks to Jon Morton for his knowledgeable support to our efforts. Finally, special thanks to Janet Starnes, Ellen Donlan, and Mike Duever for working hard to keep us moving forward at a time when support for continued restoration progress was becoming increasingly difficult to secure.

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Tables

Table 1: Acres Covered by First Foliar Treatment of Torpedograss and Cogongrass at PSRP, FY 2012

Treatment	Dates	Location	0	0-<1%	1-5%	5-25%	25-50%	50-75%	75-95%	>95%	Total Acres
Merritt Canal Footprints Initial Treatment (ACOE)	11/8/2011 to 1/4/2012	Inside Footprint	1272.0	60.2	24.4	0.8	0.6		0.4		1358.3
		Adjacent to Footprint	25.3	1.2	3.9	6.9	1.2	2.5	2.7		43.7
		Inside Logging Tram Footprint	3.9								3.9
		Merritt Demolition Site	3.6	5.6	3.1						12.2
		Merritt Demolition Site Buffer	1.5	3.6	1.0						6.1
Prairie Canal Logging Trams Initial Treatment and Misc. Footprints Re-Treatment (ACOE)	2/21/2012 to 3/30/2012	Inside Footprint	775.7	228.6	40.0						1044.3
		Inside Logging Tram Footprint	190.8	3.9							194.7
		50' outside footprint	12.7	2.0							14.8
		Adjacent to Footprint	30.5								30.5
		Demolition Site	3.8	2.0							5.7
		Demolition Site Buffer	20.1	6.4	1.3						27.9
		Total:	2340.0	313.4	73.7	7.7	1.8	2.5	3.1	0.0	2742.2

Table 2: Acres Covered by Second Foliar Treatment of Priority Species* at PSRP, FY 2012											
Treatment	**Dates**	**Location**	**0**	**0-<1%**	**1-5%**	**5-25%**	**25-50%**	**50-75%**	**75-95%**	**>95%**	**Total Acres**
Merritt Canal Footprints Initial Treatment (ACOE)	1/31/2012 to 3/22/2012	Inside Footprint	482.6	538.1	388.2	63.7	0.8	0.9	1.0		1475.2
		Adjacent to Footprint	64.3	86.6	25.6	19.0	0.8	1.4	11.1		208.7
		Inside Logging Tram Footprint		0.4		0.6					1.0
		Merritt Demolition Site	5.2	12.2	12.3	26.5			0.4		56.6
		Merritt Demolition Site Buffer	7.3	6.3	16.2	0.04		1.1			30.9
Prairie Canal Logging Trams Re-treatment and Misc. Footprints Re-Treatment (ACOE)	4/2/2012 to 5/4/2012	Inside Footprint	454.9	555.6	570.4	36.1	2.5				1619.4
		Inside Logging Tram Footprint	146.1	31.8	11.5	7.4		0.02			196.7
		50' outside footprint	11.0	4.2	2.3	0.1	0.1				17.8
		Adjacent to Footprint	11.4	0.3	0.6		0.4				12.7
		Demolition Site	2.4	0.2	3.2						5.7
		Demolition Site Buffer	17.0	3.7	2.7						23.4
		Total:	1202.3	1239.3	1032.9	153.4	4.6	3.3	12.4	0.0	3648.2

* Species Targeted in FY 2012 incuded in these cover estimates are: Impecyli, Panirepe, Neyrreyn, Panimaxi, Paspurvi, Penepurp, Pennpoly, Phraaust, Melirepe, Typhdomi, and Urocmuti

Table 3: Acres Covered by Cut-Stump Treatment of Melaleuca at PSRP, FY 2012											
Treatment	**Location**	**Dates**	**0%**	**0-<1%**	**1-5%**	**5-25%**	**25-50%**	**50-75%**	**75-95%**	**>95%**	**Total Acres**
Cut Stump	Between 62nd & 68th West of Miller	3/26/12 to 5/15/12	42.6	237.1	64.7	25.9	25.9	19.4	14.2	0.0	429.8
		Totals	42.6	237.1	64.7	25.9	25.9	19.4	14.2	0.0	429.8

Table 4: Acres Covered by First SFWMD funded Foliar Re-Treatment of Priority Species* at PSRP, FY 2012

Treatment	Dates	Location	0	0-<1%	1-5%	5-25%	25-50%	50-75%	75-95%	>95%	Total Acres
Prairie Canal Footprint Re-treatment	5/29/2012 to 9/7/2012	Inside Footprint	87.9	163.1	298.4	21.1	1.9				572.4
		Inside Logging Tram Footprint	2.7	4.8	6.0	1.3		0.0			14.9
		50' outside footprint	210.0	36.4	8.5	1.0					255.8
		Adjacent to Footprint	30.8	3.6		2.4					36.8
		Demolition Site	16.9	9.8	13.4	14.7	9.4		0.3		64.5
		Demolition Site Buffer	863.7	251.0	40.6	9.9	0.3	0.2	0.2		1165.9
		Total:	1212.0	468.7	366.8	50.4	11.6	0.2	0.5	0.0	2110.3

* Species Targeted in FY 2012 incuded in these cover estimates are: Impecyli, Panirepe, Neyrreyn, Panimaxi, Paspurvi, Penepurp, Pennpoly, Phraaust, Melirepe, Typhdomi, and Urocmuti

Table 5: Total Distance Surveyed Using GPS with ArcPAD (FY2012)		
Method	**Meters**	**Kilometers**
ATV	7,058.8	7.1
Bicycle	121,957.9	122.0
On Foot	96,937.5	96.9
Swamp Buggy	14,236.5	14.2
Standard Vehicle	224,172.4	224.2
	Totals	464.4

Table 6: List of Invasive Exotic Species Logged as Waypoints by GPS into Geodatabase				
FLEPPC	**Scientific Name**	**Common Names**	**2012**	**All Years**
I	*Abrus precatorius*	Rosary-pea, Crab-eyes	3	4
I	*Acacia auriculiformis*	Earleaf acacia		57
I	*Albizia lebbeck*	Woman's tongue, Rattlepod	2	3
	Allamanda cathartica	Yellow allamanda, Golden trumpet		1
	Alpinia zerumbet	Shellflower, Shell ginger		1
	Arundo donax	Giant reed		1
	Bambusa vulgaris	Common bamboo	1	12
I	*Bauhinia variegata*	Mountain ebony, orchidtree		5
I	*Bischofia javanica*	Javanese bishopwood		3
	Bothriochloa pertusa	Pitted bluestem, Pitted beardgrass	8	9
II	*Casuarina cunninghamiana*	Beefwood, River sheoak		3
I	*Casuarina equisetifolia*	Australian-pine, Horsetail casuarina		15
	Cortaderia selloana	Pampas grass		1
	Crotalaria spectabilis	Showy rattlebox		1
I	*Cupaniopsis anacardioides*	Carrotwood		1
	Cynodon dactylon	Bermuda grass	19	34
II	*Dactyloctenium aegyptium*	Crow's-foot grass, Durban crowfootgrass		3
II	*Dalbergia sissoo*	Indian rosewood		4
I	*Dioscorea alata*	White yam		2
I	*Dioscorea bulbifera*	Common air-potato	3	25
I	*Eichhornia crassipes*	Common Water hyacinth		18
	Epiphyllum phyllanthus var. *hookeri*	Orchid cactus		1
	Eragrostis atrovirens	Thalia love grass	5	18
	Eulophia graminea	Orchid	36	36
I	*Ficus microcarpa*	Laurel fig, Indian laurel		2
	Ficus sp.	3 veined Ficus sp., un-identified;		2
	Furcraea selloa			1
II	*Hemarthria altissima*	Limpograss	1	3
	Heteropogon contortus	Tanglehead	13	29
	Hibiscus sabdariffa	*Karkadé,* Flor de Jamaica, Sorrel		1
I	*Hydrilla verticillata*	Water-thyme		2
I	*Hymenachne amplexicaulis*	Trompetilla		69
II	*Hyparrhenia rufa*	Jaragua	68	128
	Hyptis pectinata	Comb bushmint	1	2
I	*Imperata cylindrica*	Congongrass, Cogongrass	231	1242

Table 6: List of Invasive Exotic Species Logged as Waypoints by GPS into Geodatabase				
	Ipomoea quamoclit	Cypressvine		2
	Kalanchoe daigremontiana	Devil's-backbone		2
II	*Koelreuteria elegans subsp.*	Flamegold		1
	Lagerstroemia indica	Crapemyrtle		2
I	*Lantana camara*	Shrub verbena	12	115
II	*Leucaena leucocephala*	White leadtree	7	28
	Litchi chinensis	Litchee		1
I	*Ludwigia peruviana*	Peruvian primrosewillow		2
I	*Lygodium japonicum*	Japanese climbing fern		5
I	*Lygodium microphyllum*	Small-leaf climbing fern	4	134
	Mangifera indica	Mango		1
I	*Manilkara zapota*	Sapodilla		1
I	*Melaleuca quinquenervia*	Punktree	3	1209
I	*Nephrolepis cordifolia*	Tuberous sword fern		13
I	*Nephrolepis multiflora*	Asian sword fern	2	25
	Nephrolepis sp.	hybrid, *N. multiflora, N. biserrata* , or *N. exaltata* ?	3	4
I	*Neyraudia reynaudiana*	Burmareed, Silkreed	58	283
	Oeceoclades maculata	African ground orchid, Monk orchid		2
II	*Panicum maximum*	Guineagrass	16	23
II	*Panicum maximum*	Guineagrass	16	1
I	*Panicum repens*	Torpedo grass	28	163
	Paspalum notatum	Bahia grass	13	16
	Paspalum urvillei	Vasey grass	42	60
	Pennisetum polystachion	West Indian pennisetum, Missiongrass	7	22
I	*Pennisetum purpureum*	Napier grass, Elephantgrass	4	36
	Philodendron sp.		1	1
II	*Phoenix reclinata*	Senegal date palm		1
	Phragmites australis	Common reed	21	46
	Phyllanthus acidus	Tahitian gooseberry tree		1
II	*Phyllostachys aurea*	Golden Bamboo		2
I	*Pistia stratiotes*	Water-lettuce		1
	Pongamia pinnata	Karum tree, Poonga-oil tree		1
I	*Psidium cattleianum*	Strawberry guava		1
I	*Psidium guajava*	Guava		1
II	*Pteris vittata*	China brake		17
I	*Rhodomyrtus tomentosa*	Downy myrtle, Rose myrtle		242

Table 6: List of Invasive Exotic Species Logged as Waypoints by GPS into Geodatabase

I	*Melinis repens*	Rose Natalgrass	21	91
II	*Ricinus communis*	Castor-bean		1
	Rottboellia cochinchinensis	Itch grass		2
I	*Schinus terebinthifolius*	Brazilian-pepper	8	1444
	Selenicereus pteranthus	Snake cactus, Princess-of-the-night		1
	Senna alata	Candlestick plant		2
I	*Senna pendula* var. *glabrata*	Valamuerto	9	9
II	*Sesbania punicea*	False-rattlebox		1
	Sorghum halepense	Johnsongrass	2	2
	Sporobolus indicus var. *pyramidalis*	Smutgrass, West Indian dropseed	12	33
	Stenotaphrum secundatum	St. Augustine grass	5	10
II	Syagrus romanzoffiana	Queen palm		1
I	*Syngonium podophyllum*	Nephthytis, American evergreen	1	1
I	*Syzygium cumini*	Jambolan-plum, Java-plum		30
II	*Syzygium jambos*	Rose-apple, Malabar-plum		13
	Tabebuia aurea	Caribbean trumpettree		1
II	*Terminalia catappa*	Tropical-almond, West Indian-almond		1
I	*Thespesia populnea*	Portiatree		1
I	*Tradescantia spathacea*	Oysterplant, Moses-in-the-cradle, Boatlily	1	3
	Tradescantia zebrina	Wandering-jew, Inchplant	1	1
	Triplaris melaenodendron	Long John		1
	Typha domingensis	Southern cat-tail	44	109
	Unknown Araliaceae			1
II	*Urena lobata*	Caesarweed	2	1467
I	*Urochloa mutica*	Paragrass	1	13
II	*Vitex trifolia*	Simpleleaf chastetree		1
II	*Wedelia trilobata*	Creeping wedelia, Creeping oxeye		5
II	*Xanthosoma sagittifolium*	Arrowleaf elephantear	2	2
	Zamia furfuracea	Cardboard-palm		1
	Ziziphus mauritiana	Indian jujube		8
		Spiny Mimosoid Tree, strong odor		2
		Unknown Plants		44
		Miscellaneous landscape plants*		9
		Unknown Fabaceae	1	3
		TOTAL:	738	7518

*Miscellaneous landscape plants listed in comments of database, no FLEPPC listed species

Table 7: Total Infested Acres by Cover Class and Actual Area Covered by Invasive Exotics in Prairie Canal Cleared Footprints												
Category	**Period**	**0% (No Infestation)**	**Total Infested**	**Actual Coverage***	**<1%**	**1-5%**	**5-25%**	**25-50%**	**50-75%**	**75-95%**	**95-100%**	**Total Acres****
Total Exotics	Spring 2011	4.0	1759.2	253.9	11.8	676.6	840.9	160.2	52.6	17.0		1763.2
	Spring 2012	5.4	1757.8	251.5	14.9	644.4	912.8	101.8	67.4	9.8	6.7	1763.2
Total FLEPPC I	Spring 2011	4.0	1759.2	52.5	689.4	984.7	57.5	26.1	0.3	1.1		1763.2
	Spring 2012	5.5	1757.7	47.1	723.5	939.7	92.5	0.6	0.3	1.1		1763.2
Total FLEPPC II	Spring 2011	156.0	1607.2	66.6	647.2	753.3	182.6	6.7	17.3			1763.2
	Spring 2012	156.0	1607.2	66.6	648.0	752.4	182.7	6.7	17.3			1763.2
Non-Listed	Spring 2011	29.2	1734.0	139.6	27.7	1102.8	539.4	58.2	5.8			1763.2
	Spring 2012	31.6	1731.6	148.1	15.5	1097.8	549.0	42.3	26.9			1763.2
Foliar Targets	Spring 2011	335.9	1427.3	44.0	551.6	799.8	49.9	26.1				1763.2
	Spring 2012	464.5	1298.7	28.2	613.2	648.5	36.5	0.6				1763.2
Imperata cylindrica	Spring 2011	1422.4	340.8	1.8	338.2	2.6						1763.2
	Spring 2012	1589.5	173.7	1.0	170.1	3.6						1763.2
Panicum repens	Spring 2011	1595.4	167.8	1.6	141.2	25.4	1.2					1763.2
	Spring 2012	1600.3	162.9	1.1	151.1	11.7	0.1					1763.2
**Sum of infested acres for each cover class multiplied by the midpoint of the percent cover category*												
**Total Acreage considered inside footprint is less than 2011 because some areas re-disturbed prior to re-survey were not included in calculations this year												

Table 8: Summary of Actual Area Covered by Invasive Exotics in Prairie Canal Phase Cleared Footprints					
Category	Spring 2011		Spring 2012		Total Acres
	Actual Coverage*	Percent of Site	Actual Coverage*	Percent of Site	
Total Exotics	253.91	14.4%	251.47	14.3%	1763.2
Total FLEPPC I	52.54	3.0%	47.06	2.7%	1763.2
Total FLEPPC II	66.57	3.8%	66.56	3.8%	1763.2
Non-Listed	139.60	7.9%	148.06	8.4%	1763.2
FY 2012 Foliar Targets	44.01	2.5%	28.20	1.6%	1763.2
Imperata cylindrica	1.77	0.1%	0.96	0.1%	1763.2
Panicum repens	1.65	0.1%	1.12	0.1%	1763.2

**Sum of infested acres for each cover class multiplied by the midpoint of the percent cover category*

Table 9: Total Infested Acres by Cover Class and Actual Area Covered by Invasive Exotics in Prairie Canal Phase at Demolition Sites and Buffers

Category	Period	0% (No Infestation)	Total Infested	Actual Coverage*	<1%	1-5%	5-25%	25-50%	50-75%	75-95%	95-100%	Total Acres
Total Exotics	Spring 2011	25.5	1760.1	122.0	727.7	688.7	237.6	33.1	55.5	17.0	0.4	1785.6
	Spring 2012	24.7	1760.9	87.3	712.8	746.9	260.3	15.5	22.7	2.7		1785.6
Total FLEPPC I	Spring 2011	27.2	1758.3	55.3	853.4	784.7	88.2	25.8	3.0	3.2		1785.6
	Spring 2012	27.3	1758.3	50.7	858.0	779.0	105.1	13.6	0.2	2.4		1785.6
Total FLEPPC II	Spring 2011	1379.2	406.3	56.6	15.6	250.6	72.0	24.9	35.0	8.2		1785.6
	Spring 2012	1379.1	406.5	12.7	94.0	291.6	19.7	0.8	0.4			1785.6
Non-Listed	Spring 2011	1732.4	53.1	6.1	15.3		36.9	0.5		0.3		1785.6
	Spring 2012	1670.4	115.2	15.2	33.3	19.3	40.9	21.1	0.2	0.3		1785.6
FY 2012 Foliar Targets	Spring 2011	1391.9	393.7	15.3	304.5	54.7	8.9	22.0	2.6	1.0		1785.6
	Spring 2012	1396.7	388.9	11.1	297.0	56.7	24.8	9.7	0.2	0.5		1785.6
Imperata cylindrica	Spring 2011	1406.4	379.1	5.9	338.7	30.2	6.7	0.3	2.6	0.7		1785.6
	Spring 2012	1412.8	372.7	4.4	331.7	31.1	9.3	0.3	0.2	0.2		1785.6

**Sum of infested acres for each cover class multiplied by the midpoint of the percent cover category*

Table 10: Summary of Actual Area Covered by Invasive Exotics in Prairie Canal Phase at Demolition Sites and Buffers					
Category	**Spring 2011**		**Spring 2012**		**Total Acres**
	Actual Coverage*	**Percent of Site**	**Actual Coverage***	**Percent of Site**	
Total Exotics	122.0	6.8%	87.3	4.9%	1785.6
Total FLEPPC I	55.3	3.1%	50.7	2.8%	1785.6
Total FLEPPC II	56.6	3.2%	12.7	0.7%	1785.6
Non-Listed	6.1	0.3%	15.2	0.9%	1785.6
FY 2012 Foliar Targets	15.3	0.9%	11.1	0.6%	1785.6
Imperata cylindrica	5.9	0.3%	4.4	0.2%	1785.6

Table 10: Summary of Actual Area Covered by Invasive Exotics in Prairie Canal Phase at Demolition Sites and Buffers

**Sum of infested acres for each cover class multiplied by the midpoint of the percent cover category*

Table 11: Total Infested Acres by Cover Class and Actual Area Covered by Invasive Exotics in Merritt Phase at Demolition Sites and Buffers (Incomplete mapping and 9% Treated 2011)												
Category	**Period**	**0% (No Infestation)**	**Total Infested**	**Actual Coverage***	**<1%**	**1-5%**	**5-25%**	**25-50%**	**50-75%**	**75-95%**	**95-100%**	**Total Acres**
Total Exotics	Spring 2010	711.5	4546.2	619.9	1581.1	1350.0	769.1	436.3	260.5	126.1	23.1	5257.7
	Spring 2011	711.5	4546.2	618.1	1586.7	1354.3	760.6	435.0	260.5	127.5	21.6	5257.7
Total FLEPPC I	Spring 2010	809.0	4448.7	367.8	1632.2	1629.7	903.4	73.3	137.8	71.4	1.0	5257.7
	Spring 2011	809.0	4448.7	366.4	1646.6	1623.8	894.8	73.3	137.8	71.4	1.0	5257.7
Total FLEPPC II	Spring 2010	4902.7	355.0	40.8	21.1	81.1	252.2	0.2	0.5			5257.7
	Spring 2011	4902.7	355.0	40.8	21.1	81.1	252.2	0.2	0.5			5257.7
Non-Listed	Spring 2010	4604.6	653.1	194.5	14.7	138.6	209.0	138.6	99.5	52.7		5257.7
	Spring 2011	4604.6	653.1	194.5	14.7	138.6	209.0	138.6	99.5	52.7		5257.7
FY 2011 foliar targets	Spring 2010	4027.2	1230.5	58.6	749.7	381.9	46.9	10.6	13.1	28.2	0.2	5257.7
	Spring 2011	4027.2	1230.5	57.6	768.3	367.3	42.8	10.6	13.1	28.2	0.2	5257.7
Schinus terebinthifolius	Spring 2010	2553.6	2704.2	286.1	442.8	1326.7	704.1	61.9	125.0	43.8		5257.7
	Spring 2011	2553.6	2704.2	286.1	442.8	1326.7	704.1	61.9	125.0	43.8		5257.7
Imperata cylindrica	Spring 2010	4038.0	1219.8	57.1	762.8	364.6	40.2	10.6	13.1	28.2	0.2	5257.7
	Spring 2011	4035.9	1221.9	56.9	782.3	349.2	36.1	12.8	13.1	28.2	0.2	5257.7

**Sum of infested acres for each cover class multiplied by the midpoint of the percent cover category*

Table 12: Summary of Actual Area Covered by Invasive Exotics in Merritt Phase at Demolition Sites & Buffers (Incomplete Mapping and 9% Treated)

Category	Spring 2011		Spring 2012		Total Acres
	Actual Coverage*	Percent of Site	Actual Coverage*	Percent of Site	
Total Exotics	619.9	11.8%	618.1	11.8%	5257.7
Total FLEPPC I	367.8	7.0%	366.4	7.0%	5257.7
Total FLEPPC II	40.8	0.8%	40.8	0.8%	5257.7
Non-Listed	194.5	3.7%	194.5	3.7%	5257.7
FY 2012 Foliar Targets	58.6	1.1%	57.6	1.1%	5257.7
Schinus terebinthifolius	286.1	5.4%	286.1	5.4%	5257.7
Imperata cylindrica	57.1	1.1%	56.9	1.1%	5257.7

**Sum of infested acres for each cover class multiplied by the midpoint of the percent cover category*

Table 13: Total Infested Acres by Cover Class and Actual Area Covered by Invasive Exotics in Merritt Phase Footprints (Road, Logging Tram, and some Canal Edge Footprints Combined)												
Category	**Period**	**0% (No Infestation)**	**Total Infested**	**Actual Coverage***	**<1%**	**1-5%**	**5-25%**	**25-50%**	**50-75%**	**75-95%**	**95-100%**	**Total Acres**
Total Exotics	Spring 2012	12.1	1693.7	320.4	98.4	701.2	545.1	122.5	121.3	57.5	47.7	1705.8
Total FLEPPC I	Spring 2012	200.7	1505.1	70.6	616.8	731.1	114.1	0.9	34.5	7.4	0.3	1705.8
Total FLEPPC II	Spring 2012	540.9	1164.9	118.7	440.4	347.2	251.4	56.6	54.0	12.1	3.3	1705.8
Non-Listed	Spring 2012	113.2	1592.6	161.7	215.1	969.4	270.1	50.9	23.0	38.9	25.1	1705.8
FY 2012 foliar targets	Spring 2012	618.5	1087.3	31.3	584.8	407.1	91.8	0.3	2.3	1.0		1705.8
Schinus terebinthifolius	Spring 2012	430.8	1275.0	36.5	1099.4	134.6	0.7		33.1	6.9	0.3	1705.8
Imperata cylindrica	Spring 2012	1602.0	103.9	2.8	68.1	33.4		0.6	1.3	0.5		1705.8
Panicum repens	Spring 2012	1668.7	37.1	0.3	36.3		0.8					1705.8
**Sum of infested acres for each cover class multiplied by the midpoint of the percent cover category*												

Table 14: Summary of Actual Area Covered by Invasive Exotics in Merritt Phase Footprints (Road, Logging Tram, and some Canal Edge Footprints Combined)			
Category	**Spring 2012**		**Total Acres**
	Actual Coverage*	**Percent of Site**	
Total Exotics	320.4	18.8%	1705.8
Total FLEPPC I**	70.6	4.1%	1705.8
Total FLEPPC II	118.7	7.0%	1705.8
Non-Listed	161.7	9.5%	1705.8
FY 2012 Foliar Targets	31.3	1.8%	1705.8
*Schinus terebinthifolius***	36.5	2.1%	1705.8
Imperata cylindrica	2.8	0.2%	1705.8
Panicum repens	0.3	0.018%	1705.8
**Sum of infested acres for each cover class multiplied by the midpoint of the percent cover category*			
**Includes some edes of Merritt Canal dominated by *S. terebinthifolius* not yet cleared and, therefore, can be considered an overestimate at this time			

Figures

Figure 1: Daily Temperature Chart, Naples, FL

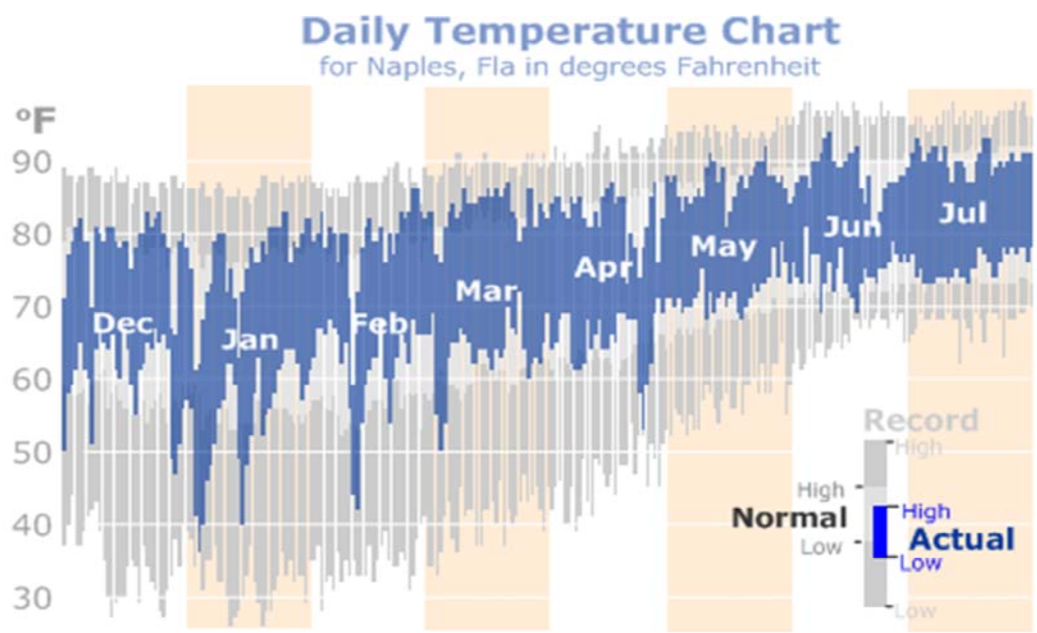


Figure 2: Big Cypress Rainfall Summary

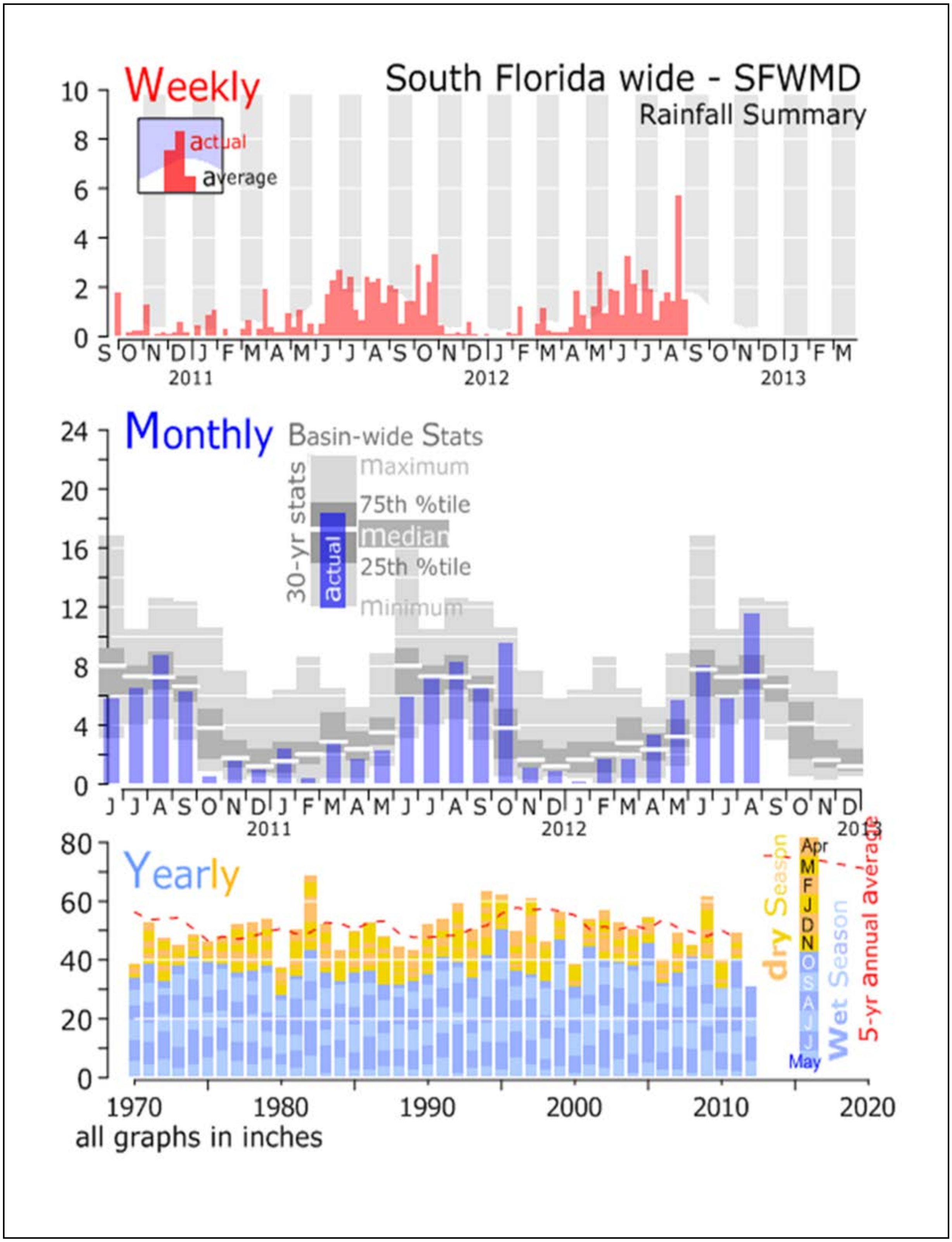


Figure 3: Water Levels at 70th and Patterson, PSRP

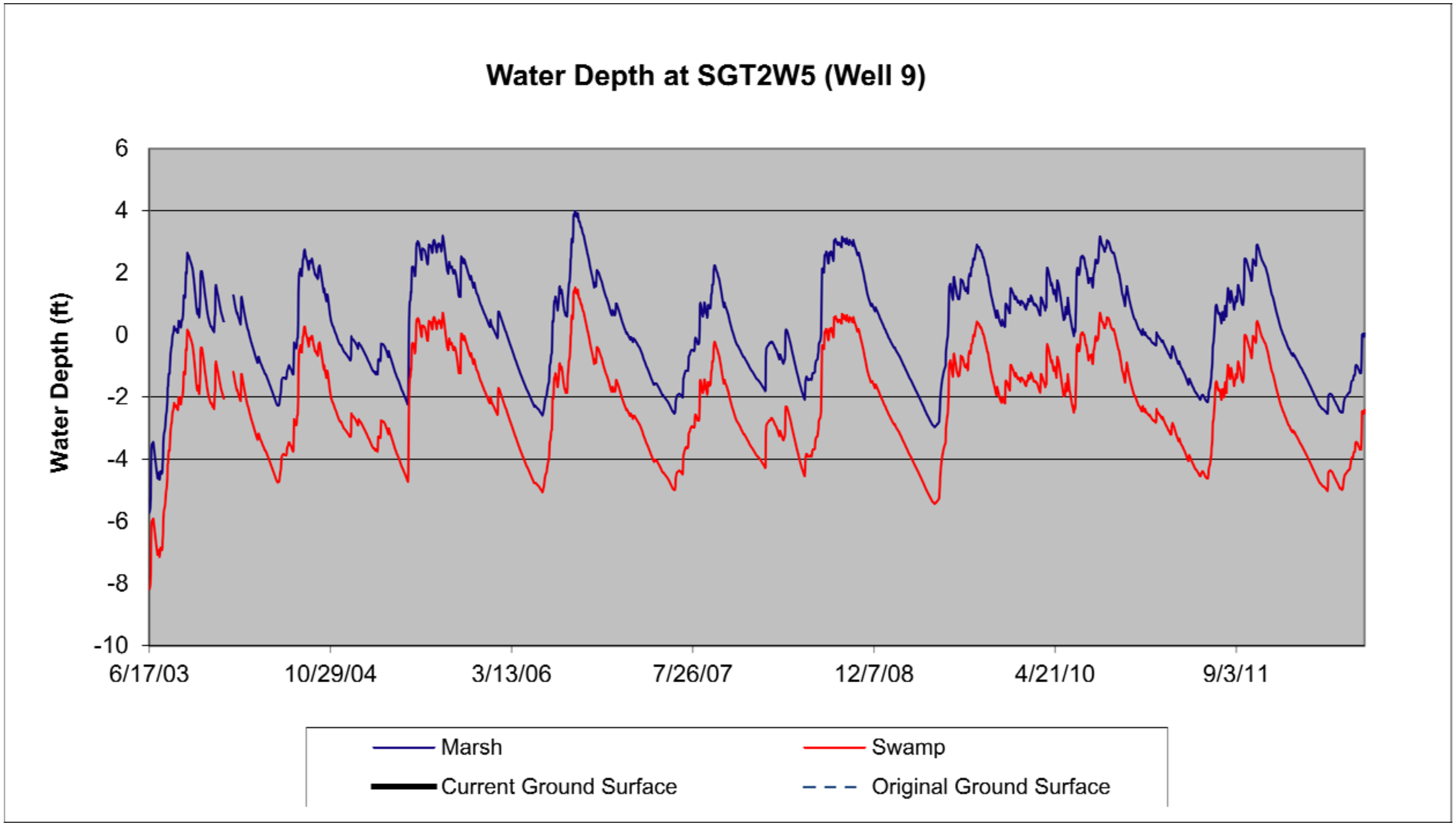


Figure 4: Year to date Rainfall by Doppler Rainfall estimates, Departures from Average

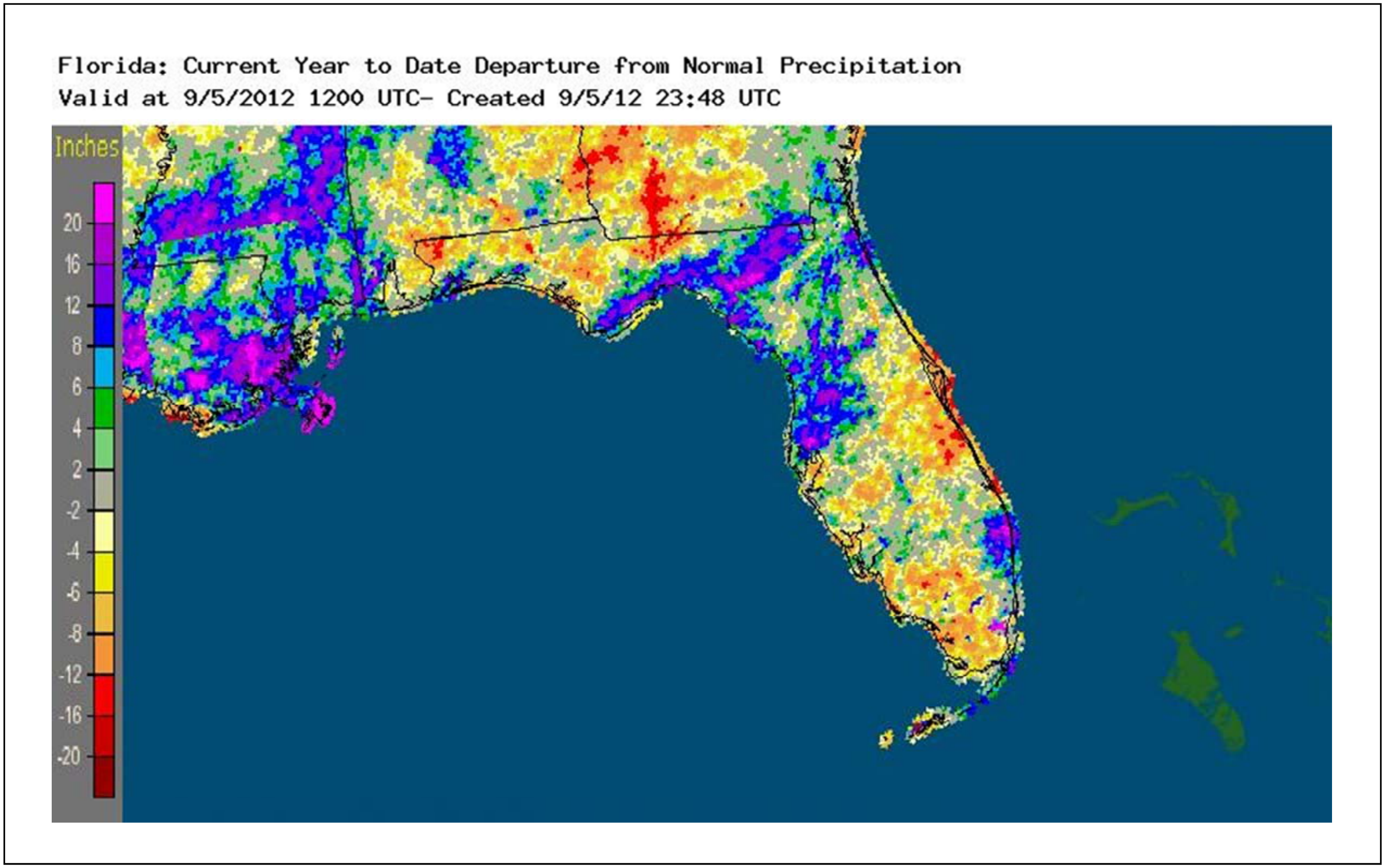


Figure 5: Initial Foliar Treatment of Merritt Footprints and Prairie Canal Logging Tram Footprints (Southern Half)

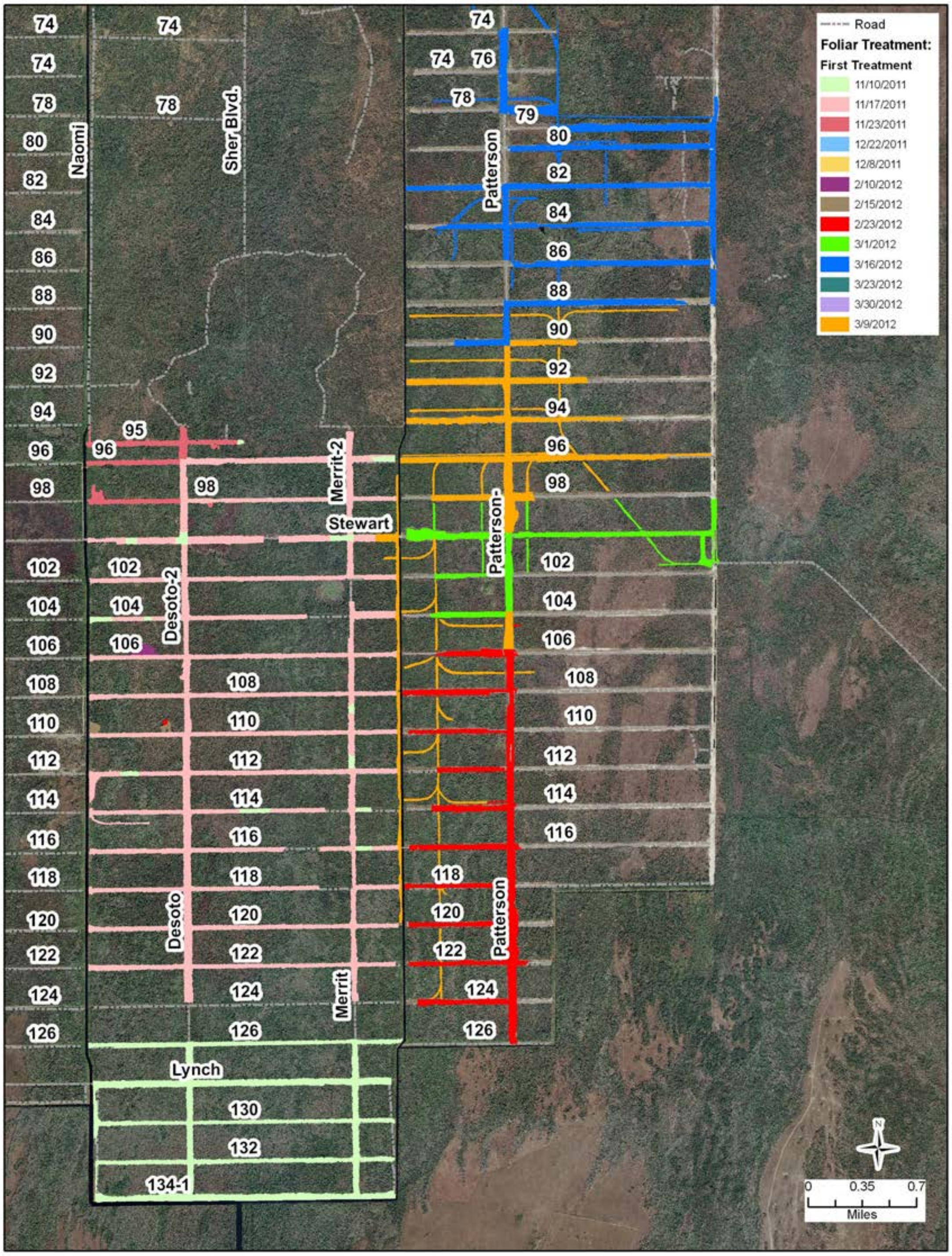


Figure 6: Initial Foliar Treatment of Merritt Footprints and Prairie Canal Logging Tram Footprints (Northern Half)

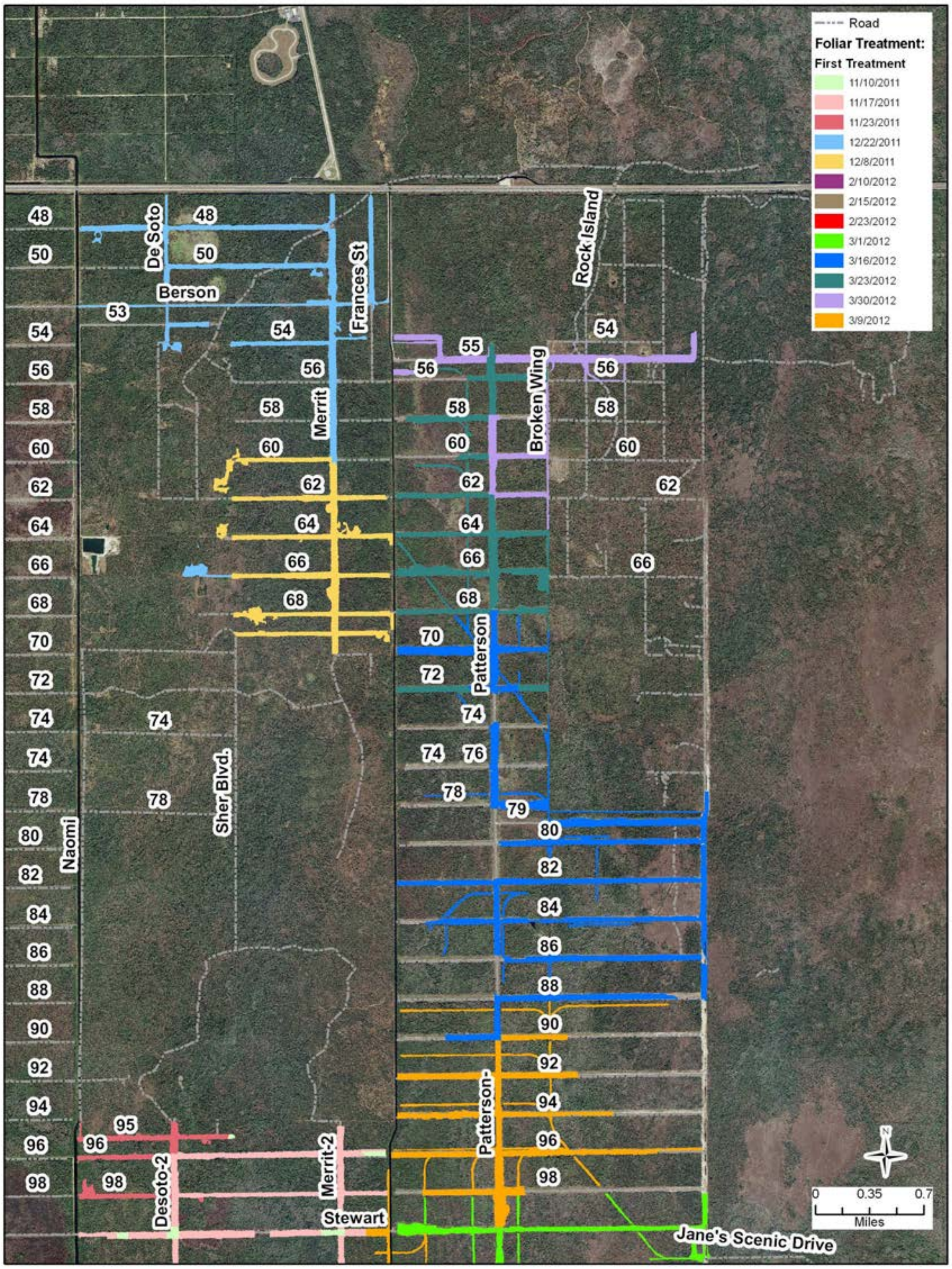


Figure 7: First Foliar Re-treatment of Merritt Footprints and Prairie Canal Logging Tram Footprints (Southern Half)

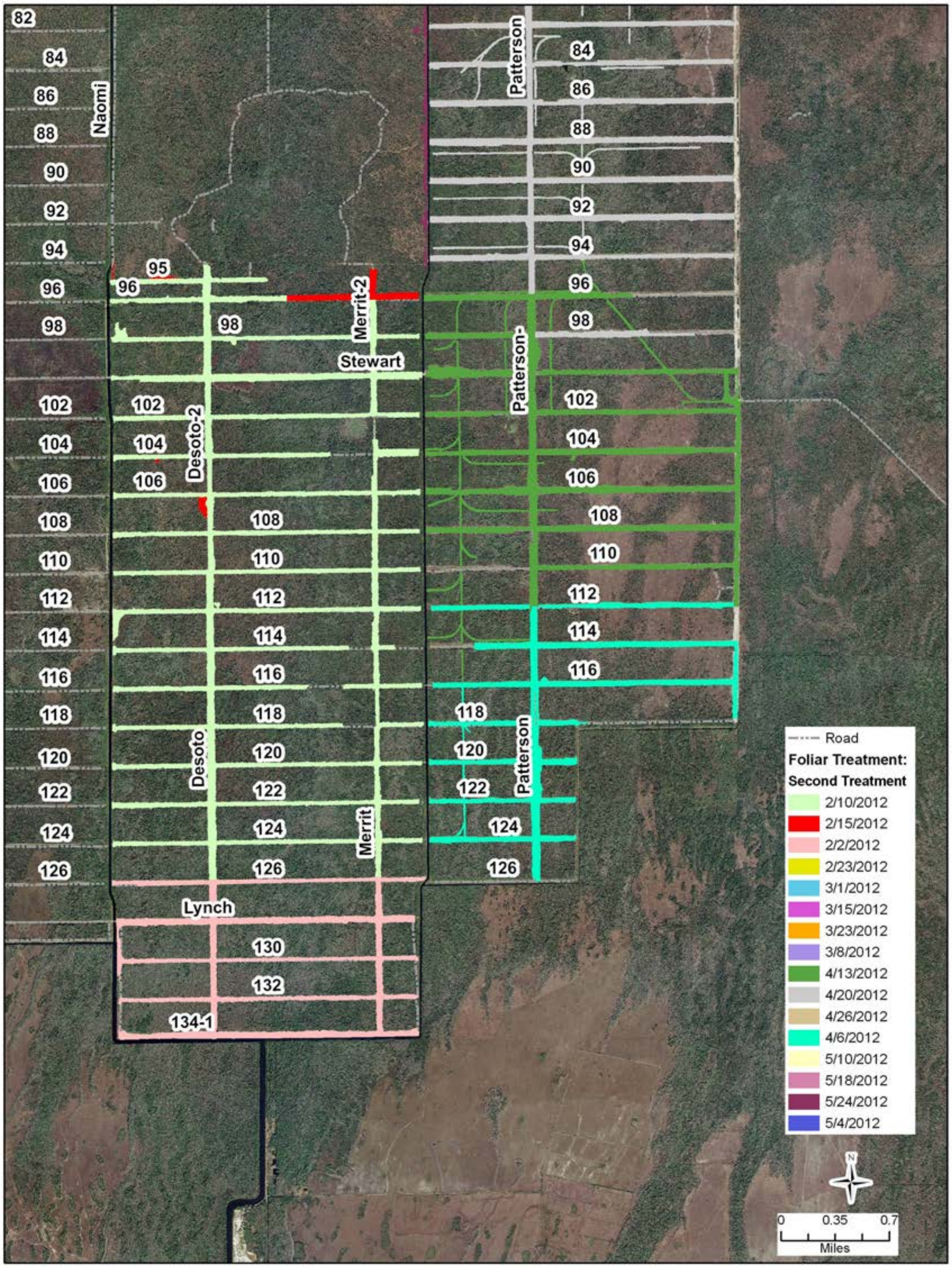


Figure 8: First Foliar Re-treatment of Merritt Footprints and Prairie Canal Logging Tram Footprints (Northern Half)

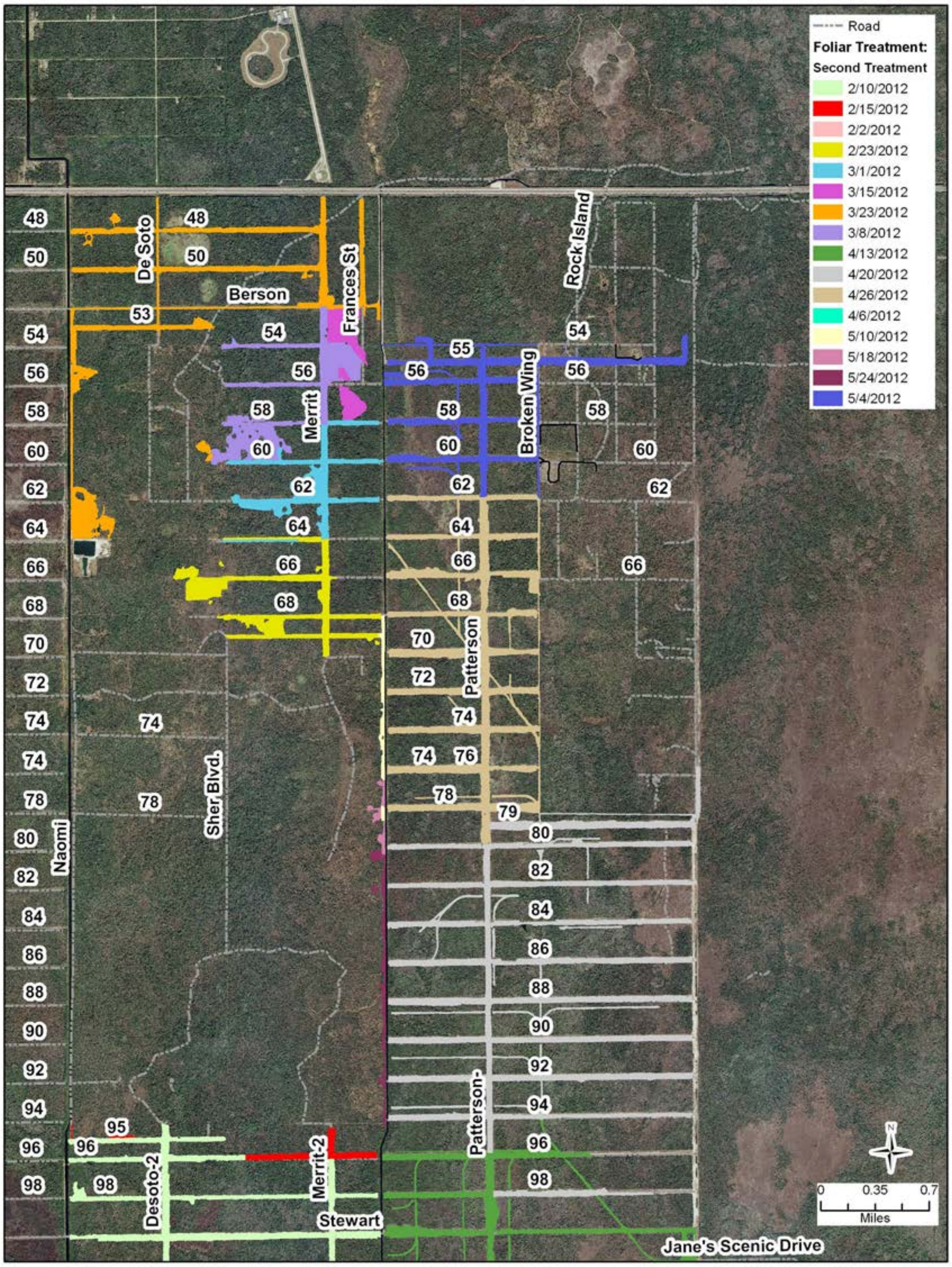


Figure 9: Melaleuca Treatments in PSRP FY 2012 (62nd through 68th)

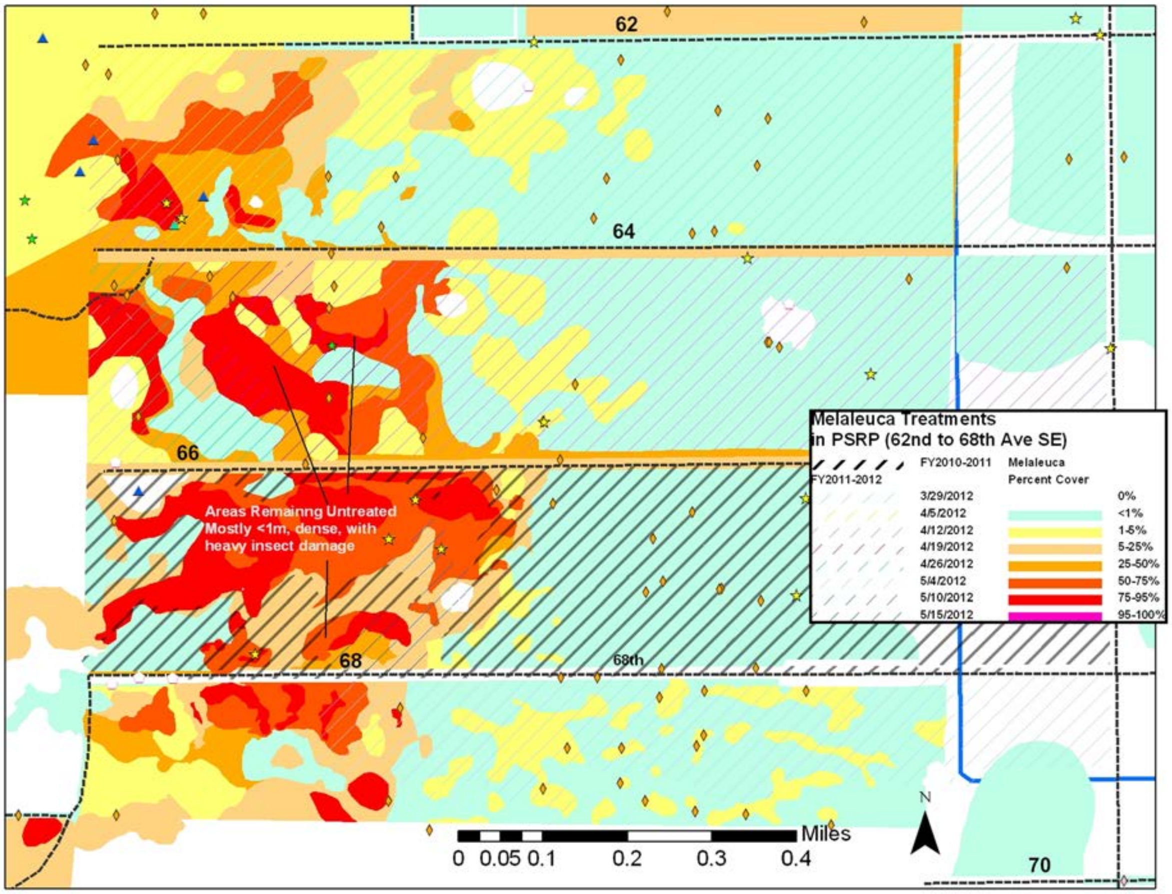


Figure 10: First Foliar Retreatment of Prairie Canal Footprints (South) SFWMD

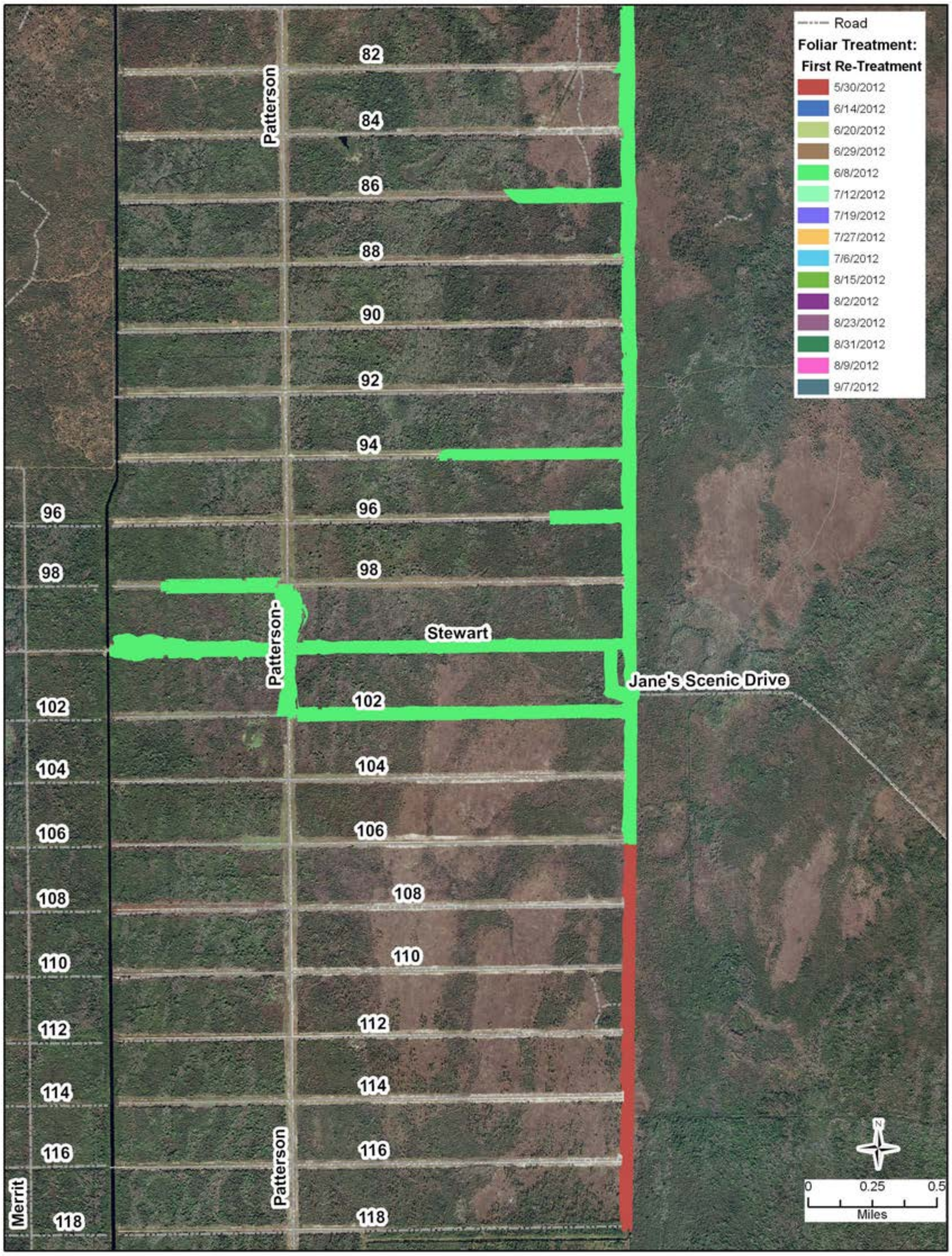


Figure 11: First Foliar Retreatment of Prairie Canal Footprints (North) SFWMD

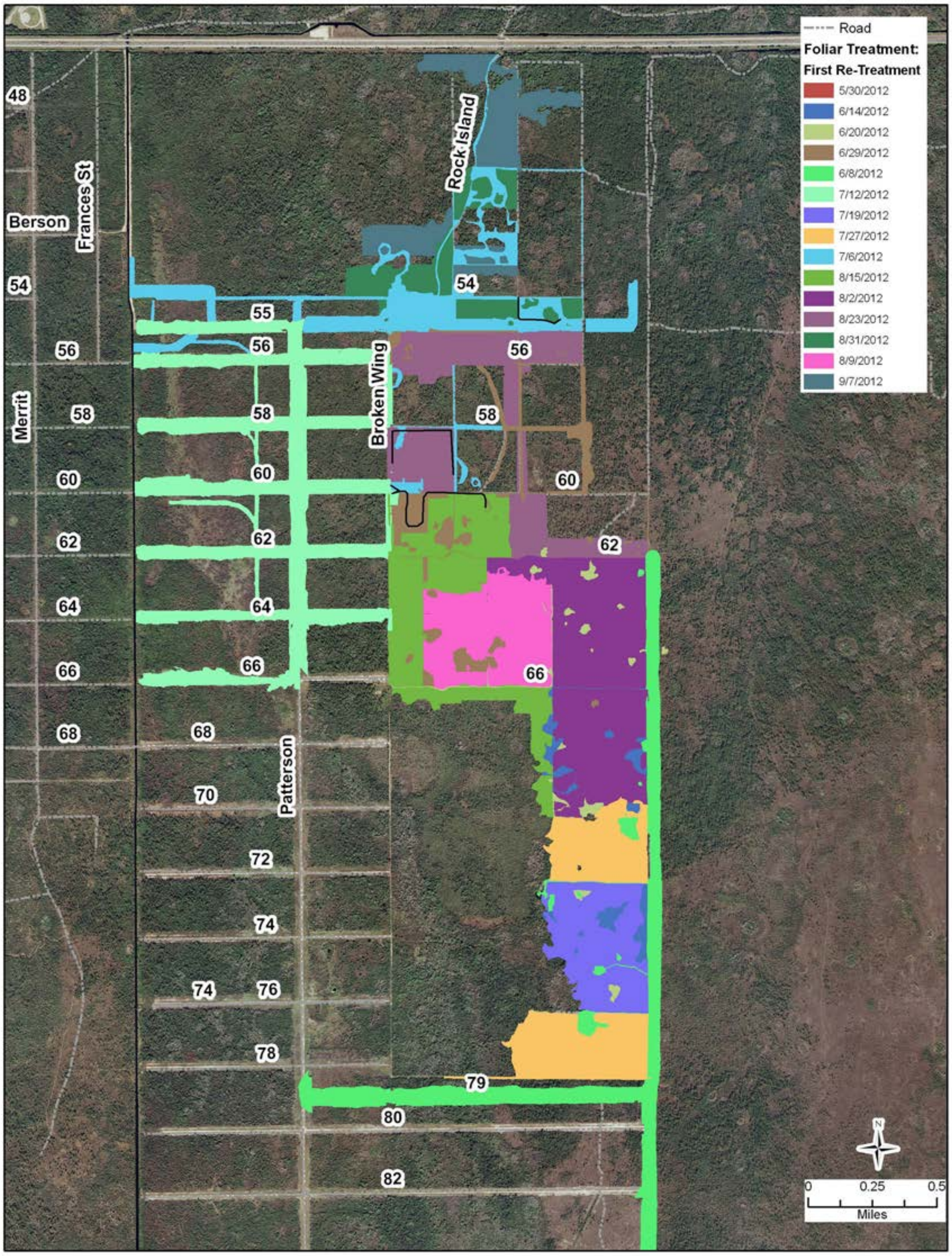


Figure 12: Total Cover by Exotic and Nuisance Species in Prairie Canal Phase Footprints and Demolition Sites (2011-2012)

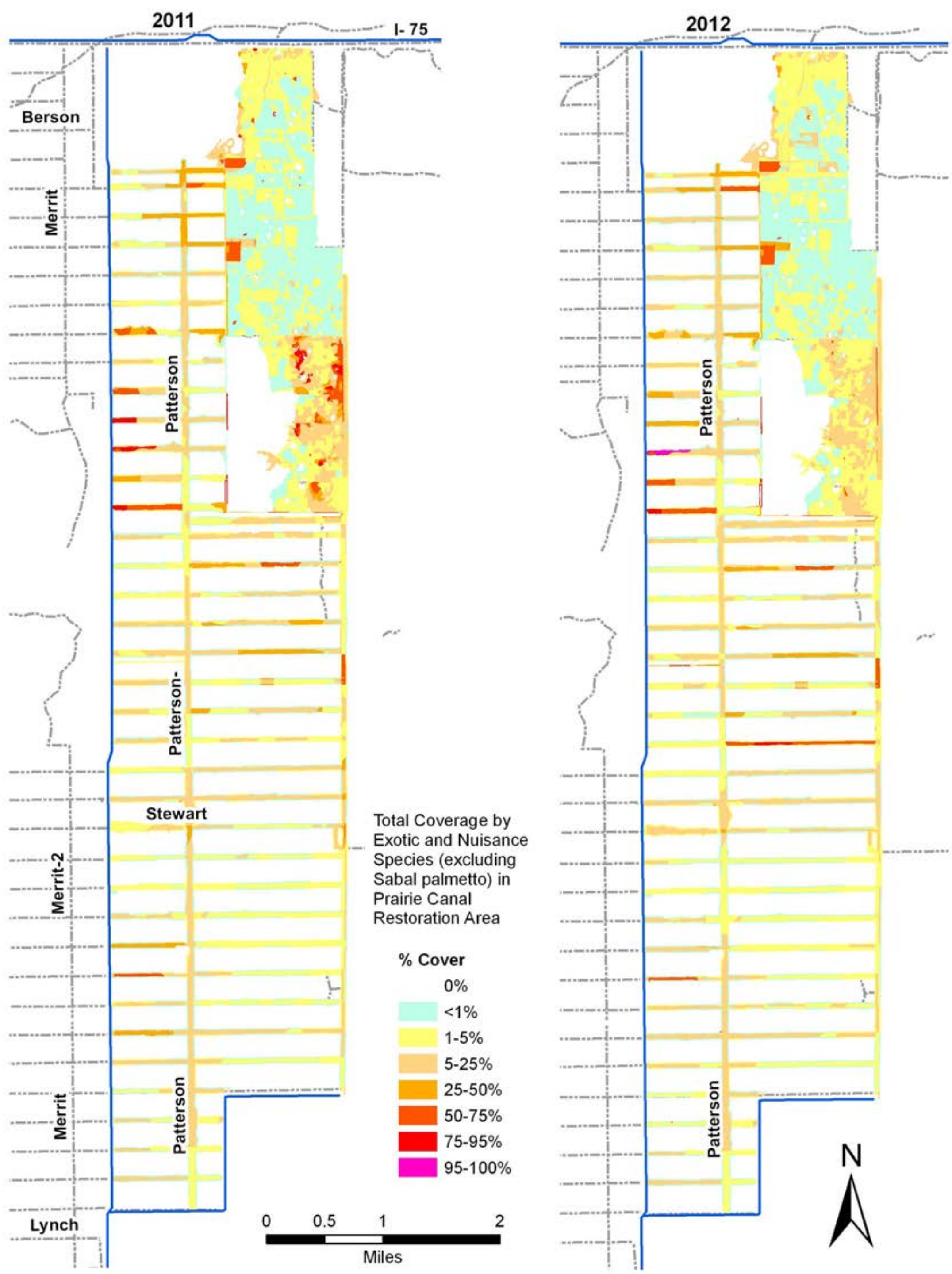


Figure 13: Total Cover by FLEPPC I Exotic and Nuisance Species in Prairie Canal Phase Footprints and Demolition Sites (2011-2012)

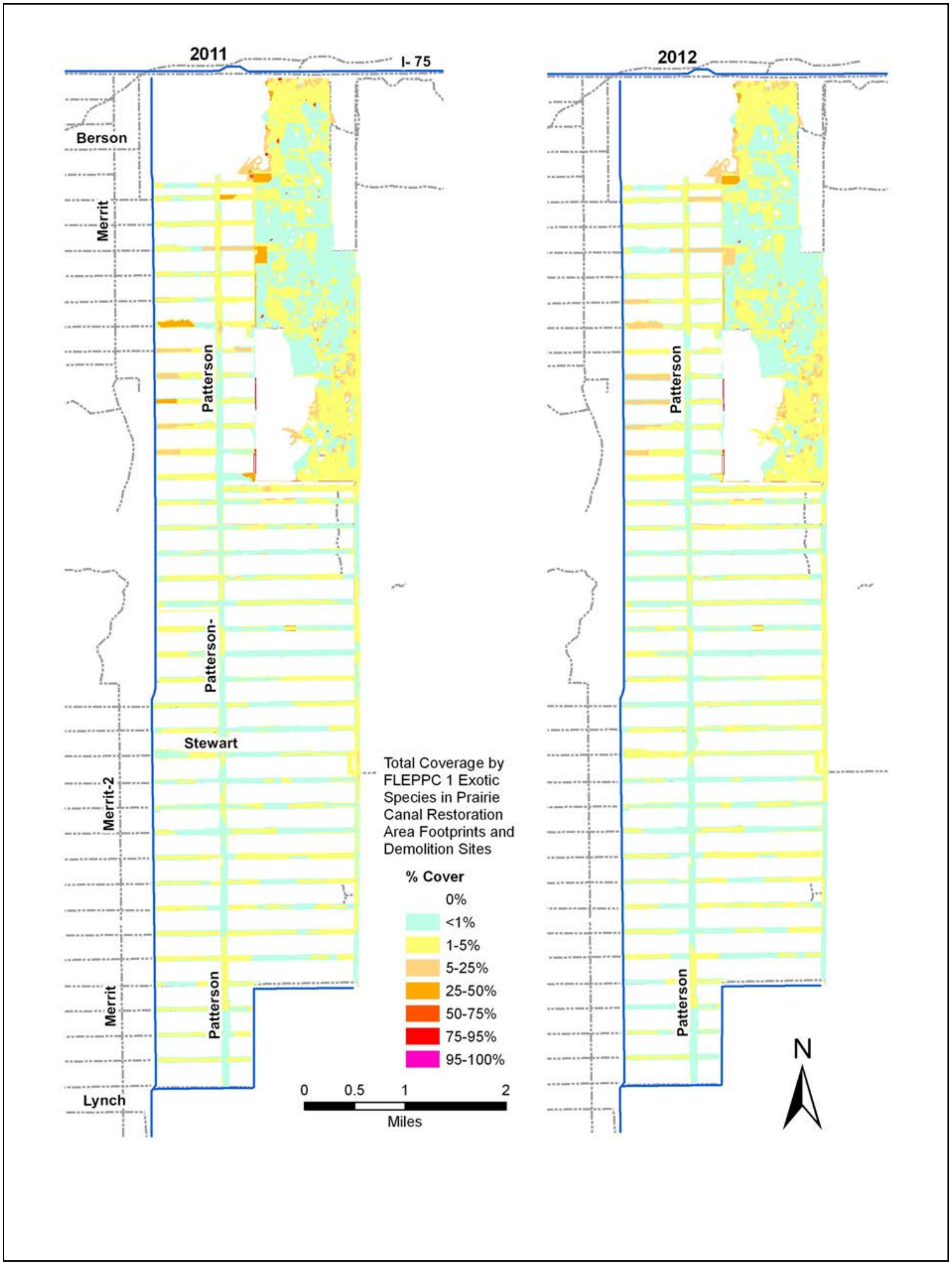


Figure 14: Total Cover by Cogongrass in Prairie Canal Phase Footprints and Demolition Sites (2011-2012)

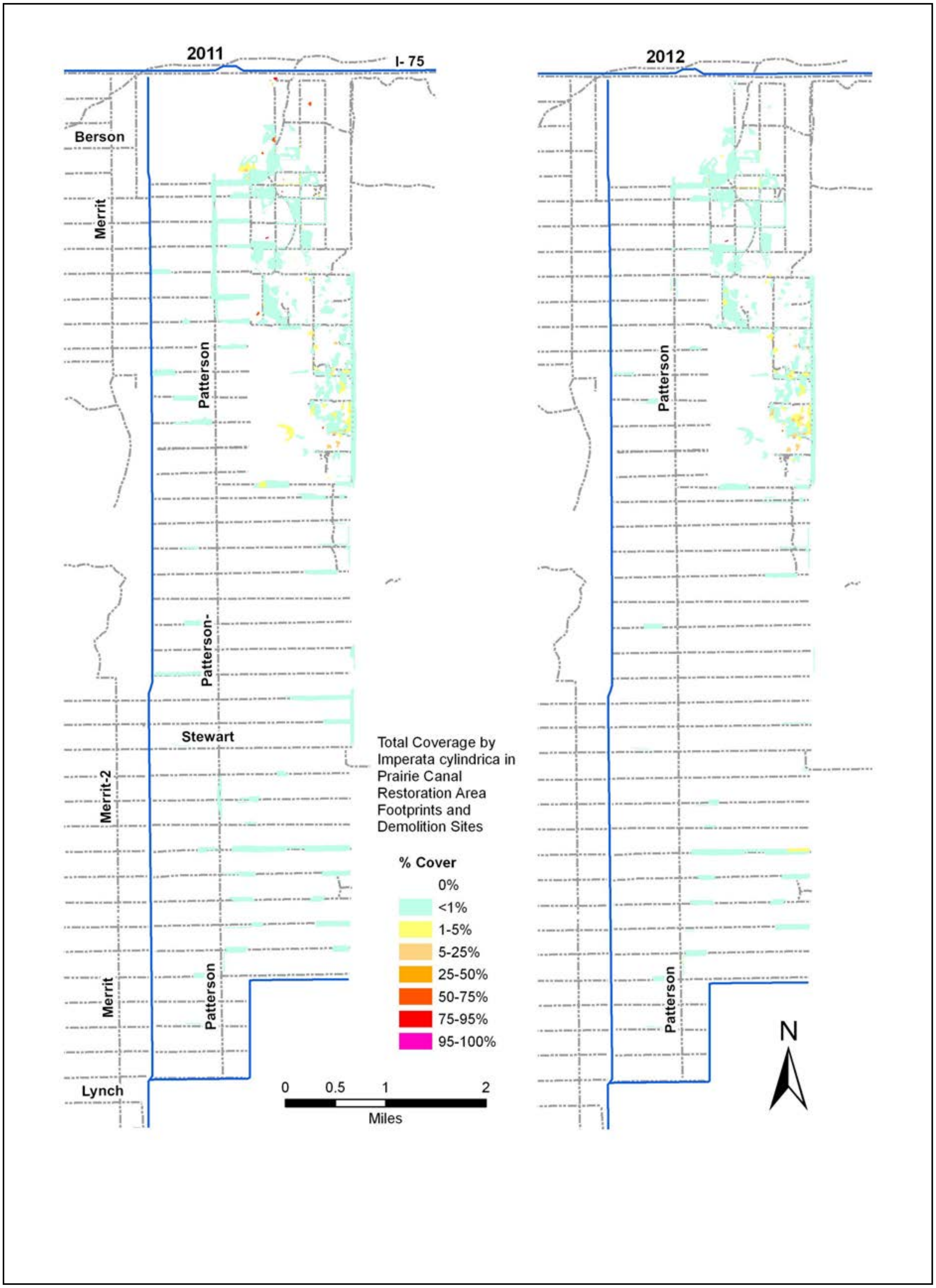


Figure 15: Total Cover by Torpedograss in Prairie Canal Phase Footprints and Demolition Sites (2011-2012)

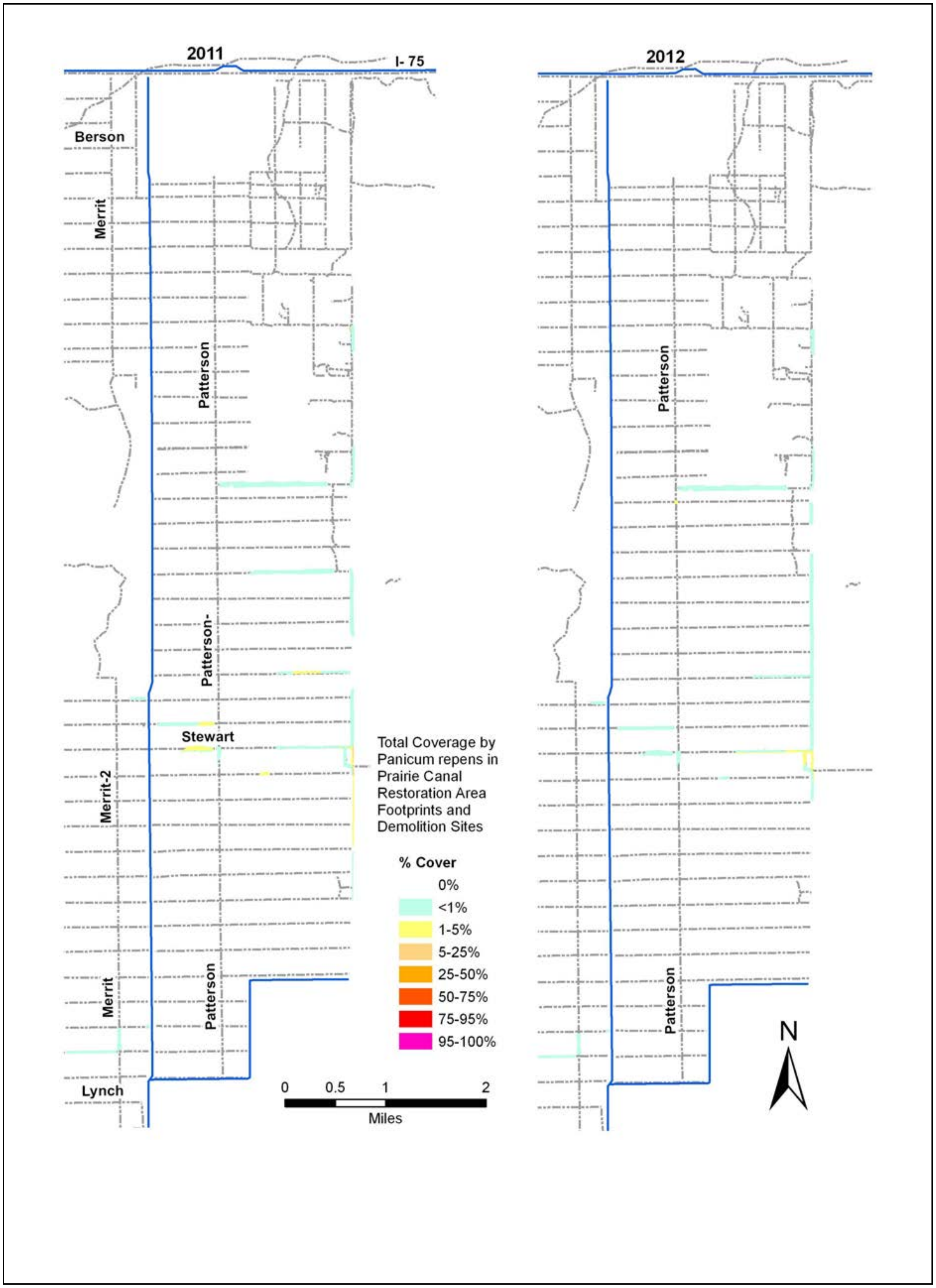


Figure 16: Total Cover by FLEPPC II Exotic and Nuisance Species in Prairie Canal Phase Footprints and Demolition Sites (2011-2012)

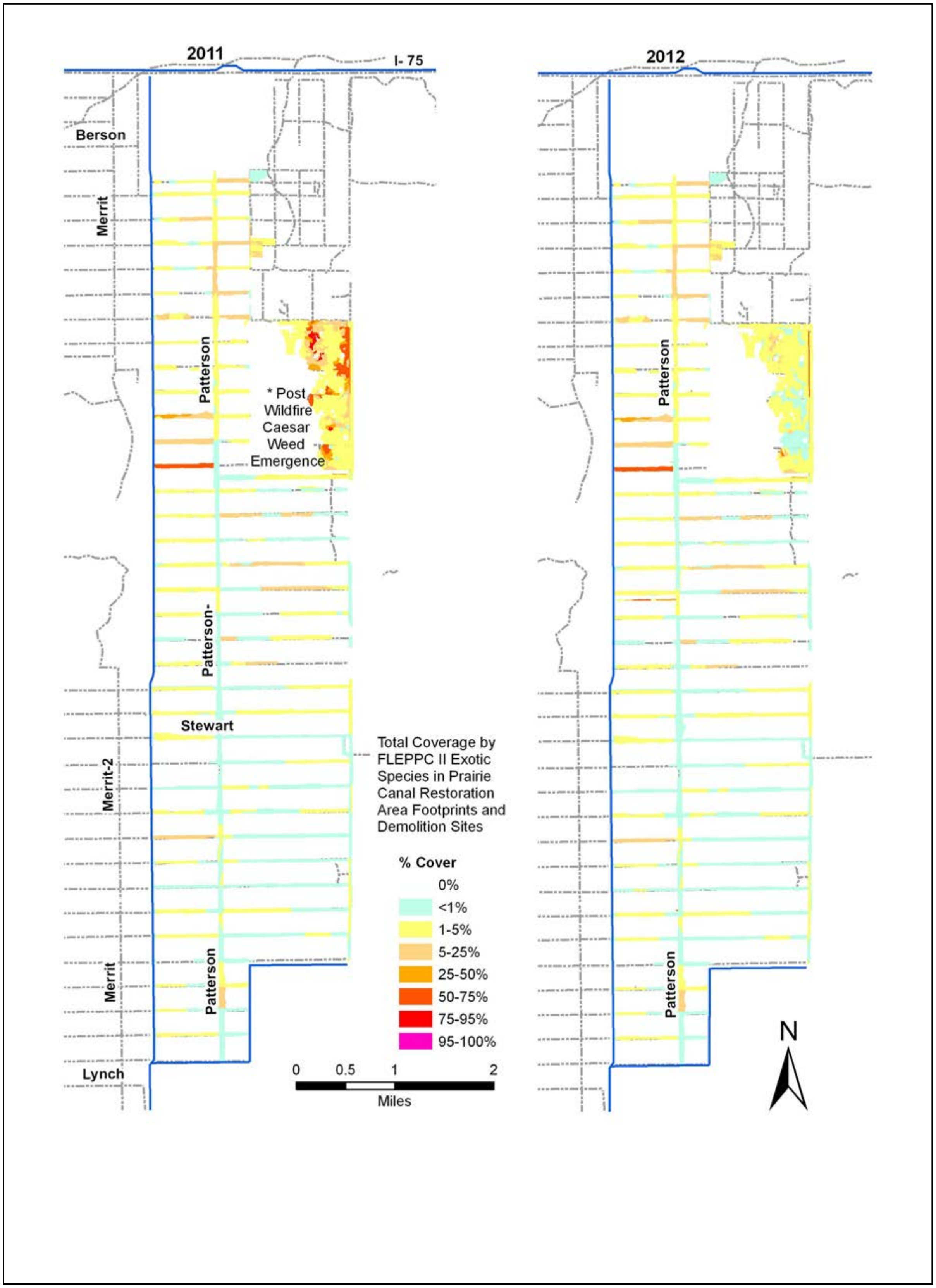


Figure 17: Total Cover by Non-FLEPPC Exotic and Nuisance Species in Prairie Canal Phase Footprints and Demolition Sites (2011-2012)

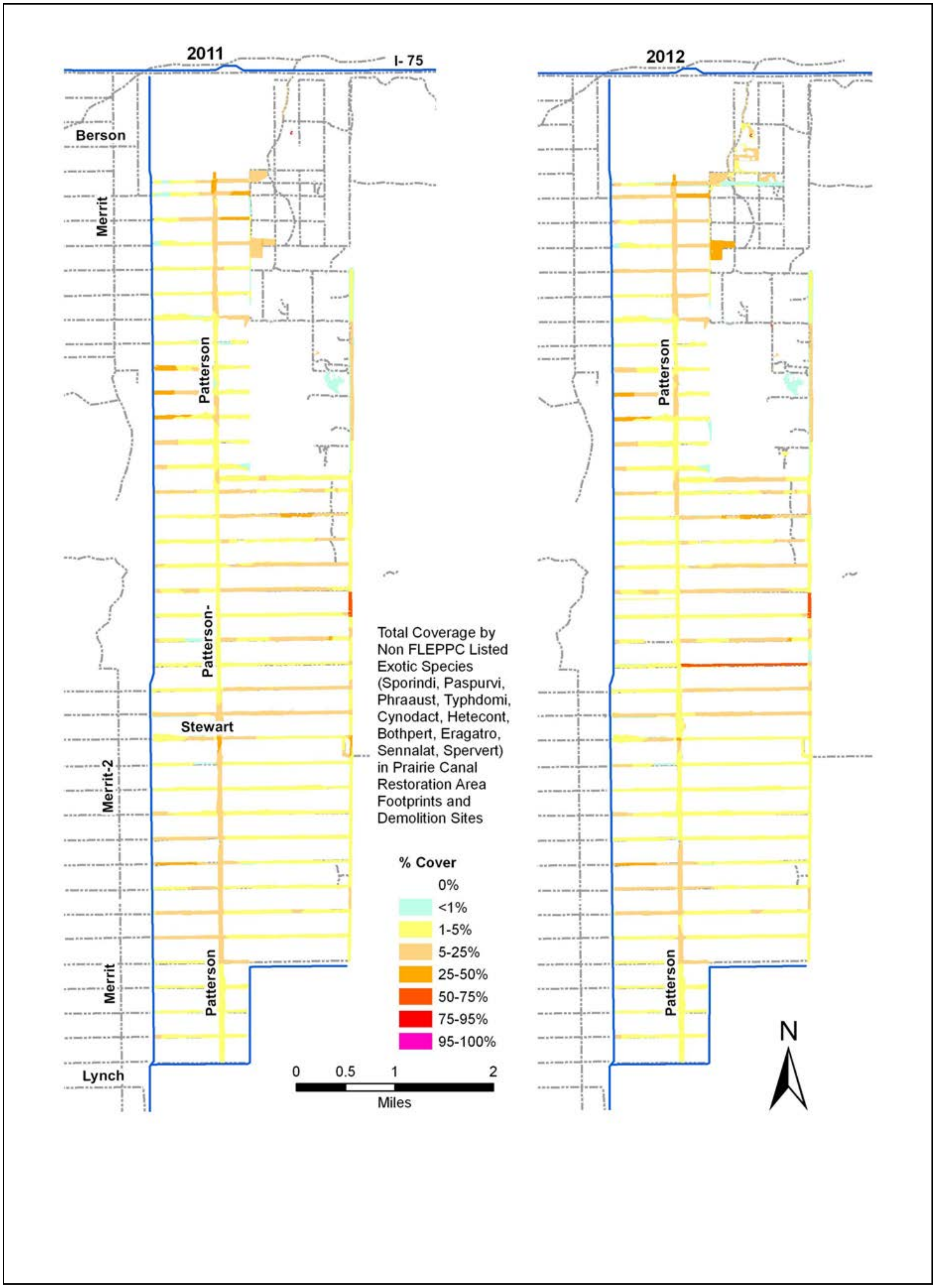


Figure 18: Total Cover by Exotic and Nuisance Species in Merritt Phase (2012) - North

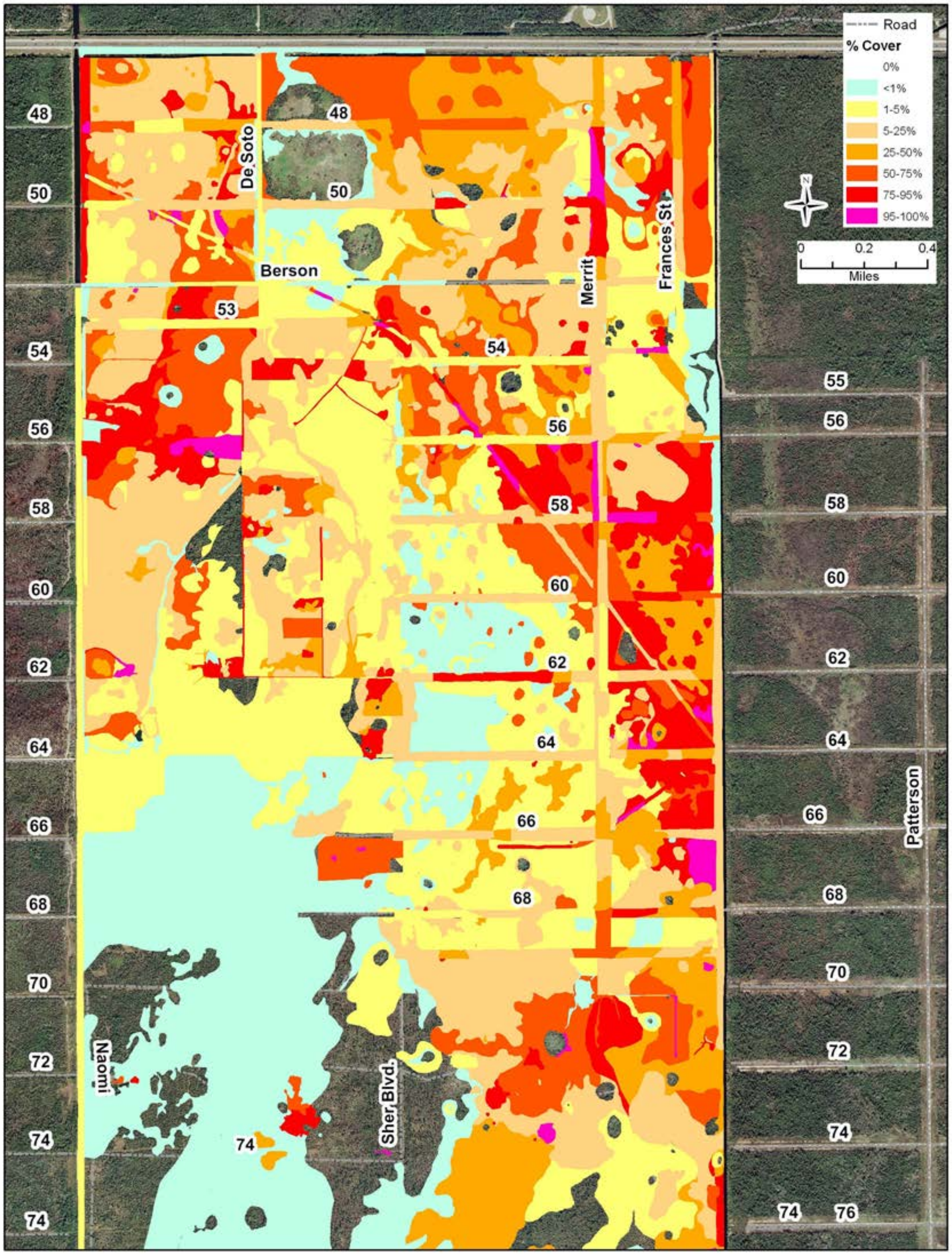


Figure 19: Total Cover by Exotic and Nuisance Species in Merritt Phase (2012) - South

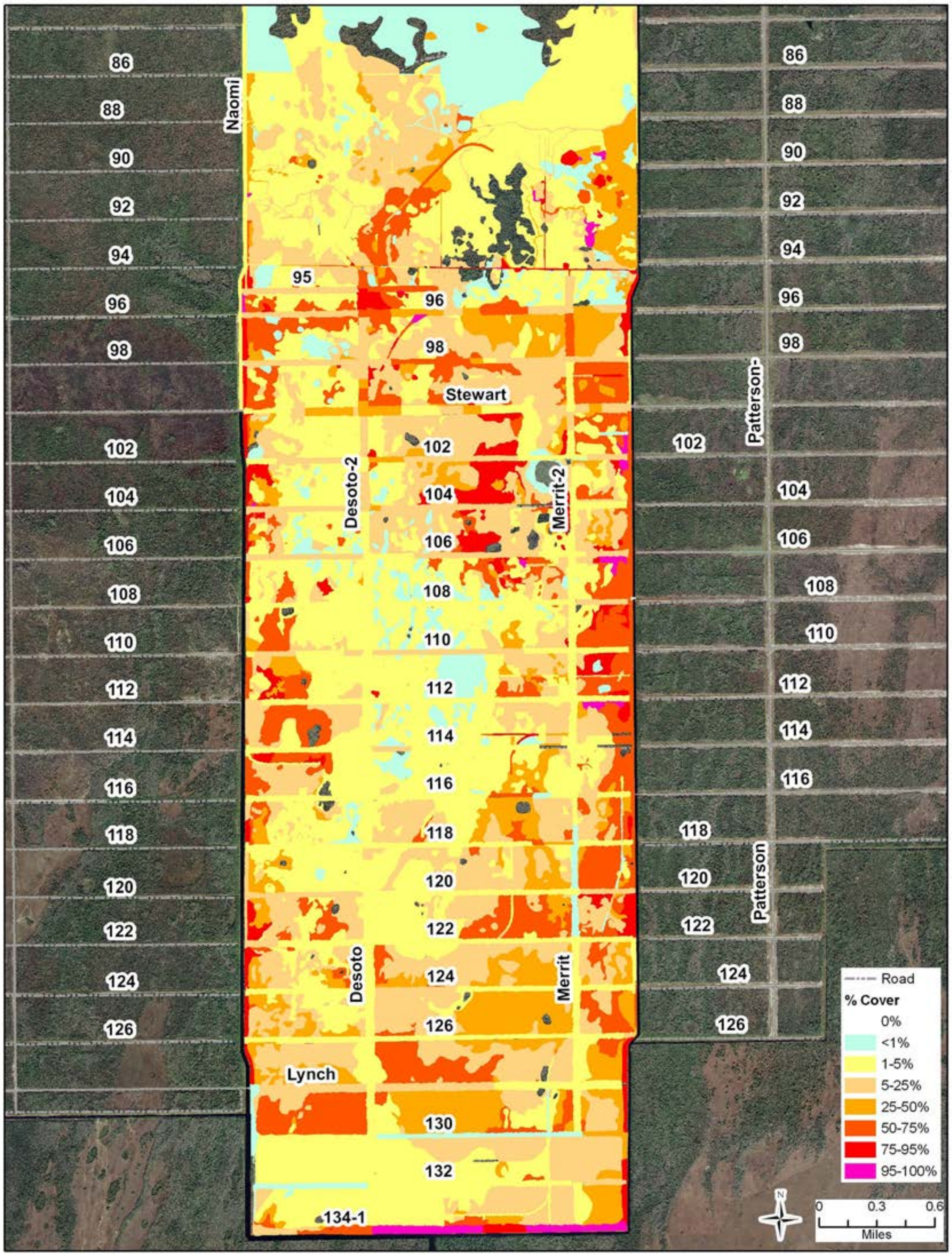


Figure 20: Total Cover by Brazilian Pepper in Merritt Phase (2012) - North

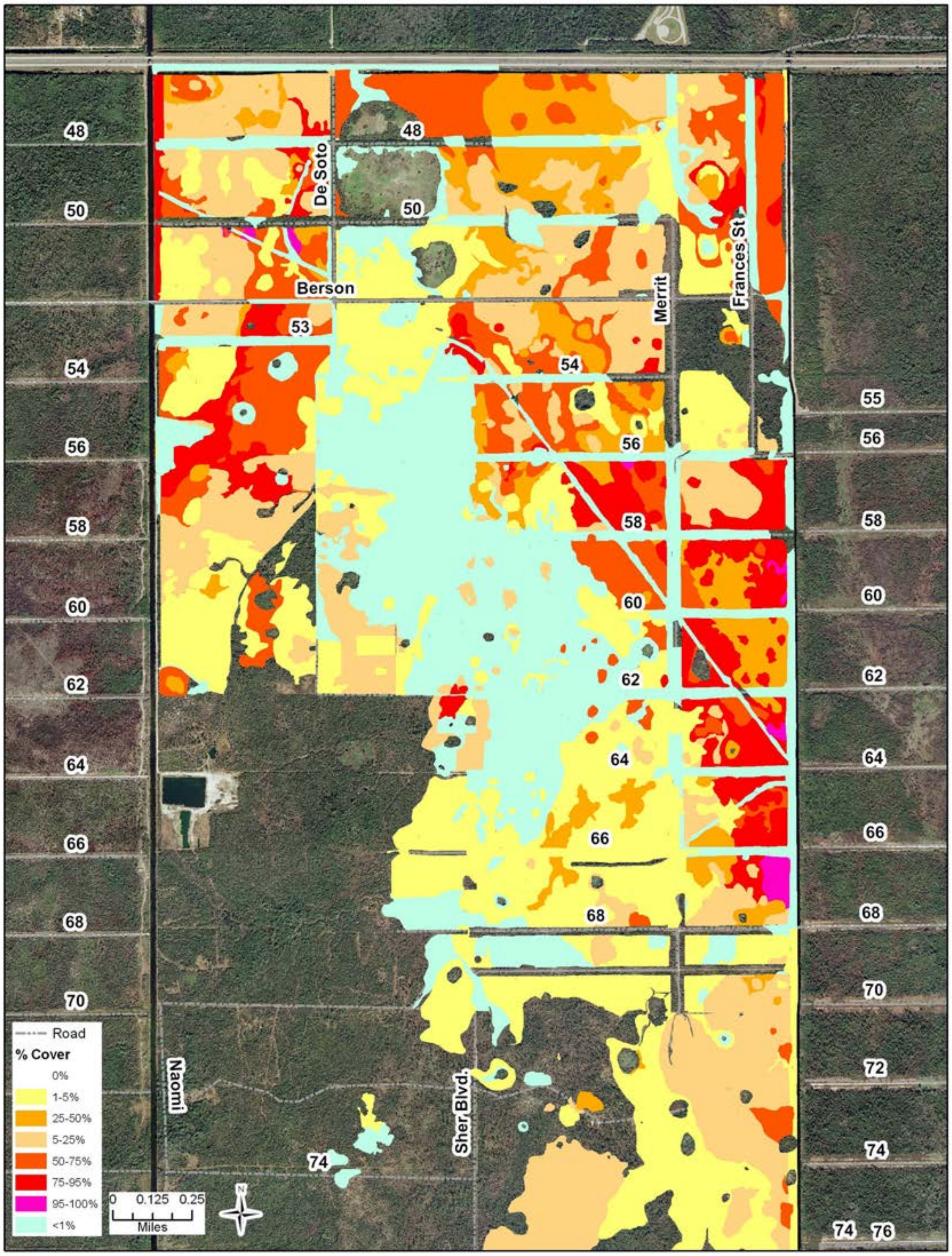
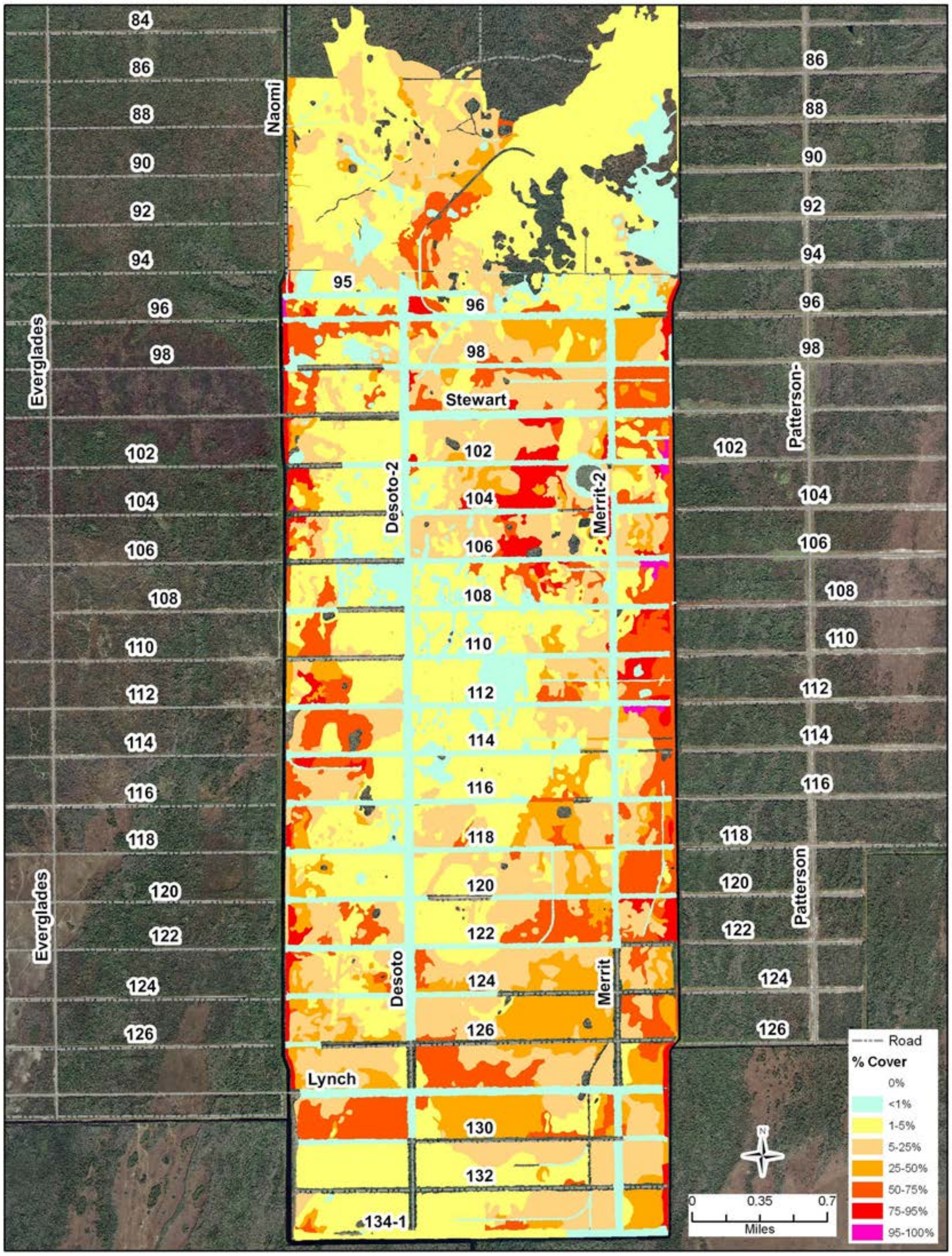


Figure 21: Total Cover by Brazilian Pepper in Merritt Phase (2012) - South



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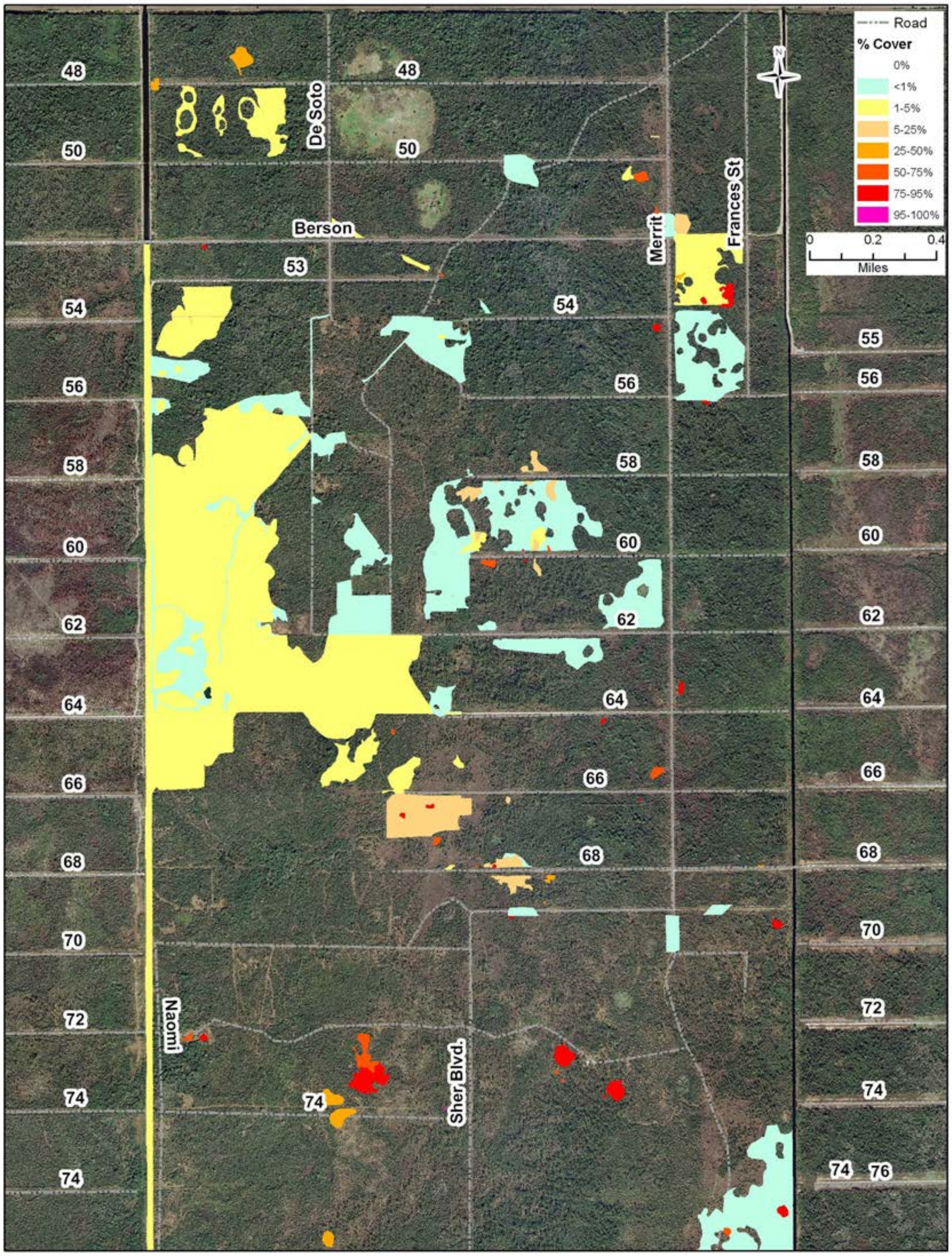
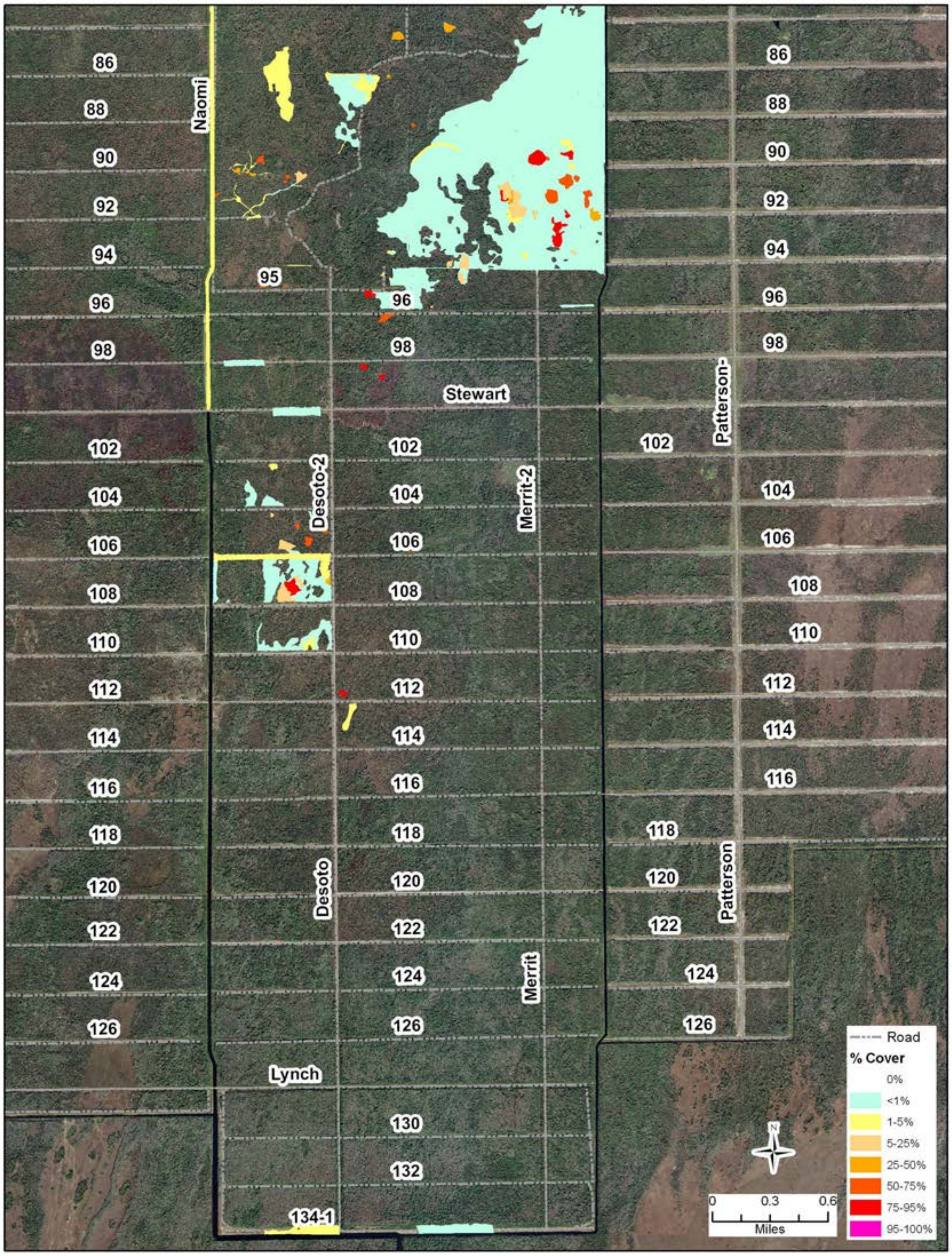
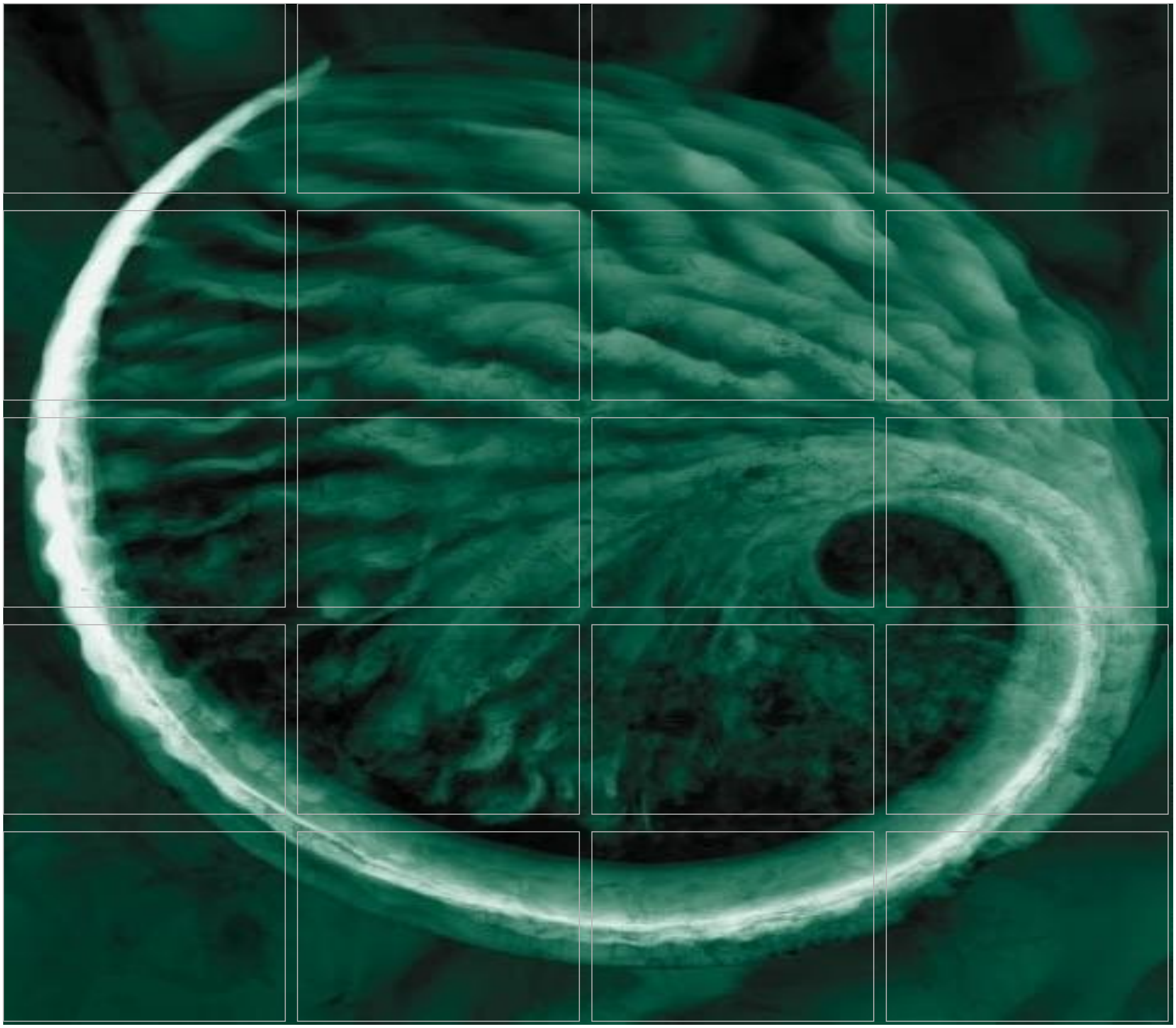


Figure 23: Total Cover by Cogongrass in Merritt Phase (2012) - South



Attachment D: Year 4 Post-Restoration Vegetation Monitoring of Prairie Canal and Control Transects – Picayune Strand Restoration PSRP Vegetation Monitoring 2011 Final Report

This report, dated January 20, 2012, was provided to the South Florida Water Management District by Environmental Resources Management under Work Order #4600001953.



Year 4 Post-Restoration Vegetation Monitoring of Prairie Canal & Control Transects - Picayune Strand Restoration PSRP Vegetation Monitoring 2011

Prepared for:
South Florida Water Management District
Fort Myers Service Center
2301 McGregor Boulevard
Fort Myers, Florida 33901

Work Order No. 4600001953

January 20, 2012

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Year 4 Post-Restoration Vegetation Monitoring of Prairie Canal & Control Transects - Picayune Strand Restoration PSRP Vegetation Monitoring 2011

Work Order No. 4600001953-WO3

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EXECUTIVE SUMMARY

As part of a long-term study to evaluate restoration effects on vegetation, sampling for the Year 4 Post Restoration Vegetation Monitoring of Prairie Canal & Control Transects was conducted between May and July 2011. Sampling was done on a total of 36 transects, including 11 control transects. Ten previously monitored transects were not sampled in 2011 because they burned in a wildfire on May 12. Sampling methods included belt transects, line-intercepts, and quadrats to identify and quantify plants within the canopy, sub-canopy, shrub, and groundcover strata. This report offers comparisons among data collected in 2011 and data collected during the dry seasons of 2008 and 2009, as well as incomplete data sets in the fall of 2005 and the spring of 2004.

Construction work to fill and plug the north-south portion of Prairie Canal began in 2004 at the northernmost portion and was completed by 2007. While the Prairie Canal has been mostly filled, it is important to note that none of these transects have been completely “restored” hydrologically because the lower east-west canal section remains as drainage, and because some flow drains westward into the Merritt Canal. Furthermore, drought conditions have dominated the site since 2007.

Water level data from monitoring wells suggest a lengthening of the hydroperiod since restoration, despite drought conditions. For example, water levels above ground level have been recorded regularly since the filling of Prairie Canal at well SGT3W6 (South Florida Water Management District). Water levels above ground levels were never recorded at nearby piezometer 13 (National Resources Conservations Services) during the period of 1997-2004.

In order to analyze data for changes over time, as well as differences between control and restoration sites, transects were classified into three major pre-drainage habitat groupings: Cypress, Pineland, and Wet Prairie. An additional subset, labeled “less-drained”, was created for four transects that are located in a transition zone between control and restoration conditions. Statistical analyses emphasized comparisons of 2011 data with data sets from 2008 and 2009 because the latter data are directly comparable, with no differences in seasonality or the timing of field monitoring activities.

Dominant tree species show minimal changes in basal area and density from 2008 to 2011 that are indicative of hydrologic alteration. Changes in this stratum are expected to be slow, with the exception of mortality of species sensitive to inundation. The dual effects of prolonged drought and incomplete restoration likely contribute to the lack of changes in this stratum. Density and basal area of cypress (*Taxodium ascendens)* in cypress habitats remains lower at restoration sites than at control sites, which is thought to indicate increased mortality rates in the drained communities prior to restoration. Relative growth rates were lower for cypress (significantly) and pop ash (*Fraxinus caroliniana)* at restoration transects, while pine (*Pinus elliottii*) growth rates are significantly higher at restoration transects, which is consistent with known ecology of these species. With restoration, we expect these trends to reverse.

To date, restoration has not altered cabbage palm (*Sabal palmetto*) densities, with the exception of some mortality in seedlings and young cabbage palm in cypress transects close to the Prairie Canal footprint. The overall trend for cabbage palm density at both control and restoration transects, since 2004, has been a slow and steady increase in cabbage palm density (this may be in part influenced by drought), although the densities and rates of change vary considerably by habitat and land management regime. High cabbage palm densities and rates of increase were recorded in pinelands within both restoration and control transects. Cypress habitats in restoration transects had high cabbage palm densities, but not in control transects. All wet prairie transects remain low in cabbage palm densities. Variability in cabbage palm densities from year to year is greatest in the younger strata (seedlings and pre-trunk palms) in cypress habitats, suggesting that fluctuating water levels and varying hydroperiods cause some mortality. Mortality of middle-stratum cabbage palm (with trunks <4.5') caused by Florida black bear depredation was observed frequently.

Differences in overall shrub cover, as measured using the line intercept method, primarily reflected recent fire history. A notable exception is mortality of invasive Brazilian-pepper (*Schinus terebinthifolius*) due to flooding in transect PC26, which is adjacent to the canal footprint and thus hydrologically more affected by restoration. We expect changes in shrub cover to be slow, but eventually species sensitive to flooding should be eliminated from transects of relatively lower elevations.

Quadrat sampling (groundcover) resulted in the identification of 2,340 records, with identification to species or variety level at 97-98%. When weighted by percent cover, identification level exceeded 99%. Evaluation of percent cover and frequency included various statistical analyses, including species richness. The Wetland Affinity Index (WAI), calculated using 1996 US Fish & Wildlife Service wetland indicator values, proved most relevant for evaluating changes due to hydrological restoration.

In both cypress and wet prairie transects, WAI values in restoration transects are converging with WAI values in control transects. A discernible increase in WAI values in restoration transects is apparent, while WAI values in control and less-drained transects show a slight decrease (perhaps due to drought conditions). WAI values for pineland transects show greater variability (likely due to transects covering a range from mesic to hydric pinelands), with control transect WAI mean values decreasing. Restoration transect WAI mean values are increasing and surpassing control values. Considering drought conditions, it is especially encouraging that restoration transects have exhibited increases in WAI, suggesting hydrological restoration is having a positive effect on groundcover vegetation. Transects closest to the canal footprint exhibited the greatest increases.

Classification and ordination analyses for most transects show no discernible trend relating to hydrological restoration. However, data reveal that groundcover strata in restoration transects adjacent to the Prairie Canal footprint are becoming more similar to control transects. These transects, being closest to the canal, were more severely drained. As analyzed separately by habitat groupings, transects in cypress and wet prairie showed greatest similarity to transects within the same management regime (control versus restoration). Pineland transects showed greatest similarity according to fire history, rather than hydrology.

1.0 INTRODUCTION

The Picayune Strand Restoration Project (PSRP) area, formerly known as Southern Golden Gate Estates (SGGE), is a large, former development, located east of Naples in southern Collier County. It is located within the southeastern portion of Picayune Strand and is part of a larger development, the Golden Gate Estates (GGE), the northern portion of which is a residential community. The entire GGE area has undergone hydrologic and environmental alteration due to construction of a network of canals, levees, and roads built in the 1960s. Four major, north-to-south canals drain the PSRP. These four canals interconnect at the southern end of the area and, together, drain into the Ten Thousand Islands, the marine ecosystem downstream and outside the PSRP.

Prior to development, the PSRP was characterized by seasonal flooding and slow-moving overland sheet flow that supported a variety of plant and animal communities in uplands and freshwater wetlands and, in downstream areas, brackish wetlands and estuaries. Channelization of water flows has resulted in the elimination of sheet flow across the PSRP and into the estuaries, lowered water tables within the PSRP, and a fluctuating freshwater point discharge to the estuarine ecosystem in the Ten Thousand Islands. As a result, upland, wetland, and estuarine plant communities have been degraded, the abundance of native fish, wildlife, and estuarine shellfish populations has declined, recharge of the surficial aquifer has been reduced, and non-native species have increased in abundance. The drained conditions have resulted in widespread and more intense wildfires than occurred under pre-drainage conditions. These fires are accelerating the change in vegetation from wetlands to upland communities dominated by fire tolerant species, such as cabbage palm (*Sabal palmetto*) and exotics, such as Brazilian-pepper (*Schinus terebinthifolius*). In addition, these impacts extend a mile or more into other conservation areas, including the Fakahatchee Strand Preserve State Park.

The PSRP currently has a network of east-west roads, at quarter-mile intervals, connected by north-south roads at approximate one mile intervals. These roads formerly had paved surfaces overlying emplaced fill. This network of roadways resulted in several environmental impacts: the impeded the natural sheet flow of surface water, and their construction resulting in altered habitat that allowed the invasion of a wide diversity of exotic plants. Additionally, the roads also provide access to all parts of the project area where there are impacts from off-road vehicles, poaching of animals and plants, vandalism, and the illegal dumping of solid waste. This has resulted in the fragmentation of an extensive block of contiguous natural lands that compromises the value of the area for a variety of wide-ranging wildlife, such as the Florida panther and other threatened and endangered species.

In 2007, the removal of 65 miles of road east of the Merritt Canal and the filling of the north-south portion of Prairie Canal was completed. Construction work began in 2004 at the northernmost portion (north of 79th Avenue SE) and progress of the filling of the canal continued southward until 2007.

The plugging and filling of long sections of the Prairie Canal, the eastern-most canal in the PSRP, has eliminated the rapid loss of water along most of its seven-mile length by stopping quick flows and re-establishing sheet flow in the area during high rainfall periods. It has also greatly slowed drainage after the water table falls below ground during drier periods, although slightly increased flows probably remain through the less consolidated fill material in the restored canal and adjacent substrates that were fractured during construction. Over time, these slightly higher groundwater flows should steadily diminish as organics accumulate in the pools remaining along the canal and seal the pool bottoms.

The area benefited hydrologically by the plugging and filling of the Prairie Canal, including virtually all of SGGE to the east of Patterson Boulevard. Based on 20 years of monitoring water levels in the adjacent Fakahatchee Strand (a reference site), the effects from the Prairie Canal plugging have extended from one to three miles into Fakahatchee Strand during the wet and dry periods. These beneficial effects are increasingly apparent proximal to the canal.

Assuming a similar extent of impacts from the other SGGE canals, the portion of SGGE to the west of Patterson Boulevard will probably continue to be severely impacted until the Merritt Canal is restored. Also, since the southern-most, east-west portion of Prairie Canal (below the restored upper seven miles) is still open and draining into Merritt Canal, it is likely that the water table in the lower one-to-three miles of the area between Patterson Boulevard and the north-south portion of the filled Prairie Canal is still being negatively impacted hydrologically.

An additional influence on water levels to the west of Prairie Canal is the major cypress strand that crosses I-75 and enters SGGE in the vicinity of the Merritt Canal. This large strand swamp is the actual Picayune Strand and the namesake of the entire state forest and project area. This large flow-way turns to the east and approaches Prairie Canal above Stewart Boulevard, before turning back to the west and leaving SGGE in the vicinity of the Faka Union Canal at US 41. Historically, during and for some time following wetter periods, flows in this strand would have increased water levels along and to the west of the Prairie Canal, prior to the construction of the SGGE canal system. These water levels cannot be completely restored until Merritt Canal is restored.

Based on the above observations, hydrologic restoration resulting from plugging and filling Prairie Canal should be close to complete east of the canal, but benefits should diminish moving west from the canal and approaching the unfilled east-west (southernmost) section between the Merritt and Prairie Canals.

In the spring of 2004, prior to plugging and filling the Prairie Canal, three series of east-west vegetation transects were established, with 10 transects in each of the upper, middle, and lower portions of the seven-mile long north-south portion of the canal. These transects were sampled once to establish baseline conditions to form a basis for comparison when subsequently documenting the restoration of plant communities along the canal. Vegetation monitoring was scheduled to commence along these transects after one full growing season, following the completion of construction, and then annually for some additional years. Depending on the observed restoration response, less frequent sampling might occur thereafter, until a trend toward pre-development conditions was established.

The original baseline monitoring was conducted during spring 2004, and all post-construction monitoring began in spring 2008. Therefore, the data collected in the northern-most areas have potentially been affected by a lengthened hydroperiod since the rainy seasons of 2005, while the rest of the area would have only experienced post-restoration rainy seasons since 2007.

The purpose of this report is to analyze vegetative changes observed in re-sampling of these transects along the Prairie Canal, from pre-restoration to post-restoration, to evaluate if restoration is indeed having an impact on vegetation composition and structure, and if the vegetation is converging towards the baseline composition. This report specifically addresses the monitoring activities completed in FY2011.

2.0 METHODS

Permanently marked, 50-meter (m) transects were previously established along the Prairie Canal, and control transects were established in the Florida Panther National Wildlife Refuge (FPNWR) and Fakahatchee Strand Preserve State Park (FSPSP), as depicted in Figure 1. A field guide for transect methods is included as Appendix 1.

In 2011, re-sampling was conducted on 36 transects, including 11 control transects. The Prairie Canal area includes 30 transects (PC01-PC30), located along three east-west lines (Northern Series, Middle Series, Southern Series), which extend 1 kilometer (km) to the east and 1 km to the west of Prairie Canal. These transects were established in 2004. Transects to the east of the Prairie Canal are within Picayune Strand State Forest (PSSF), while those to the west are within the FSPSP. Five additional Prairie Canal transects (42, 53, 55, 56, and 57) were established at the original Natural Resources Conservation Service (NRCS) monitoring sites within the PSSF at that same time. Additional control transects in FPNWR and FSPSP were re-sampled as they were in 2005, 2008 and 2009. Most of these were established in 2005 (32, 45, 37, 39, 51, 64, and 67), but in some cases, we utilized transects established as early as 1996 (07PI11, 07WP11, 32PI33, 32WP33), which include several sampling events prior to 2005.

Each transect was relocated using a Global Positioning System (GPS) and marked with rebar at each end. Each rebar position was recorded in UTMs (NAD83 17N), using a GPS device with sub-meter accuracy. Trees near each rebar were flagged using orange tape. A 50-meter transect tape was then strung tightly between the two rebar locations to provide a taught, straight transect line. In all cases, transects were positioned North/South and East/West, with the origins occurring at the East or North, with the exception of those transects established prior to 2004. These older transects, established on FPNWR, had start ends closest to buggy trails; and most have the start marked on aluminum foil tags attached to the rebar. Start ends also are recorded accordingly in the geo-database. Although not required, for each transect, at least one photo was taken at each rebar position in the direction of the other rebar stake.

Vegetation sampling methods similar to those used during the pre-construction sampling were utilized during the post-construction sampling (Woodmansee & Barry 2005). These methods were derived from those utilized at FPNWR, with some modification to include the canopy stratum (Main et al. 2000). Restoration targets for the Prairie Canal monitoring sites are a function of the new hydrologic regime and should be comparable to the composition and structure of hydrologically similar reference sites in the FPNWR and FSPSP sampled during the baseline PSRP vegetation monitoring effort. This included a total of 13 transects placed as control plots (see Figure 1).

The vegetation along the transects was divided into four strata, based on Chapter 62-340.200, Florida Administrative Code (F.A.C.) (1996) of the Florida Wetlands Delineation Manual, *Delineation of the Landward Extent of Wetlands and Surface Waters*.

- Canopy trees, consisting of those woody plants with a diameter at breast height (dbh) greater than 10 centimeters (cm) or 4 inches (in);

- Sub-canopy trees, consisting of tree species with a dbh between 2.5 and 10 cm (1-4 in), excluding woody shrubs;

- Shrub layer, consisting of trees with a dbh less than 2.5 cm (1 in) and any-sized individuals of shrub species (see "shrub notes" in Appendix 1); and

- Ground cover, consisting of all plants not found in the other strata and primarily herbaceous species.

Extra emphasis was placed on cabbage palm densities due to the current high densities observed in the drained areas of PSRP relative to historical accounts of the area, prior to drainage. Cabbage palms were separated into 5 strata described below.

- Canopy palms with apical meristems above 2.4 m (8 feet (ft)). Sub-stratum below 1.5 m was noted for "old growth", or pre-disturbance cabbage palms (or pre-disturbance overstory slash pine (*Pinus elliottii*), as well), based on morphological characters such as bootless trunks lacking boot-scars, and the presence of adventitious roots. For slash pine, this determination was based on characters such as crown form and swollen base. A detailed explanation of old-growth cabbage palm can be found in the 2006 FPNWR report (Barry 2006);

- Sub-canopy palms with apical meristems greater than breast height of 1.4 m (4.5 ft), but less than 2.4 m (8 ft);

- Shrub layer palms with apical meristems just above ground level to a breast height of 1.4 m (4.5 ft);

- Groundcover palms, including individuals with apical meristems still at ground level (*i.e.,* no trunk), and with palmate leaves or with at least four (or evidence of having produced four) simple leaves. According to McPherson and Williams (1996), this stratum would include pre-trunk plants with palmate leaves to plants with simple leaves, but with leaf widths>8 mm. In 2011, stratum 4 was additionally segregated into sub-stratum 4-palmate and sub-stratum 4-simple; and

- Palm seedlings, defined as individuals without palmate leaves and only two to three leaves (including remnant petioles at the base, if present). McPherson and Williams (1996) defined new recruits to be the smallest plants with leaves of three or fewer, accordion, V-shaped folds and leaf widths less than or equal to 8 millimeters (mm).

For cabbage palms with trunks conforming to strata 1-3, the presence or absence of adventitious roots was recorded

Canopy trees, sub-canopy trees, and all strata of cabbage palms were sampled along 5-m wide, belt transects (Mueller-Dombois & Ellenberg 1974). Diameters of all canopy trees were measured and tagged to facilitate re-sampling and to document mortality and recruitment. Sub-canopy trees were counted by species to estimate density, but not measured or tagged. The number of cabbage palms was recorded in each of the five strata.

The composition and cover of the shrub stratum, as defined above, was quantified using the line-intercept method, along each transect (Canfield 1941, Lindsey 1955, Mueller-Dombois & Ellenberg 1974). Line-intercept data included all overhanging or underlying species in the shrub stratum. Saw palmetto (*Serenoa repens*) was consistently considered a shrub. Cabbage palms in strata 3–5 were also recorded. These data were used to calculate percent coverage.

Ground cover species were sampled using rectangular quadrats (40.5 in x 20.75 in) with an area of 0.5-square meter (m^2), placed at 0-0.5 m, 10-10.5 m, 20-20.5 m, 30-30.5 m, 40-40.5 m, and 50-50.5 m, with the short edge of the rectangle on the intercept, and the long edge extending to the west (for transects starting on the north end) or north (for transects starting on the east end). Species composition and cover were quantified using Daubenmire (1959) cover classes: 1) 0-5%, 2) 5-25%, 3) 25-50%, 4) 50-75%, 5) 75-95%, and 6) 95-100%.

All plant species whose stems originated from within the quadrat were assigned cover class values. Shrub stratum species, epiphytes, and vines were assigned cover class values, if any part of the plant overhung the quadrat, regardless of where the stems originated. Cabbage palm strata 3–5 were lumped into one cover class, with additional notation made for the number of seedlings within the quadrat. Records were kept of all plant species observed within the quadrat that were flowering, fruiting, at seedling stage, or deer-browsed. Records of other species observed in or near the transect were made and incorporated into the site species lists.

Because fire is so important to the re-establishment of natural vegetation on the PSRP, records of wildfires and prescribed burns that affect portions of the PSRP vegetation monitoring sites were requested from appropriate agencies in the course of sampling. For each transect, fire interval was recorded. Fire intervals were placed into three categories: 1 = <1 year; 2 = 1-7 years; and 3 = > 7 years. Intervals were determined using these recorded burn history data or field observations when actual burn dates were not available.

Plant nomenclature followed Wunderlin & Hansen (2003), with certain exceptions, including any generally accepted taxonomic changes, since the date of this publication. Important departures include South Florida bluestem (*Schizachyrium rhizomatum*), which in Wunderlin & Hansen (2003) is treated as a synonym of little bluestem (*S. scoparium)*. To avoid confusion, the synonyms are provided in the species list included in the database.

In accordance with our work order requirements, the weighted (by total percent cover) percentage of species not identified to species level must be less than 1% of the total species recorded. Taxa not identified to species level were identified to the lowest taxonomic level possible, and a specimen was collected from outside the transect as a voucher, where possible.

2.1 DATA ENTRY

Data were entered into a Microsoft Access database. A single table was used for each study type: belt transect data, line intercept data, and quadrat data. In addition, tables were created for descriptions of each transect, including well number, location, rebar number, transect number, fire history, habitat, former habitat, and any notes. A table was also created for sampling events containing dates, surveyors, and "time since fire data". Comment fields were included in all tables. Additional tables were provided, including a GPS table linking geographic coordinates of each rebar belonging to each transect, an Accepted Names table (linking taxonomic code with genus species, higher taxonomic data, plant authority code, nativity, rare plant status, and Florida Exotic Pest Plant Council status), an Authority table (linking authority code with the appropriate literature reference), and Lookup tables for each of the data tables. After initial data entry, data were cross-checked for errors and corrected accordingly.

Previous data collection events utilizing the same field study methods were incorporated into the Access database and were included in some of the analyses documented in this report. These sampling events, listed in Table 1, were conducted as early as 1996. This was done to allow discussion of preliminary findings and to summarize pre-restoration habitats.

A total of 309 transects have been established and sampled multiple times (totaling 1,006 samples) through multiple funding sources. Pertinent data associated with all of these samples were included in the current database. A summary of all data set events is provided in Table 1. For a complete discussion of these events refer to Barry (2006).

2.2 *DATA ANALYSES*

For the purposes of this report, data analysis was performed utilizing a subset of the overall database described above. This data subset is presented in Table 2. Basic statistics were calculated and presented for each of the field methods, including standard forestry parameters, such as density, basal area, and stand basal area for belt transect data, percent cover for line intercept data, and percent cover, percent frequency of occurrence in quadrats, and percent dominance using quadrat data. Additional analysis was carried out using wetland indicator values (Reed 1988). Wetland Affinity Indices (WAI) were computed and utilized when evaluating the effects of hydrological conditions on the plant communities.

All analyses were conducted using SPSS 11.5 and graphs were made with Sigma Plot 10. PCORD5 was used to determine community traits such as species richness and species diversity. Classification and ordination analyses were conducted using PRIMER V.6 (Clarke and Gorley 2006).

Parametric tests were used on either the raw data or transformed data to meet normality criteria. Univariate ANOVA was conducted to examine the effects of restoration on species richness, Wetland Affinity Index (WAI), and on relative diameter growth rates (RGR), using habitats (cypress, pineland, and wet prairie), management regimes (control and restoration), year of data collection (2008, 2009, 2011), and species (cypress, pop ash, pines, etc.) as the predictor variables when applicable. Data from 2004-2005 sampling event were not included in the statistical analyses database, with the exception of RGR, where the 2004-2005 data were because RGR is a rate expressed on per year basis. RGR was calculated as:

$$\mathrm{RGR}_{diameter} = \frac{(\ln diameter\ t_2) - (\ln diameter\ t_1)}{t_2 - t_1}$$

In addition, data were evaluated to discern patterns of species composition across habitats to examine the role of fire, hydroperiod, and restoration in cypress dominated habitats in distinguishing areas of similar species composition and abundances. Results are organized as follows: p-values, data means, and standard errors are included in the text. Were significant effects were noted, the results were graphed to further evaluate and depict the affects of management regimes on response variables. Statistical tests were considered to be significant at a significance level of α <0.05%.

2.2.1 *Percent Cover and Species Richness*

Species richness (*S*) was defined as total number of all species occurring per transect. Species diversity is a non-biased measure of species composition, which takes into consideration *S* and the relative abundance (n/N) of each species in a transect. Where n is the frequency, percent cover, or count of individuals of a species and N is the total sum of occurrences of all species in a transect. For this study, frequency was utilized. Shannon Weaver's index *H'* was used to estimate diversity and was computed as:

$$H' = -\sum_{i=1}^{S} p_i \ln p_i$$

Where p_i is the relative abundance measured by percent frequency of a constituent species, *i*, in the transect.

Transect means are provided for each sampling type in the appendices.

2.2.2 *Wetland Affinity Index*

Dominance by hydrophytic species can be quantified by summarizing the data using wetland indicator values (Reed 1988). These values were revised in 1996, but not yet published, though the list is due for publication soon (Steve Mortellaro, USFWS, personal communication). The calculations used herein follow the revised 1996 classification method. This classification assigns a probability for each plant species in the region to occur in a wetland (P_{usfws}). The WAI, or simply the weighted mean probability of occurrence in wetlands for all species combined in each one square meter quadrat, is calculated by the following formula:

$$WAI = \sum XiWi \Big/ \sum Wi$$

Where:

X_i = P_{USFWS} for indicator category, i, based on the above-noted 1996 classification; P_{usfws} = Probability that a plant species in the region occurring in a wetland; and W_i = Weight = Percent Frequency by plants in indicator category i.

WAI, as an artificial index of dominance by hydrophytic vegetation, allows the quantification of the degree of dominance by inundation-tolerant species.

2.2.3 *Classification and Ordination*

Testing was performed to assess if significant clustering of transects occurred to examine if control and restored transects cluster together, or if they have different species composition. Bray-Curtis similarity matrices (Bray and Curtis 1957) were employed for the hierarchical cluster analysis using the group average method. Although the statistical routines used were non-parametric, all abundance data, as measured by percent cover per quadrat, were square-root transformed prior to the analysis to down-weight the influence of extremely abundant species (Clarke and Warwick 2001).

Standardization is appropriate for comparing data sets with varying levels of effort to obtain percent composition values for individual taxa within a community (by samples) or percent composition of individual taxa between communities (by variable). This was undertaken to identify relative distribution among habitat types and endemism where an individual species or taxa is found only at one site or habitat type. Standardization of sample results was not considered to be appropriate for the multivariate analysis, since the level of effort was consistent (or standardized) between sampling events and sites (Clarke, personal communication 2007), and individual species were already ranked by percent cover at each quadrat.

Non-metric multi-dimensional scaling (MDS) was used, in addition to classification as an ordination technique, to display in 2-dimensions the relative distances (dissimilarity) between points (communities at different sites or different sampling events). The relative position of each point in proximity to all other points (sites or events) is maintained. The plot is a visual representation of the Bray-Curtis similarity matrix in multi-dimensional space. The multi-dimensions represent species presence/absence and abundance values of all plant species at all sites.

3.0 *RESULTS & DISCUSSION*

Vegetation sampling was conducted for the Prairie Canal vegetation transects and control/reference sites beginning on May 16, 2011 and ending July 9, 2011, capturing the peak and end of the dry season. Sampling was completed on 11 control transects and 25 restoration area transects. These data were compared to data collected during dry seasons of 2008 and 2009. The data also were compared to control sites sampled in the fall of 2005 (wet season) and restoration sites sampled in the spring (dry season) of 2004.

Because of a lightning-ignited wildfire, the Cobalt Fire (May 12, 2011), a total of 10 transects burned, and these transects were not sampled during this monitoring period. These burned transects included all of the western half of the northern Prairie Canal transects (PC01-PC05), 4 transects from the eastern half (FSPSP) of the middle transect (PC16-PC19), and one transect near monitoring well SGT off 79thAvenue SE, east of Patterson (55). With the exception of one transect (PC02), all of these transects were either wet prairie, or pineland transects. It is expected the groundcover strata in these areas will benefit greatly from the fire. Photos at the ends of each of these transects (matching photos taken normally while sampling) were taken on May 23, 2011 to generally capture pine canopy scorch percent, char height, percent consumption of fuels, and overall severity of the fire.

Due to the lack of data for these burned transects, this report addresses data for transects actually sampled during this reporting period. To evaluate restoration, available data were compared to conditions noted in 2004, 2005, 2008, 2009 to 2011 (see Table 2). Analyses of data for the transects burned in the Cobalt Fire was presented in the Year 2 Monitoring Report (Barry et al. 2009).

For the statistical analysis of trends over time the data set was further reduced. Comparisons with the control sites sampled in the fall of 2005 (wet season) were not considered valid for groundcover analysis because the wet season sampling typically consists of greater species richness and abundance of wetland plants compared to the dry season in pinelands and prairies and lower species richness in cypress wetlands. Nevertheless, these data are presented for discussion purposes. Assessment of woody vegetation is not influenced by seasonality of sampling, but because 2004 and 2005 sampling events are more than a year apart they were also excluded from most analyses in this report. The 2004 and 2005 data are included in the transect mean tables (Appendices) and cluster analyses for reference.

In comparing control/reference sites to restoration transects, it has become apparent that 4 transects considered "restoration" transects are more similar to control transects. As a result, these transects were excluded from the analyses to bring to light the differences between management regimes.

These "less drained" transects include transect PC20, which is a burned over cypress strand on the far eastern end of the middle transect perpendicular to the Prairie Canal footprint, and PC28-PC30, at the far eastern end of the southern transect (Figure 1). These transects were included in mean tables (Appendices) and the cluster analysis for reference.

Also, it should be noted that transects 51 and 64, located off Janes Scenic Drive, in FSPSP, near South Florida Water Management District (SFWMD) monitoring well SGT3W7, were originally intended to be analyzed as "restoration" transects when they were installed because of their proximity to the Prairie Canal footprint (Mike Duever, personal communication). However, after initial vegetation sampling the data indicated a greater similarity to control sites with which they have been combined since initial sampling. These transects, which are upstream of PC28-30 (Figure 1), could be considered a part of the "less drained" category in the future. For this report, transects 51 and 64 remain a part of the control category.

3.1 HYDROLOGY

In 2007, the removal of 65 miles of road east of Merritt Canal and the filling of the north-south portion of Prairie Canal was completed. Construction work began in 2004 at the northernmost portion (north of 79th), and progress of the filling of the canal continued southward until 2007. Therefore, the data collected in the northernmost areas have potentially been affected by a lengthened hydroperiod, starting during the rainy seasons of 2005, experiencing restoration for six years. The southern portion would have only experienced a shorter timeframe of four "restored" rainy seasons, starting in 2007. While the Prairie Canal has been mostly filled, it is important to note that none of these transects have been completely "restored" hydrologically because the lower east-west section remains as drainage and because some of the overland flow in this area still drains off to the west into the Merritt Canal.

Rainfall data have been recorded at SFWMD's SGGEWX weather station (located in PSSF), since its establishment in September of 2002. These data are presented in Figure 2.

Water levels were manually recorded in the PSRP area between 1997 and 2004, using piezometers installed by NRCS. Deeper monitoring wells with automated data recorders were installed by SFWMD in 2003. The locations of these monitoring wells can be found in Figure 1.

Hydrographs were prepared for select NRCS wells, while charts for SFWMD wells were provided by Dr. M. Duever and the SFWMD. A hydrograph for SFWMD well SGT3W7 is presented in Figure 3, as a control data comparison, though it is near the eastern edge of the expected zone of influence for the former Prairie Canal. Hydrographs for NRCS piezometer 14 and SFWMD well SGT2W6 at the same location are presented in Figures 4 and 5 to represent the middle to northern section of the Prairie Canal study area. Data for NRCS piezometer 13 and SFWMD well SGT3W6 are presented in Figures 6 and 7 to represent the middle to southern area. Data for NRCS piezometer 21 and SFWMD well SGT4W6 are presented in Figures 8 and 9 to show additional data from the southernmost area.

These hydrographs begin to suggest a lengthening of the hydroperiod since restoration, as water levels above ground level are recorded at the restoration sites by SFWMD wells. Water levels were rarely above ground level in the data collected in the NRCS piezometers. NRCS piezometer 13 and SFWMD well SGT3W6 most strongly suggest the effect of restoration at this early stage of restoration, with the evidence of a brief period of standing water during a close to average year of rainfall in the wet season of 2006 and again in 2008. This is significant in light of the lack of recorded standing water in the period from 1997 to 2004.

The weather influence on water levels, especially since 2009, is best explained by looking at timing and duration of flooding, as well as total rainfall. Drought from below average rainfall during the wet season, especially in June and October, along with above average temperatures, has been fairly common since 2007, although, in general, rainfall data indicate patterns roughly consistent with long-term averages posted by the SFWMD.

Total rainfall in 2005, the year that hurricanes Katrina, Rita, and Wilma passed nearby or over the study site, was 74 inches, which is above average for the Naples area average (52-55 inches/year). This resulted in a more extended hydroperiod, even at the control well site (SGT3W7).

In 2007, rainfall totaled 50 inches, slightly below average. Notably, however, monthly totals were especially low during July through October (wet season). Following this rain pattern, all wells showed a shortened hydroperiod in 2007.

The spring 2008 rains, which appear in the hydrograph, helped ease effects of drought conditions. The dry season was very hot and dry in May and was made somewhat more severe due to the presence of very dry air masses throughout winter. Steady rains from June through September resulted in a good period of high water roughly from July through September. Rainfall for 2008 was 61 inches.

The dry season started in October 2008 and was below average rainfall, until sampling in 2009. After a brief period of high water in the summer of 2009, the dry season began with a hot and dry October.

The winter of 2009-2010 proved to be a substantial departure from average, with rains occurring through mid-May, which maintained higher than expected water levels, although not flooding the majority of transects.

In June 2010, conditions changed dramatically with below average rainfall, above average temperatures, and dry air masses contributing to a quick dry-down before the rainy season commenced. The hot June of 2010 lowered water levels substantially. The summer water levels followed with a brief period of high water.

The dry season of 2010-2011 began abruptly in October, coupled with above average temperatures. Dry-down through the entire spring and early summer resulted in extreme low water levels well into July. In fact, June 2011 was the lowest recorded water levels (20 years of data) for Bridge 105 Tamiami in the Big Cypress (http://www.gohydrology.org). Since June, summer precipitation has been near normal levels, but water levels had not recovered by August.

In short, weather and water levels since time zero restoration (2007) have resulted in more drought than flood, and hydroperiods have been relatively short. Specifically, the beginning and the ends (May/June and October, respectively) of a few of the rainy seasons have been characterized by above average temperatures and below average rainfall. Longer-term data, however, suggest that prior to the last two decades such droughts definitely were more prevalent (http://www.gohydrology.org).

This recent drought, coupled with high temperatures, could also potentially be indicative of long-term trends predicted by climatologists. IPPC models based on mid-range scenarios of CO_2 loading until the end of this century predict slight decreases in precipitation for December-February and a 10-15 percent decrease in the wet season from June-August (ENP 2009). In the literature synthesis, it goes on to say that "the combined effect of even modest increases in temperature, along with modest reductions in rainfall during the historic wet season, would be extended droughts with increased evaporation and uncertain recharge of Everglades' wetland ecosystems and surface aquifers during the wet season."

If warmer and drier conditions become more prevalent, effects of hydrological restoration on vegetation will be less obvious than anticipated. Conversely, if canals are not filled, we would see more severe effects on vegetation than what observed over the past 30-40 years. For example, cypress throughout study area began turning yellow in late July which is the earliest that authors have observed. While uncertain, this occurrence may well be a manifestation of heat and drought stress. The early leaf drop was more substantial in the more severely drained areas to the west of Merritt Canal (personal observation), while leaves dropped and re-flushed on FPNWR (Refuge staff, personal communication)._Early leaf drop was also observed on a variety of tree species in Texas this summer, which has experienced its worst drought on record, as reported at http://txforestservice.tamu.edu/main/article.aspx?id=13768.

3.2 *HABITATS*

Habitat designations followed the Burch et al. (1998) definitions with some modifications. This habitat classification system was chosen for analyses because previous work for PSRP utilized these habitat types, including pre- and post-drainage vegetation maps. The database also includes the vegetation classification system for south Florida (Rutchey et al. 2006) and more detailed mapping of PSRP using this more precise classifications system (Barry et al. 2009). However, for analytical purposes, we have found it necessary to reduce precision below even the NRCS codes due to small sample size.

A total of eight distinct habitats (including altered habitat types) were studied under this project at control and reference sites (see Table 3). For most statistical analyses, we found it helpful to combine all cypress habitats (Ch, Cg, and C) and combine both mesic and hydric pinelands for comparisons between control and restoration sites, thus increasing sample size by habitat. This results in 4 control and 12 restoration cypress transects along with 3 control and 12 restoration pinelands transects in total. As noted earlier, only 11 restoration cypress transects and 5 pineland transects were sampled during current sampling due to fire impacts.

The general location of all transects at control and restoration sites were described above in the Methods section and in Figure 1. Each transect is presented below with both pre-drainage and current (baseline) habitat type in Table 4. Soil types, following the mapping data from the Soil Survey for Collier County (Liudahl et al. 1998) also are tabulated. The restoration sites are shown over 1940 and 2009 aerial photography separated by Northern, Middle, and Southern transects in Figures 10-15. Existing conditions or baseline habitat types were based on general assessment of the site in the field and utilizing transect data. Historic or pre-drainage habitat types were determined using a combination of factors, including evaluation of 1940's aerial photography and field evidence, such as the presence or absence of old-growth trees, dead stumps or trunks, and species composition.

Dominant soil types generally follow habitat types. Half of the transects (23 of 46) consist of Ochopee fine sandy loam and Ochopee fine sandy loam, low. These conditions are prevalent in the wet prairies (G), graminoid-dominated hydric pinelands (Ph), and some of the more open cypress with graminoid (Cg) transects. Pinelands also consisted of Hallandale and Boca fine sands. Cypress areas included Boca, Riviera, limestone substratum, and Copeland fine sands, digressional. The wet prairie with this soil type is a narrow area around a cypress dome, thus the soil type is probably different, likely just reflecting the lack of precision in the soils mapping. To analyze effects of soils specifically it would be advisable to first have a soil scientist evaluate each transect in the field.

Historic aerial photograph interpretation was also utilized for indications of past site conditions. Interpretation of the 1940's aerial photography of the PSRP suggests that, in areas not directly cleared or disturbed since 1940, the woody vegetation has increased and has encroached on graminoid-dominated areas, or has reduced graminoid coverage within pineland and transitional cypress (Cg) habitats. This same trend of reduced openness in pinelands was also observed in aerial photography in Rookery Bay National Estuarine Research Reserve and in TTINWR (Mike Barry, personal observation).

While, in general, the 1940's aerial photography is a good indication of pre-drainage conditions, when examining these photos it is important to recognized that logging of slash pine may have occurred here in the 1920's and 1930's, as saw mills were operating during these years along S.R. 29 (Duever et al. 1986). This may contribute to the observed changes in canopy of the pinelands. Several disturbed areas and trails evident in the 1940's aerial photography may have been utilized for timber extraction. Also, geo-referencing of the 1940's aerials was less precise than the 2008 aerials, so transect placement over the photography is less accurate.

The Northern Series transects include PC01-PC10, which historically were predominantly open and assumed to be fire-maintained habitats, with the possible exception of PC02. It is also possible that the very open-canopy nature of this general area evident in the 1940's aerial may be, in part, artificial due to logging, as evidenced by the visible trail running through the middle of the most open area. PC02 consists of more visible canopy (less open) in the 1940 aerial and is currently considered to be cypress with hardwoods (Ch) because of abundant swamp bay (*Persea palustris*) and old growth cabbage palms. The canopy appears more closed in the current aerial photography. The Cobalt Fire (May 12, 2011) burned PC01 to PC05. Incidentally, PC02 had already changed dramatically after the "Pretty Island" Fire in June of 2004, which substantially opened the canopy by killing much of the swamp bay and promoting growth of sawgrass (*Cladium jamaicense*) underneath. Now, following the Cobalt Fire, the transect is even more open and is basically scattered mature cabbage palm with a graminoid understory on the east half, while shrubs still dominate the west half. Two additional transects in the area include one pineland (53) and one cypress (42) transect, which were closer to the actual Picayune Strand Swamp that extends from north to south along the western side of the Northern Transect area.

The Middle Series transects include PC11-PC20. Transects which were predominantly cypress-dominated communities are located to the west of the Prairie Canal (the main Picayune Strand jogs to the east just north of this location), as well as the eastern-most transect. Wet prairies occur just to the west of the former Prairie Canal in transect PC14 and to the east in transects PC16 and PC17. To the east, a slightly higher, fire-maintained area of pineland is present (PC18 and PC19), which grades back into another cypress dominated area (PC20). This area has since burned (2001) killing overstory cypress trees. One additional transect sampled (55) occurs about a mile to the north, on the Picayune Strand side of the former Prairie Canal. This area represents a stretch of former cypress with a graminoid understory (Cg) that has become colonized by slash pine and shrubs.

Another important change that is evident in the cypress with graminoid (Cg) transects (PC11 and PC13) in the Middle Series area is that they have become much more closed-canopy since the 1940's aerial photography. This suggests that shrubs, palms, and vines dominating these transects may have increased since that time. Also, young pines in eastern PC11 may be recent colonization, since it appears there was a prairie-like open area extending from the edge of that transect in the 1940's aerials.

The Southern Series transects (PC21-PC30) are open, fire-maintained wet prairie and pineland to the west of the former Prairie Canal. Areas around the canal (PC26) and to the east generally are cypress-dominated ecosystems. Changes since 1940 are less obvious in the aerial photography compared to conditions observed in the field. Most of the wet prairies have changed little in overall structure, although scattered dead trunks of small cypress trees indicate cypress was more abundant previously, but not dominant. The cypress areas appear to have a closed canopy in both the 1940 and 2009 aerial photography. However, based on the abundant, large, cypress stumps and logs found in these areas, overall canopy height is currently lower, likely due to cypress logging post-1940, drainage, and fire. PC28 is a good example of a logged, old-growth stand with large stumps.

PC27 was considered to be cabbage palm hammock (Hp) in both historic and current conditions because it occurs on an isolated slightly higher, rocky area. PC27 is currently dominated by old growth cabbage palms, a variety of shrubs typical of hammock areas, and the absence of dead cypress trunks or stumps. The transect also appears more open in 1940, suggesting that historically it was more of a woodland with scattered palms, which is typical along the edges of less disturbed areas of the Fakahatchee Strand. The designation of hammock (Hp) is the closest fit in the NRCS habitat classification system.

Large areas of this habitat type likely occurred along the edges of the actual Picayune Strand flow-way, which is evidenced by persisting old palms in the field and large areas mapped by NRCS in the 1940's vegetation map called "cabbage palm flatwoods". It is important to take notice of these historic palm hammock areas when considering control of cabbage palm as a nuisance species (in other habitats a substantial increase in palms has affected species composition and the ecology of the area negatively).

3.3 FIRE HISTORY

In the short term, fire may have a much more immediate and substantial effect on vegetation transect data than hydrological restoration. To address this, a geodatabase of wildfire and prescribed (Rx) burns was compiled using existing GIS data from PSSF, FSPSP, and FPNWR. These data, however, are still incomplete. The three fire-interval categories described in the Methods section were, at times, determined based on estimates of time of year or, in a few cases, fire category was determined in the field based on professional judgment, using signs of char and woody growth. Unfortunately, since the previous event in 2009, it has become more difficult to incorporate GIS data into our analysis of fire, with FPNWR being the only agency at this time to record and provide these data for our geodatabase.

Maps of fires occurring prior to the 2004 sampling and between sampling events in 2004, 2008 and 2009 were presented in the Year 2 monitoring report (Barry et al. 2009). Wildfires in PSSF affecting transects in the Northern Series transects (PC01-PC05) occurred under drought conditions (after periods of fire suppression in June of 2004, immediately following sampling). Photographs of the transects were taken immediately following this fire. The Middle Series transects (PC11-PC15) are long fire-suppressed, while the Southern Series transects (PC21-PC25, 57) in PSSF have been burned more than once in prescribed burns. Fakahatchee fires along Prairie Canal are the least mapped, therefore, the fire histories of some of the transects may be in error. These are largely wildfires prior to 2004 and more recently in June 2007 (PC08-PC10, PC18-PC20), with the exception of the wet prairie transects (PC06-PC07, PC16-PC17), which were prescribed burns in early 2007. Fakahatchee control transects in the isolated prairies and areas of Janes Scenic Drive (39, 64, and 67) have been burned during both Rx burns and wildfires, but the exact data have not yet been acquired. No fires along Prairie Canal occurred between sampling events in 2008 and 2009. Transect (64), along Janes Scenic Drive was burned again between the 2008 and 2009 sampling event, although the exact date is not known.

At least 3 fires have affected Prairie Canal vegetation transects since 2009. On the FPNWR, a controlled burn on July 9, 2010 affected transects 07PI11 and 07WP11, but did not penetrate the cypress in transect 32, all of which were sampled on May 26, 2011. In FSPSP, a prescribed burn conducted on March 9, 2011 (Mike Owen, personal communication) affected transects 39 and 67, which were sampled on June 1 and June 4, 2011, respectively. Finally, the Cobalt Fire consumed fuels in transects PC01-05, PC16-PC19, and 55 on May 12, 2011. As a result, these transects were not sampled.

Within the study area, one transect in 2004 and 8 transects in 2008 were sampled less than one year following fire (Category 1) in hydric flatwoods (Ph), mesic flatwoods (Pm) and prairie (G) habitats (see Table 5). Twenty-six transects in 2004 and 2005 and nineteen transects in 2008 were sampled from 1-7 years since fire (Category 2) in various habitats. Nineteen transects in 2004 and 2005 and sixteen transects in 2008 were sampled greater than 7 years since fire (Category 3). The majority of these transects were cypress or former cypress (C, Cg, Ch, Hh) habitats, which rarely burn. Additionally, these transects included some hydric and mesic flatwoods (Ph, Pm) and wet prairie (G) sites in PSSF, which are long fire-suppressed. Only one wet prairie site (G) and one cypress with graminoid understory (Cg) transect burned between the 2008 and 2009 sampling events, totaling 2 transects of less than 1 year since fire in 2009. A total of 28 transects were from 1-7 years since fire (Category 2) in 2009. A total of 16 transects were long fire-suppressed (Category 3) in 2009.

One difference to note in the data since the Year 2 Report regards transect 56. This area was considered hydric hammock (Hh) and historically was cypress (C). After reviewing the data, the area has been re-categorized to long fire-suppressed (Category 3) because a controlled burn on August 2, 2006 apparently did not penetrate the area.

A total of 4 Category 1 transects were sampled in 2011, all of which were control sites (see Table 5). A total of 15 Category 2 transects were sampled in 2011. A total of 17 Category 3 transects were sampled in 2011. A total of 10 transects, all in the restored areas of PSSF and FSPSP, burned in the Cobalt Fire in May 2011 and were not sampled during 2011.

3.4 EFFECTS OF WIND DAMAGE & HURRICANE WILMA ON BELT TRANSECTS

Several hurricanes hit the monitoring area between the 2004/2005 sampling events and the 2008/2009 sampling events, with Hurricane Wilma having the most impact. The 75-mile wide eye of Hurricane Wilma passed directly over the study area with 120 mph sustained winds on October 24, 2005. Other storms, such as hurricanes Charley, Frances, Jeanne, Katrina, and Rita may also have effected some of the transects to a lesser degree, since the initial sampling in the spring of 2004/2005.

Based on sampling results immediately after Wilma on FPNWR, the most substantial effect of the storm on pine flatwoods was an approximate 9% reduction in slash pine overstory density. Secondarily, there was an approximate 3.5% reduction in old (tall bootless) cabbage palms and a 14% reduction in the density of the fairly uncommon live oak, as discussed in more detail in the Year 1 monitoring report (Barry 2006). Effects on cypress habitats differed greatly, with no measurable effect on pop ash (*Fraxinus caroliniana*) or pond cypress in control sites and up to 50% mortality observed in restoration transects (Barry and Saha 2008). No major widespread windstorms hit the study area since the 2008 sampling event.

3.5 BELT TRANSECT EVALUATION

Data for each transect sampled in 2011 are presented in Appendix 2, and they include overstory basal area, overstory density, understory density and density of cabbage palm in all strata. Sampling data for prior years for these same transects was provided to SFWMD electronically.

3.5.1 *Overstory and Understory Density and Basal Area Excluding Cabbage Palm*

In general, the changes since sampling in 2009 have been subtle and similar to changes from 2004 and 2005 to 2009, as reported in the 2-year monitoring report (Barry et al. 2009). At this time, none of the changes suggest effects of restoration. Changes in the overstory are expected to be slower than other strata, unless mortality occurs for species more sensitive to inundation. Because we have had drought years since 2005, and because restoration is incomplete, the lack of observed changes is not unexpected.

For cypress habitats, overall density and basal area of cypress remained lower at restoration sites than at control sites, which, as discussed in previous reports, is indicative of higher mortality of cypress in drained sites over time. Pop ash overstory density continues to increase steadily at all sites where present, as observed in 2009 (Barry et al. 2009). This is also reflected in the data by decreases in density in the understory strata; however, in some transects the decrease in the density in the understory exceeds the increase, suggesting some mortality of stems as the larger stems achieve dominance. Other species such as swamp bay and laurel oak (*Quercus laurifolia*) remain in greater densities and basal area at the restoration sites, which is indicative of shorter hydroperiods, as suggested in the last report.

Cabbage palm hammock (Hp) was represented solely by transect PC27 in the restoration transects of Fakahatchee Strand, between two north to south flowing sloughs. In this transect, the relative composition of laurel oak, which has an affinity for wet conditions, and live oak (*Quercus virginiana*), which prefers drier conditions, is being monitored. At this time, laurel oak in the understory has increased more substantially than live oak since 2009; however, this may simply be indicative of the faster growth rates of young laurel oak. It is important to note that no live oak mortality (which could be caused by wetter conditions) has occurred.

Woody plant dominance remains low in wet prairie transects, as discussed in the 2-year monitoring report. No substantial changes were observed this event (Appendix 2).

Slash pine densities in all habitats remained nearly the same in the overstory with some reduction overall in the understory (Appendix 2). In general, mortality has been associated with either fire or Hurricane Wilma in the past, and not necessarily related to hydrological restoration (Barry et al. 2009). It is anticipated that some mortality will have occurred when transects that burned just prior to this sampling event (which were not sampled) are sampled after recovering from burning. Also, slash pine in some of the restoration cypress transects, such as PC11 and PC13, has not changed; although, with increasing hydroperiod one might expect some mortality.

3.5.2 Analysis of Relative Growth Rates of Dominant Overstory Tree Species

Diameter growth was determined as relative growth rate measured in centimeters at two points in time to assess differences between control and restoration transects. Comparisons of RGR in future events will focus on changes over time within management regimes to see if hydrological restoration is altering the growth rates; however, a longer time since restoration will be necessary to draw any conclusions. For this report, measurements were analyzed between 2004 or 2005 (t1) and 2011(t2). Relative growth rate normalizes for the initial differences in size across individuals and also for the elapsed time over which the growth is assessed, so that growth rates can be compared (see Analysis section 2.2).

Since all species do not occur at all sites, for growth rates, we compared a) slash pine growth across management regimes for pineland habitats, b) cypress growth across management regimes for cypress-dominated habitats, and c) pop ash growth across management regimes for cypress habitats.

The trends of faster growth of slash pine and slower growth of cypress at restoration sites discussed in the 2-year monitoring report (Barry et al. 2009) were also observed this sampling event; however, the differences are more obvious with the "less drained" transects removed from analysis, especially PC28, which is somewhat anomalous.

With 2011 data analyzed, slash pine growth was significantly higher ($p = .01$) in the restoration pineland transects (0.022 ±0.003) than the control transects (0.008 ±0.0063) (Tables 6 and 7, Figure 16). Slash pine growth is known to be slower in more hydric conditions, suggesting the hydroperiods in the pinelands of the restoration transects remain too short to affect growth.

Cypress and pop ash growth rates were both found to be higher in control transects (0.007 ±0.001, 0.012 ±0.002) compared to restoration transects (0.000 ±0.001, 0.005 ±0.005) (Tables 8-10, Figure 16); however, the growth rates were significant in control transects for cypress only ($p < 0.01$). Both species appear to continue to grow slowly at the restoration transects, which is more typical of a drained condition rather than restored condition. The "less drained" transect PC28 is included for reference and has one of the highest growth rates of all transects (0.025 ±0.002, 0.032 ±0.007, for cypress and pop ash, respectively).

3.5.3 *Cabbage Palm Densities*

Thus far, restoration does not appear to have had an effect on cabbage palm density, with the exception of causing some mortality in lower strata in a few cypress transects close to the Prairie Canal footprint. The overall trend at both control and restoration transects over time, since sampling began in 2004, has been a slow and steady increase in cabbage palm density, although the densities and rate of change varies considerably by habitat and management regime (Tables 11-22, Figures 17-19, Appendix 2).

Restoration transects in both cypress and pineland habitats had significantly higher ($p < 0.05$ for cypress and $p < 0.01$ for pine) densities of established (upper strata) palms (147.654 ±48.309, 203.88 ±54.30) than control (26.969 ±19.087, 80.33 ±23.51) transects (Tables 11, 12, 15, and 16, Figures 17 and 18). Densities were higher in restoration wet prairie transects (though not significant ($p = 0.89$)), as overall densities remain low in this habitat type in general (Table 20, Figure 19). Control sites had the highest densities and rates of increase in the pineland habitats with low densities in other habitats, while restoration sites had highest densities in both pinelands and cypress habitats, as reported in the past (Barry 2006, Barry and Woodmansee 2006). This is likely related to hydroperiod, since the restoration cypress sites have had over 30 years of hydroperiods that resemble control pineland hydroperiods.

The upper strata (strata 1 and 2 combined or all individuals with meristems >4.5′) for both control and restoration transects shows an increase trend over time, as shown in Tables 11, 15, and 19, with the exception of the pineland control transects; although the difference between sampling years is not significant ($p = 0.98$, $p = 0.66$, $p = 1.0$ for cypress, pineland, and wet prairie, respectively). Some strata 2 palms were observed to be depredated by Florida black bear at these 3 control transects.

Intermediate strata 3 palms, or those with meristems above ground up to 4.5′, seems to be variable, showing no patterns between control and restoration transects, except in cypress habitats where density is higher in restoration transects (127.427 ±42.446 vs. 43.150 ±28.103) (Table 13, Figures 17-19); although, the difference is not significant (p=.091). Predation by Florida black bear was most often observed in this strata (Barry et al. 2009). Also, cabbage palms grow more quickly in this strata, so palms move in and out of this strata frequently (Barry et al. 2009, McPherson and Williams 1996).

The lower strata, strata 4 plus 5, includes seedlings through pre-trunk palms, is the most variable in terms of density between habitats and over time (Tables 11, 15, 19, Figures 17-19, and Appendix 2). The lower strata are arguably the most important for understanding the effects of restoration and the future of dominance by cabbage palm, especially in light of this variability. The variability from year to year is highest in cypress habitats, suggesting that fluctuating water levels and varying hydroperiods from year to year may cause some mortality. Unlike established cabbage palms, the densities of lower strata palms are also high in cypress habitats at the control sites, and no significant difference ($p = 0.051$) was observed between management regimes (1654.531 ±110.616 restoration and 1666.667 ±140.634 control) (Table 14). Weather and restoration effects on hydroperiod may be playing a role in the fluctuation in lower strata densities in cypress communities. For example, PC25, which is located adjacent to the Prairie Canal footprint on the southern end, showed a dramatic decrease from the 2004 baseline to 2008 (Barry and Saha 2008), which was encouraging for effects of restoration; however, recent sampling following several drought years indicates numbers in the lower strata have increased again (Appendix 2).

The density of cabbage palm in the lower strata of pineland habitats remains high in both control (1957.67 ±76.74) and restoration sites (2087.38 ±343.90) (Table 15, Figure 18). Densities of cabbage palm at the restoration transects in pineland were not significantly different from the lower strata at the control transects ($p = 0.69$, Table 18). Observed densities over 1,000 individuals per acre could have a substantial effect on the ecology of the site over the long term, especially in light of the gradual increase over time observed at both control and restoration sites. The difference between years was not significant ($p = 0.641$), but it is important to note that a general increase was observed. These numbers may simply reflect drought effects; however, they are nevertheless discouraging for potential restoration effects on the establishment of cabbage palms, if control sites are also continuing to exhibit such increases.

The density of lower strata of cabbage palm in wet prairies is consistently the lowest of all habitat types with no significant difference between control and restoration transects ($p = 0.14$, Tables 19 and 22, Figure 19). Though the differences are not significant, it is important to note that density is a little higher at restoration sites (309.755 ±65.155) compared to control (64.725 ±24.903) and has been increasing slightly over time, independent of management regime. It is interesting that wet prairies, with a hydroperiod between cypress and pineland transects (both of which have higher densities of cabbage palm), seem to have a resistance to establishment of cabbage palm. Although the lack of perches for birds, which are a known dispersal agents, may definitely be influencing this phenomenon (Mike Duever, personal communication), the edaphic characteristics of the marl may play a more important role. Soils of adjacent transitional cypress communities have both a readily observable higher organic content and more sand (less marl) and have dramatically higher densities of cabbage palm (Barry, personal observation). More research is needed to better understand cabbage palm establishment in wet prairies.

3.6 LINE INTERCEPT DATA

Percent cover by species for each transect sampled in 2011 and sampling data for prior years for these same transects is provided in Appendix 3. These data also are being provided to SFWMD electronically. Measures of shrub cover are important for characterizing overall species composition and structure of transects, and it can have an important influence on groundcover species richness. Typically, with increased shrub cover, there is an increase in shade over the groundcover and a resulting reduction in species richness. However, differences in overall shrub cover, excluding cabbage palm and saw palmetto, seemed to relate more to fire than hydrological restoration, with the exception of a few cases to date (Barry 2006, Barry and Saha 2008, Barry et al. 2009). This report reviews some of the results of previous analyses and some of the general observations from data collected in 2011. All of the analyses conducted during this event are not discussed, as it is not directly relevant to determining the effects of hydrological restoration.

Total shrub cover was analyzed for effects of time since fire and management regime in the 2-year monitoring report (Barry et al. 2009). Although differences were not found to be significant, the data from pineland transects suggest that the influence of fire may relate to fire return interval over a longer term (not simply time since fire) and also may be related to controlled burning versus more severe wildfires. In short, the changes observed following fire in transects on the FPNWR, which have been burned using controlled burning regularly every 3-5 years for the past 20 years, showed much less influence from fire (pre-fire total shrub cover was achieved much more quickly) than restoration transects. In contrast, marked decreases, though not significant, in shrub cover were observed in burned restoration transects, which typically were fairly long fire-suppressed prior to being burned by wildfires. Conversely, shrub cover steadily increased with fire suppression at restoration sites.

Because of the wildfire on May 12, 2011, it will be possible to analyze the effects of fire again during the next sampling. A few other smaller fires may actually have burned additional restoration transects in July as drought continued well into the summer following sampling in 2011. Unfortunately, only one pineland transect sampled this event, transect 67, a control transect in FSPSP, burned since the last event and because it burned just a few months prior to sampling during severe drought, any analysis of fire effects would be premature.

Cover by Brazilian-pepper was highest at restoration transects in prior reports (Barry 2006, Barry et al. 2009), and this has not changed (Appendix 3). A significant effect of fire on differences in Brazilian-pepper cover over time was observed at restoration transects in the 2-year monitoring report (Barry et al. 2009). One control transect sampled during 2011, transect 67, was burned since the last sampling event and a reduction in Brazilian-pepper cover had occurred.

A freeze event also occurred in mid-December 2010 that top-killed Brazilian-pepper in areas of sparse canopy or open areas (personal observation). The data collected in 2011 reflects this effect, with all of the transects with previous cover of Brazilian-pepper >1% showing marked decreases, except transect PC28. This transect has a dense canopy of cypress, which, with moist conditions, prevented freezing conditions. The top-killed individuals were not killed and were re-sprouting at the time of sampling; therefore, the observed reduction is likely temporary.

Brazilian-pepper has been observed dying from flooding in and around transect PC26 (Barry and Saha 2008). In 2011, data for transect PC26 indicated that cover was further reduced to zero percent (Appendix 3). This transect is located adjacent to the Prairie Canal footprint and, therefore, was more severely drained. As a result, the effects on Brazilian-pepper are similar to the effects on lower strata of cabbage palm on PC25 on the other side of the footprint.

Cover of middle and lower strata cabbage palm (meristems <4.5′) varied between transects and over time, but not as a result of the management regime (i.e. hydrological restoration). Cover correlates significantly with time, which is consistent with belt transect density analysis (Barry et al. 2009). The exception is that cover by cabbage palms measured by the line intercept method in cypress transects was substantially lower at control sites. Variables such as changes in density within measured strata (i.e., as palms grow over 4.5′ they are no longer recorded in line-intercept data) were most important, although predation by Florida black bear and temporary post-fire decreases were also noted (Barry et al. 2009). In data collected in 2011 (Appendix 3), cover by cabbage palm changed little, except in the pineland control transect 67, which had burned only a few months prior to sampling, and in a few other transects (consistent with belt transect densities in strata 3). For example, cabbage palm coverage changed in PC15 (lower) and PC27 (higher), which have high densities of palms in multiple strata, thus likely reflecting growth and changes in height, rather than mortality or establishment. Potentially, long-term hydrological restoration will reduce palm cover in this strata at least in the cypress communities, thereby becoming more comparable to control sites.

3.7 QUADRAT DATA EVALUATION

All data collected using 0.5-meter quadrats is maintained in the PLANT_RAWDATA.mdb database, which has been provided to the SFWMD. The "QUAD_DA' table in this database now houses 57,098 records. The data table includes the data summarized and discussed below. The data table also includes many data fields not analyzed to date for the PSRP, such as phenology, and evidence of browsing by white-tailed deer, as well as data from PSSF and FPNWR dating from 1999. Summaries by species and transects, habitat, and time since fire are available in the QUAD_ANALYSIS.mdb file, which also has been provided to SFWMD.

3.7.1 *Plant Identification*

Plant species were identified to the lowest possible taxonomic level during all sampling events. Approximately 97-98% of the records were identified to species- or variety-level. When weighted by percent cover, identification to the species or variety level exceeded 99% (see Table 6). Identification problems primarily included immature members of Poaceae, Cyperaceae, and Asteraceae.

3.7.2 *Mean Percent Cover and Frequency of Each Species Observed by Transect*

Transect mean values of percent cover and percent frequency of species for transects sampled in 2011, including data collected for the same transects in prior years are being provided to SFWMD electronically with some summary tables added in the Appendices. In past reports, data were summarized by habitat and management regime and presented as tables. However, prior analysis of these data (Barry et al. 2009), no trends over time identified in these tables were found to be significant with regard to the effects of management regime or hydrological restoration. Therefore, the tables are not included in this report. Cluster analysis and ordination have proven more reliable in determining effects of hydrological restoration on species cover, as discussed below in Section 3.7.4.

Species richness in previous analyses showed variation first by habitat, with highest species richness in pineland, followed by wet prairie, and finally by cypress habitats (Barry et al. 2009). Species richness was higher in control pineland transects than restoration transects, though this was more likely an influence of frequency of burning and time since fire, rather than hydrology. The recently burned and more frequently burned transects had significantly higher species richness compared to long fire-suppressed pineland transects (Barry et al. 2009).

Species richness in cypress transects was found to be higher in restoration transects, which may indicate the effects of drainage because of the shortened hydroperiod, allowing more species to become established (Barry et al. 2009). The expected outcome of restoration is to see a decrease in species richness in cypress restoration transects with a lengthening of the hydroperiod. Mean species richness was higher in control wet prairie transects than in restoration transects, but the differences were not significant.

Changes in species richness over time were not significant through 2009 (Barry et al. 2009), nor through 2011 (cypress: $p = 0.62$, pineland: $p = 0.82$, and wet prairie: $p = 0.56$, Appendix 5 (a-d)). It is unclear if the slight increase in species richness in 2011 was due to sampling variation (different field botanists) or ecological variables (e.g., drought, fire frequency or hydrology).

3.7.3 *Effects of Management Regimes on Wetland Affinity Index*

Wetland indicator values (Reed 1988) were utilized to calculate Wetland Affinity Indices (WAI) to assist with evaluating the effects of hydrological conditions on plant communities across management regimes (see Data Analyses Section 2.2.2 above). Transect mean WAI values for transects sampled in 2011, including data for the same transects from previous sampling events are being provided to SFWMD electronically and are presented in Appendix 6.

WAI values have generally remained stable or decreased slightly at control transects, while values have increased at restoration transects (Tables 24-29, Figure 20, Appendix 6). WAI also showed variation between habitats with both pineland and cypress transects, showing higher variability and perhaps following weather more closely than wet prairies, which have changed less at control sites. Given that drought has affected all transects, it is especially encouraging that restoration transects have exhibited increases in WAI, suggesting hydrological restoration is having an effect on the vegetation.

WAI at cypress transects was significantly higher at control sites (0.742 ±0.029) than restoration sites (0.670 ±0.023) ($p = 0.01$, Tables 24 and 25). Although differences were not significant between sampling years ($p = 0.99$), mean WAI at control transects showed a trend of decreasing over time (0.793 ±0.031 in 2008, 0.758 ±0.033 in 2009, and 0.742 ±0.029 in 2011), perhaps reflecting drought conditions. It is notable that during those same drought years, mean WAI at restoration transects increased (0.624 ±0.022 in 2008, 0.662 ±0.020 in 2009, 0.670 ±0.023 in 2011).

The 2005 data were not included in the statistical analyses because sampling that year was conducted during high water when there were fewer herbaceous plants, thus WAI reflected more woody vegetation and non-wetland species on hummocks and cypress. This resulted in a lower WAI for 2005 during high water (Appendix 6). Data from individual transects (Appendix 6) shows variability among control transects and between years, although control WAI values generally ranged between 0.70-0.85. Four of five restoration transects that had WAI values within that range in 2004, remained above 0.70 in 2011. Moreover, all six restoration transects with WAI <0.70 in 2004 had higher values in 2011, and the lowest value among all restoration transects went up from 0.53 in 2004 to 0.62 in 2011.

Transect PC26 exhibited the most dramatic increase in WAI from 0.70 in

2004 to 0.80 in 2011, which is largely a result of the die-off of Brazilian-pepper (see section 3.6) and subsequent increase in cover by Carolina willow and wetland herbs likely taking advantage of the increased light conditions. This transect and PC25, which also increased (0.60 in 2004 to 0.62 in 2011), are located in the southern series adjacent to the Prairie Canal footprint, which (as mentioned in Sections 3.5.3 and 3.6) were likely more severely drained and exhibiting more pronounced effects of restoration on vegetation as a result.

In pineland transects, overall differences between control (0.536 ±0.071) and restoration (0.649 ±0.045) sites were not significant ($p = 0.95$). Although differences between sampling years were not significant ($p = 0.91$), mean WAI at control sites decreased over time (0.642 ±0.071 in 2008, 0.624 ±0.071 in 2009, and 0.536±0.071 in 2011). The mean WAI at restoration transects increased over time (0.553 ±0.045 in 2008, 0.610 ±0.045, and 0.649 ±0.045 in 2011) (Tables 26 and 27, Figure 20). This may reflect topographic variation in pineland habitats (slash pine has a wide tolerance of hydroperiod) whose data were pooled for this statistical analysis. Pineland restoration transects analyzed in this report were more hydric, since a number of mesic pineland transects burned and were not sampled in 2011. Thus, the 2011 data set is expected to skew pineland restoration mean WAI values higher than control mean WAI values. Also, one of the three control transects (67) had recently burned (approximately 5 months prior), so this may have affected the WAI. As for the changes over time, in general, the most probable explanation for the decrease in WAI at the control sites is the recent drought years, while increases at restoration transects was likely due to hydrological restoration.

Mean WAI in wet prairie transects was significantly higher at control transects (0.788 ±0.031) than restoration transects (0.667 ±0.020) ($p = 0.01$, Tables 28 and 29, Figure 20), most likely reflecting the longer hydroperiods at the control sites. Changes over time in WAI in the wet prairie transects were more subtle than in other habitats. The trend in the subsample suggests that mean WAI of the wet prairie transects has remained stable since 2008. When previous years (spring 2004, see Appendix 6) are included, the data show an increase at the restoration sites over time (Barry et al. 2009). Comparisons can be extended for control sites on the FPNWR to include sampling conducted in May 1998, also a drought year. These data show similar values for transect 07WP11 (0.71 May 1998, 0.72 June 2011) and a decrease over time for transect 32WP33 (0.80 May 1998, 0.73 June 2011). Since 2004, seven of eight restoration transects increased in WAI values, and the lowest value among all restoration transects went up from 0.53 in 2004 to 0.63 in 2011.

The highest WAI values are at transect 39, a control transect in FSPSP. This transect is perhaps closer to a marsh than a wet prairie with gulf-dune paspalum completely dominating along with mostly obligate wetland plants (WAI=0.83 to 0.85 in all sampling events 2005-2011). PC06 is a restoration transect, which may have been similar to this control transect in pre-drainage conditions. PC06 is also completely dominated by gulf-dune paspalum and shows a much lower WAI (0.55 to 0.63 in 2011). PC06 is located adjacent to the canal, so was likely severely drained based on hydrological data (Mike Duever, personal communication). The increase in WAI at wet prairie restoration sites since 2004 is encouraging, since wet prairie habitats are inherently resistant to change.

3.7.4 *Classification and Ordination*

In the 2-year monitoring report (Barry et al. 2009), cluster analysis produced four major groups, but these did not correlate to habitat types (based on current condition for restoration sites rather than pre-drainage habitat type) or to management regimes (control vs. restoration). Owing to the lack of discernible patterns using all transects, analysis for the present habitat groups (based on pre-drainage habitat types) was conducted separately using a SIMPROF test with control, restoration, and the "less drained" transects identified (Figures 21-27). Fall 2005 (control) and late spring 2004 (restoration) sampling events were included for discussion purposes, despite the difference in seasonality that makes comparison between management regimes misleading.

Within cypress habitats, control and restoration transects generally grouped separately (at roughly a similarity of 30%) and secondarily by relative elevation or type of cypress habitat (e.g., deep strand swamp to transitional cypress) at similarity of 42% (lines presented on Figure 21). Hammock-like transitional transects (all with swamp dogwood (*Cornus foemina*) in the understory) grouped together (transects PC15, PC25, PC29, 42, and 56). Formerly longer hydroperiod (lower relative elevation) transects (PC11 and PC12) west of Prairie Canal (very drained) grouped together while the similar deeper strand transects east of the canal in the south (PC26 and some of the "less drained" transects PC20 and PC28) grouped together. The control transect 45 on FPNWR was an outlier as it represents the only intact, fire-maintained cypress with species-rich graminoid groundcover. PC13 also was somewhat an outlier grouped with restoration transects. PC13 probably was formerly cypress with graminoid habitat, but it is now a tangled vine thicket.

Interestingly, the 2005 sampling event for control strand swamp transect 32 sampled during high water fell out as an outlier, both from the same transect in other years and from all other transects. While transect 32 was the most extreme example, sampling during high water influenced other transects in 2005, as well, showing a greater dissimilarity during that sampling event. This further exemplifies the importance of season of sampling in order to standardize year-to-year comparisons of vegetation.

It appears the effects of restoration over time are minimal to date. With few exceptions, most transects show no trends over time. PC15 and PC25 showed greater distance between sampling events and clear direction towards control sites in MDS (Figure 22). PC26 also shows a directional shift towards control, with the 2004 event standing alone, then shifting after the Brazilian-pepper die-off observed since 2008 (Section 3.6). Not surprisingly, transects showing these trends are located adjacent to the Prairie Canal footprint that were most severely affected by the canal (Mike Duever, personal communication) and, therefore, were most affected by restoration. These transects were also some of the few transects showing the effects of restoration on woody vegetation and cabbage palm density (see Section 3.5.3 and Barry and Saha 2008). In a sense, these transects are the "canaries in the coal mine" with respect to observable restoration effects.

Pineland transects did not cluster according to management regime (control vs. restoration). However, there appears to be a strong influence of time since fire on cluster analysis, followed secondarily by relative elevation or type of pineland (e.g., hydric vs. mesic, correlating with percent cover of saw palmetto) (Figures 23 and 24). One exception is PC23, which fell out as an outlier, perhaps because of its transitional nature to the adjacent cypress habitats and its high density of cabbage palms in all strata. It is not surprising that fire seems to have a strong effect on clustering, since we have demonstrated in past reports the importance of time since fire on species richness, with fire-maintained transects showing significantly higher diversity (Barry et al. 2009).

Fire suppressed transects (>7 years since fire) fell out as a distinct group (similarity of 40%). This group also included transect 53 (restoration) and 67 (control). Fire seems important even within the group for transect 67, with the 2011 event (only a few months post-fire) falling out at a similarity of roughly 50%, while all prior sampling events showed about 70% similarity. Two of the three other transects in which a sampling event occurred <1 year since fire exhibited similar groupings (i.e., the recently burned sampling event is less similar).

The effect of year (sampling event) did not show specific trends, suggesting no effect of restoration in pineland transects MDS (Figure 25). As noted above, time since fire has a stronger influence. It is important to note, however, that the fire suppressed transects were the only transects to show a trend and were clearly moving away from the other transects. Thus, it is not surprising that transect 53, for which all sampling events are long fire-suppressed, has a directional trend away from control sites. Conversely, it was a bit surprising to see that the 2011 sampling event at recently-burned transect 67 also trended away from the other pineland control transects. This may be because the groundcover had not yet recovered from the fire. It will be interesting to see if the next sampling event for transect 67 exhibits a trend back towards the fire maintained pinelands.

Cluster analysis of the wet prairie group of transects showed fairly well defined clustering by management regime, with control and restoration transects separating into 2 distinct groupings at about 55% similarity based on the SIMPROF test (Figure 26). Exceptions include three transects, PC30, 39, and PC14, which separated from the rest of the transects regardless of management regime. This is thought most likely due to the lower relative elevations of these locations, although edaphic characteristics cannot be ruled out. PC30 was a definite outlier, which is not surprising as this "less-drained" transect is located in the transition from cypress habitats to open wet prairie and is now dominated by cabbage palms. As a result, PC30 does not conform to either cypress or wet prairie habitats specifically. Transect 39, a control transect in FSPSP off Janes Scenic drive, also is somewhat separated, as it is perhaps closer to a marsh then a wet prairie (see WAI discussion, Section 3.7.3). Finally, PC14 also represents a transition to an adjacent cypress community and includes a few small cypress at the west end of the transect, as it approaches the strand swamp. This transect also has very high and unique diversity of groundcover, perhaps in part due to soil characteristics, as it has a sand and marl mix.

To date, cluster analysis of most wet prairie transects has not shown trends over time, with an encouraging exception (Figure 27). Data for PCO6, which lies adjacent to the Prairie Canal footprint, show an obvious directional trend over time towards the control transect 39, which it closely resembles in terms of relatively low elevation and dominance by gulf-dune paspalum.

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Tables

Table 1: Summary of Sampling Events Included in Database.

Location	Funding Source	Principal Investigator	Management Regime	Sampling Event No.	Start Date	End Date	No. of Transects
Florida Panther National Wildlife Refuge (FPNWR)	USFWS	Dr. M. Main	Control	0	12/20/1997	1/5/1998	4
	USFWS	Dr. M. Main	Control	1	5/20/1998	6/2/1998	4
	SFWMD PC P502173	M. Barry & S. Woodmansee	Control	4	10/19/2005	12/5/2005	6
	SFWMD 4500026581	M. Barry	Control	5	6/7/2008	6/7/2008	3
	SFWMD 4500026581	M. Barry	Control	6	5/29/2009	6/11/2009	6
	SFWMD 4600001953	M. Barry & M. Bonness	Control	7	5/26/2011	6/1/2011	6
	USFWS	Dr. M. Main	N/A	0	4/29/1996	1/7/1998	212
	USFWS	Dr. M. Main	N/A	1	8/12/1996	6/2/1998	201
	USFWS	Dr. M. Main	N/A	2	11/14/1996	12/10/1997	153
	USFWS	Dr. M. Main	N/A	3	4/23/1997	9/20/1998	135
	Everglades Reprogram	M. Barry	N/A	4	5/13/2005	9/20/2006	72
Fakahatchee Strand Preserve State Park	SFWMD PC P502173	M. Barry & S. Woodmansee	Control	4	9/30/2005	11/10/2005	5
	SFWMD 4500026581	M. Barry	Control	5	6/5/2008	7/8/2008	5
	SFWMD 4500026581	M. Barry	Control	6	6/18/2009	6/25/2009	5
	SFWMD 4600001953	M. Barry & M. Bonness	Control	7	6/1/2011	6/4/2011	5
	Interagency	M. Barry	Restored	0	3/11/2004	5/3/2004	15
	SFWMD 4500026581	M. Barry	Restored	5	5/8/2008	6/4/2008	15
	SFWMD 4500026581	M. Barry	Restored	6	5/21/2009	6/22/2009	15
	SFWMD	M. Barry & M. Bonness	Restored	7	5/17/2011	6/21/2011	11
Picayune Strand State Forest	Interagency	M. Barry	Restored	0	12/9/2003	5/11/2004	23
	SFWMD PC P502173	M. Barry & S. Woodmansee	Restored	4	9/6/2005	10/6/2005	46
	SFWMD 4500026581	M. Barry	Restored	5	5/20/2008	7/9/2008	20
	SFWMD 4500026581	M. Barry	Restored	6	5/19/2009	6/16/2009	20
	SFWMD 4600001953	M. Barry & M. Bonness	Restored	7	5/16/2011	7/9/2011	14

Location	Funding Source	Principal Investigator	Management Regime	Sampling Event No.	Start Date	End Date	No. of Transects
Ten Thousand Islands National Wildlife Refuge	SFWMD PC P502173	M. Barry & S. Woodmansee	Restored	4	8/10/2005	10/14/2005	4
Rookery Bay National Estuarine Research Reserve	N/A	M. Barry	N/A	0	10/21/2010	10/21/2010	1
309 permanently marked transects						Sample Total:	1,006

Table 2: Summary of Transects and Sampling Events Analyzed in this Report.

Location	Management Regime	Sampling Event No.	Start Date	End Date	Transect ID	No. of Transects
FPNWR	Control	4	10/19/2005	12/5/2005	07WP11, 07PI11, 32, 32PI33, 32WP33, 45	6
FPNWR	Control	5	6/7/2008	6/7/2008	07WP11, 07PI11, 32 (32PI33, 32WP33, 45 not sampled due to Rx burn)	3
FPNWR	Control	6	5/29/2009	6/11/2009	07WP11, 07PI11, 32, 32PI33, 32WP33, 45	6
FPNWR	Control	7	5/26/2011	6/1/2011	same as above)	6
FSPSP	Control	4	9/30/2005	11/9/2005	37, 39, 51, 64, 67	5
FSPSP	Control	5	6/5/2008	7/8/2008	(same as above)	5
FSPSP	Control	6	6/18/2009	6/25/2009	(same as above)	5
FSPSP	Control	7	6/1/2011	6/4/2011	(same as above)	5
FSPSP	Restored	0	3/11/2004	5/3/2004	PC06, PC07, PC08, PC09, PC10, PC20, PC26, PC27, PC28, PC29, PC30; (PC16, PC17, PC18, PC19 excluded from analysis due to wildfire 5/12/2011)	11
FSPSP	Restored	5	5/8/2008	6/4/2008	(same as above)	11
FSPSP	Restored	6	5/21/2009	6/22/2009	(same as above)	11
FSPSP	Restored	7	5/17/2011	6/21/2011	(same as above)	11
PSSF	Restored	0	12/9/2003	5/11/2004	PC11, PC12, PC13, PC14, PC15, PC21, PC22, PC23, PC24, PC25, 42, 53, 56, 57 (PC01, PC02, PC03, PC04, PC05, 55 excluded from analysis due to wildfire 5/12/2011)	14
PSSF	Restored	5	5/20/2008	7/9/2008	(same as above)	14
PSSF	Restored	6	5/19/2009	6/16/2009	(same as above)	14
PSSF	Restored	7	5/16/2011	7/9/2011	(same as above)	14

Table 3: Transects by Existing Habitat Type and Management Regime.

Management Regime	Habitat Name	Habitat	Total No. of Transects	No. Sampled in 2011
Control	Cypress	C	3	3
Control	Cypress with graminoid understory	Cg	1	1
Control	Pine flatwoods/hydric	Ph	3	3
Control	Wet Prairie	G	4	4
Restored	Cypress	C	5	5
Restored	Cypress with graminoid understory*	Cg	5 (7)	5 (5)
Restored	Cypress with hardwoods	Ch	2	1
Restored	Hammock/cabbage palm	Hp	1	1
Restored	Hammock/hydric (historically C)	Hh (C)	1 (0)	1
Restored	Pine flatwoods/hydric (2 were historically Cg)	Ph	10 (8)	5 (5)
Restored	Pine flatwoods/mesic	Pm	2	0
Restored	Wet Prairie	G	9	7
Totals			46	36

* 2 Cg historically colonized by slash pine.

Table 4: Transect Descriptions.

Transect	Management Regime	Location	Habitat Group	Pre-Drainage NRCS Habitat	Baseline NRCS Habitat	Soil No.	Soil Type Name
07PI11	Control	FPNWR	Pineland	Ph	Ph	11	Hallandale Fine Sand
07WP11	Control	FPNWR	Wet Prairie	G	G	50	Ochopee Fine Sandy Loam, Low
32	Control	FPNWR	Cypress	C	C	51	Ochopee Fine Sandy Loam
32PI33	Control	FPNWR	Pineland	Ph	Ph	49	Hallandale and Boca Fine Sands
32WP33	Control	FPNWR	Wet Prairie	G	G	25	Boca, Riviera, Limestone substratum, Copeland Fine Sands, Depressional
37	Control	FSPSP	Cypress	C	C	25	Boca, Riviera, Limestone substratum, Copeland Fine Sands, Depressional
39	Control	FSPSP	Wet Prairie	G	G	50	Ochopee Fine Sandy Loam, Low
42	Restored	PSSF	Cypress	C	C	11	Hallandale Fine Sand
45	Control	FPNWR	Cypress	Cg	Cg	25	Boca, Riviera, Limestone substratum, Copeland Fine Sands, Depressional
51	Control	FSPSP	Cypress	C	C	25	Boca, Riviera, Limestone substratum, Copeland Fine Sands, Depressional
53	Restored	PSSF	Pineland	Pm	Pm	11	Hallandale Fine Sand
55	Restored	PSSF	Cypress	Cg	Ph	50	Ochopee Fine Sandy Loam, Low
56	Restored	PSSF	Cypress	C	Hh	25	Boca, Riviera, Limestone substratum, Copeland Fine Sands, Depressional
57	Restored	PSSF	Wet Prairie	G	G	50	Ochopee Fine Sandy Loam, Low
64	Control	FSPSP	Wet Prairie	G	G	50	Ochopee Fine Sandy Loam, Low
67	Control	FSPSP	Pineland	Ph	Ph	51	Ochopee Fine Sandy Loam, Low
PC01	Restored	PSSF	Pineland	Pm	Pm	11	Hallandale Fine Sand
PC02	Restored	PSSF	Cypress	Ch	Ch	11	Hallandale Fine Sand
PC03	Restored	PSSF	Pineland	Ph	Ph	11	Hallandale Fine Sand
PC04	Restored	PSSF	Cypress	Cg	Ph	51	Ochopee Fine Sandy Loam
PC05	Restored	PSSF	Pineland	Ph	Ph	51	Ochopee Fine Sandy Loam
PC06	Restored	FSPSP	Wet Prairie	G	G	51	Ochopee Fine Sandy Loam
PC07	Restored	FSPSP	Wet Prairie	G	G	51	Ochopee Fine Sandy Loam
PC08	Restored	FSPSP	Pineland	Ph	Ph	51	Ochopee Fine Sandy Loam
PC09	Restored	FSPSP	Pineland	Ph	Ph	51	Ochopee Fine Sandy Loam
PC10	Restored	FSPSP	Pineland	Ph	Ph	51	Ochopee Fine Sandy Loam
PC11	Restored	PSSF	Cypress	Cg	Cg	49	Hallandale and Boca Fine Sands
PC12	Restored	PSSF	Cypress	C	C	49	Hallandale and Boca Fine Sands
PC13	Restored	PSSF	Cypress	Cg	Cg	49	Hallandale and Boca Fine Sands
PC14	Restored	PSSF	Wet Prairie	G	G	50	Ochopee Fine Sandy Loam, Low
PC15	Restored	PSSF	Cypress	C	Ch	11	Hallandale Fine Sand
PC16	Restored	FSPSP	Wet Prairie	G	G	50	Ochopee Fine Sandy Loam, Low
PC17	Restored	FSPSP	Wet Prairie	G	G	50	Ochopee Fine Sandy Loam, Low
PC18	Restored	FSPSP	Pineland	Ph	Ph	51	Ochopee Fine Sandy Loam, Low
PC19	Restored	FSPSP	Pineland	Ph	Ph	51	Ochopee Fine Sandy Loam, Low
PC20	Restored	FSPSP	Cypress	C	C	25	Boca, Riviera, Limestone substratum, Copeland Fine Sands, Depressional

Transect	Management Regime	Location	Habitat Group	Pre-Drainage NRCS Habitat	Baseline NRCS Habitat	Soil No.	Soil Type Name
PC21	Restored	PSSF	Wet Prairie	G	G	50	Ochopee Fine Sandy Loam, Low
PC22	Restored	PSSF	Wet Prairie	G	G	50	Ochopee Fine Sandy Loam, Low
PC23	Restored	PSSF	Pineland	Ph	Ph	49	Hallandale and Boca Fine Sands
PC24	Restored	PSSF	Wet Prairie	G	G	50	Ochopee Fine Sandy Loam, Low
PC25	Restored	PSSF	Cypress	Cg	Cg	49	Hallandale and Boca Fine Sands
PC26	Restored	FSPSP	Cypress	C	C	49	Hallandale and Boca Fine Sands
PC27	Restored	FSPSP	Hammock	Hp	Hp	49	Hallandale and Boca Fine Sands
PC28	Restored	FSPSP	Cypress	C	C	51	Ochopee Fine Sandy Loam
PC29	Restored	FSPSP	Cypress	Cg	Cg	25	Boca, Riviera, Limestone substratum, Copeland Fine Sands, Depressional
PC30	Restored	FSPSP	Cypress	Cg	Cg	25	Boca, Riviera, Limestone substratum, Copeland Fine Sands, Depressional

Table 5: Transects by Habitat and Time Since Fire.

Management Regime	Habitat	Transect	Time Since Fire Category					Burned Since Last Event		
			2004 (Spring)	2005 (Fall)	2008 (Spring)	2009 (Spring)	2011 (Spring)	2008	2009	2011
Control	C	32		3	3	3	3	Yes		
Control	C	37		3	3	3	3			
Control	C	51		3	3	3	3			
Control	Cg	45		2		1	2		Yes	
Control	G	07WP11		2	2	2	1	Yes		Yes
Control	G	32WP33		2		2	2		Yes	
Control	G	39		2	2	2	1			Yes
Control	G	64		3	2	1	2	Yes	Yes	
Control	Ph	07PI11		2	2	2	1	Yes		Yes
Control	Ph	32PI33		2		2	2		Yes	
Control	Ph	67		3	3	3	1			Yes
Restored	C	42	3	3*	3	3	3			
Restored	C	PC12	3		3	3	3			
Restored	C	PC20	2		3	3	3			
Restored	C	PC26	3		3	3	3			
Restored	C	PC28	3		3	3	3			
Restored	Cg	PC11	3		3	3	3			
Restored	Cg	PC13	3		3	3	3			
Restored	Cg	PC25	2		2	2	2	Yes		
Restored	Cg	PC29	2		2	2	3			
Restored	Cg	PC30	2		2	2	3			
Restored	Ch	PC02	3		2	2	N/A	Yes		Yes
Restored	Ch	PC15	3		3	3	3			
Restored	G	57	2	2*	2	2	2	Yes		
Restored	G	PC06	2		1	2	2	Yes		
Restored	G	PC07	2		1	2	2	Yes		
Restored	G	PC14	3		3	3	3			
Restored	G	PC16	3		2	2	N/A	Yes		Yes
Restored	G	PC17	2		1	2	N/A	Yes		Yes
Restored	G	PC21	2		2	2	2	Yes		
Restored	G	PC22	2		2	2	2	Yes		

Management Regime	Habitat	Transect	Time Since Fire Category					Burned Since Last Event		
			2004 (Spring)	2005 (Fall)	2008 (Spring)	2009 (Spring)	2011 (Spring)	2008	2009	2011
Restored	G	PC24	2		2	2	2	Yes		
Restored	Hh	56	3	3*	3	3	3			
Restored	Hp	PC27	3		3	3	3			
Restored	Ph	55	1	2*	2	2	N/A			Yes
Restored	Ph	PC03	2		2	2	N/A	Yes		Yes
Restored	Ph	PC04	2		2	2	N/A	Yes		Yes
Restored	Ph	PC05	2		2	2	N/A	Yes		Yes
Restored	Ph	PC08	2		1	2	2	Yes		
Restored	Ph	PC09	2		1	2	2	Yes		
Restored	Ph	PC10	2		1	2	2	Yes		
Restored	Ph	PC18	2		1	2	N/A	Yes		Yes
Restored	Ph	PC19	2		1	2	N/A	Yes		Yes
Restored	Ph	PC23	2		2	2	2	Yes		
Restored	Pm	53	3	3*	3	3	3			
Restored	Pm	PC01	3		2	2	N/A	Yes		Yes

** These data were not included in analysis*

Table 6: Comparison of Relative Growth Rate of Slash Pine between Control and Restoration Pineland Transects. Relative growth rate was significantly higher in restoration than control sites.

Dependent Variable: Relative

Source	Type III Sum of Squares	Degrees of Freedom	Mean Square	F	Significance
Corrected Model	.002	1	.002	13.587	.001
Intercept	.008	1	.008	66.915	.000
Management	.002	1	.002	13.587	.001
Error	.004	34	.000		
Total	.014	36			
Corrected Total	.006	35			

Table 7: Mean Relative Growth Rate of Slash Pine in Pineland Transects

Dependent Variable: Relative

Management Regime	Mean	Standard Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Restoration	.022	.003	.016	.027
Control	.008	.003	.003	.013

Table 8: Mean Relative Growth of Cypress in Cypress Transects. Transect PC28 was not included in the analysis; however, the means are shown here to clarify that despite being considered a restoration transect, PC28 was less drained and resembled a control transect.

Dependent Variable: Relative

Management Regime	Mean	Standard Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Restoration	.000	.001	-.002	.002
Control		.001	.005	.009
PC28*		.002	.021	.029

Table 9: Comparison of Relative Growth Rate of Pop Ash between Control and Restoration Cypress Transects. Differences between Control and Restoration were not significant. Restoration Cypress transects showed a lower growth rate compared to control sites.

Dependent Variable: RELATIVE

Source	Type III Sum of Squares	Degrees of Freedom	Mean Square	F	Significance
Corrected Model	.000	1	.000	1.173	.291
Intercept	.001	1	.001	8.683	.007
Management	.000	1	.000	1.173	.291
Error	.002	22	.000		
Total	.005	24			
Corrected Total	.002	23			

Table 10: Mean Relative Growth Rate of Pop-Ash in Cypress Transects. The transect PC28 was not included in the analysis but is included in this table to demonstrate that it is a significantly wetter site compared to control and restoration cypress habitats.

Dependent Variable: Relative Growth Rate

Management Regime	Mean	Standard Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Control	.012	.002	.008	.016
Restoration	.005	.005	-.006	.017
PC28	.032	.007	.018	.046

Table 11: Mean Density of Cabbage Palm Individuals in Upper, Lower and Intermediate (Strata 3) Strata in Cypress transects.

Year	Strata	Control		Restoration	
		Mean	Standard Error of the Mean	Mean	Standard Error of the Mean
2008	Upper	21.58	14.27	133.50	42.10
	Strata3	26.97	12.35	107.20	32.14
	Lower	3009.71	175.53	1288.43	92.53
2009	Upper	21.58	14.27	143.61	46.43
	Strata3	26.97	16.81	107.20	38.07
	Lower	1871.63	153.43	819.18	78.53
2011	Upper	26.97	19.09	147.65	48.31
	Strata3	43.15	28.10	127.43	42.45
	Lower	1666.67	140.63	1654.53	110.62

Table 12: Comparison of Density of Cabbage Palm in Upper Strata in Cypress Transects. Density is significantly higher in the restoration transects.

Dependent Variable: Upper Strata Cypress Habitat

Source	Type III Sum of Squares	Degrees of Freedom	Mean Square	F	Significance
Corrected Model	92377.18	5	18475.435	1.387	.260
Intercept	178110.69	1	178110.69	13.375	.001
Mgmt. Regime	91468.04	1	91468.04	6.868	.014
Year	417.21	2	208.61	.016	.984
Mgmt. Regime * Year	131.58	2	65.789	.005	.995
Error	359561.07	27	13317.08		
Total	846503.49	33			
Corrected Total	451938.24	32			

Table 13: Density of Cabbage Palm in Strata 3 in Cypress Transects. No significant difference in the number of Strata 3 palms was found between restoration and control sites.

Dependent Variable: Strata 3 Cypress habitat

Source	Type III Sum of Squares	Degrees of Freedom	Mean Square	F	Significance
Corrected Model	46267.931	5	9253.586	.653	.663
Intercept	140107.004	1	140107.004	9.864	.004
Mgmt. Regime	43562.332	1	43562.332	3.067	.091
Year	1928.037	2	964.019	.068	.935
Mgmt. Regime * Year	23.803	2	11.901	.001	.999
Error	383485.981	27	14203.184		
Total	707208.764	33			
Corrected Total	429753.913	32			

Table 14: Comparison of Cabbage Palm Density in Lower Strata in Cypress Transects. No significant difference was found in density of cabbage palm in lower strata between years or management regime.

Dependent Variable: Lower strata Cypress habitat

Source	Type III Sum of Squares	Degrees of Freedom	Mean Square	F	Significance
Corrected Model	11590872.991	5	2318174.598	1.719	.164
Intercept	77308357.612	1	77308357.612	57.315	.000
Mgmt. Regime	5644409.236	1	5644409.236	4.185	.051
Year	2862064.604	2	1431032.302	1.061	.360
Mgmt. Regime * Year	3236913.099	2	1618456.549	1.200	.317
Error	36418742.126	27	1348842.301		
Total	122984677.588	33			
Corrected Total	48009615.117	32			

Table 15: Mean Density of Cabbage Palm by Strata in Pineland Transects.

Year	Strata	Control		Restoration	
		Mean	Standard Error of the Mean	Mean	Standard Error of the Mean
2008	Upper	89.33	30.03	135.92	24.33
	Strata3	323.75	121.57	359.22	71.53
	Lower	1423.67	37.69	1715.21	341.31
2009	Upper	97.12	26.97	200.65	50.81
	Strata3	331.29	90.74	339.81	62.25
	Lower	1885.00	30.37	1686.08	323.44
2011	Upper	80.33	23.51	203.88	54.30
	Strata3	339.08	65.40	330.10	54.54
	Lower	1957.67	76.74	2087.38	343.90

Table 16: Comparison of Cabbage Palm Density in the Upper Strata between Control and Restoration Pineland Transects. Restoration sites had significantly greater density of established cabbage palm individuals. Year and the interaction of year and density were not significant.

Dependent Variable: Upper strata Pineland

Source	Type III Sum of Squares	Degrees of Freedom	Mean Square	F	Significance
Corrected Model	92226.044	5	18445.209	2.450	.073
Intercept	332363.983	1	332363.983	44.144	.000
Mgmt. Regime	77295.791	1	77295.791	10.266	.005
Year	6486.166	2	3243.083	.431	.657
Mgmt. Regime * Year	4827.894	2	2413.947	.321	.730
Error	135524.353	18	7529.131		
Total	672908.794	24			
Corrected Total	227750.397	23			

Table 17: Comparison of Cabbage Palm Densities between Control and Restoration in Strata 3 Pineland Transects. Management effects were not significant for strata 3 *Sabal* densities

Dependent Variable: Strata 3 Pineland

Source	Type III Sum of Squares	Degrees of Freedom	Mean Square	F	Significance
Corrected Model	55115.676	5	11023.135	.492	.778
Intercept	1989718.178	1	1989718.178	88.860	.000
Mgmt. Regime	46923.238	1	46923.238	2.096	.165
Year	1101.150	2	550.575	.025	.976
Mgmt. Regime * Year	8039.703	2	4019.852	.180	.837
Error	403047.055	18	22391.503		
Total	2746619.810	24			
Corrected Total	458162.731	23			

Table 18. Comparison of Cabbage Palm Density between Control and Restoration in Lower Strata in Pineland Transects. None of the effects (year, management regime, or their interaction) were significant

Dependent Variable: Lower strata density of Sabal in pineland – Tests of Between-Subjects Effects

Source	Type III Sum of Squares	Degrees of Freedom	Mean Square	F	Significance
Corrected Model	859466.681	5	171893.336	.226	.946
Intercept	55087759.919	1	55087759.919	72.328	.000
Mgmt. Regime	586925.546	2	293462.773	.385	.687
Year	23401.564	1	23401.564	.031	.863
Mgmt. Regime * Year	178317.701	2	89158.850	.117	.890
Error	11424602.798	15	761640.187		
Total	80964013.782	21			
Corrected Total	12284069.478	20			

Table 19: Mean Density of Cabbage Palm per Size-class Category in Wet Prairie Transects

Year	Strata	Control		Restoration	
		Mean	Standard Error of Mean	Mean	Standard Error of Mean
2008	Upper	8.09	12.40	9.25	4.63
	Strata 3	0.00	.00	23.12	8.05
	Lower	48.54	14.377	131.76	34.96
2009	Upper	8.09	12.40	9.25	4.63
	Strata 3	.00	.00	20.80	7.677
	Lower	48.54	14.377	157.19	36.346
2011	Upper	8.09	12.40	9.25	4.63
	Strata 3	0.00	.00	39.297	10.16
	Lower	64.73	24.90	309.755	66.16

Table 20: Comparison of Cabbage Palm Density in the Upper Strata between Control and Restoration Wet Prairie Transects. No significant management regime and year affect on Upper strata Cabbage Palms in wet prairie

Dependent Variable: Upper strata

Source	Type III Sum of Squares	Degrees of Freedom	Mean Square	F	Significance
Corrected Model	6.234	5	1.247	.004	1.000
Intercept	1402.672	1	1402.672	4.565	.045
Mgmt. Regime	6.234	1	6.234	.020	.888
Year	.000	2	.000	.000	1.000
Mgmt. Regime * Year	.000	2	.000	.000	1.000
Error	6452.293	21	307.252		
Total	8640.462	27			
Corrected Total	6458.528	26			

Table 21: Comparison of Cabbage Palm Density in Strata 3 between Control and Restoration Wet Prairie Transects. No significant management regime and year affect on strata 3 Cabbage Palms in wet prairie

Dependent Variable: Strata 3

Source	Type III Sum of Squares	Degrees of Freedom	Mean Square	F	Significance
Corrected Model	5012.216	5	1002.443	.440	.816
Intercept	3590.842	1	3590.842	1.575	.223
Mgmt. Regime	3590.842	1	3590.842	1.575	.223
Year	315.861	2	157.931	.069	.933
Mgmt. Regime * Year	315.861	2	157.931	.069	.933
Error	47877.887	21	2279.899		
Total	65458.049	27			
Corrected Total	52890.104	26			

Table 22: Comparison of Cabbage Palm Density in Lower Strata between Control and Restoration Wet Prairie Transects. No significant management regime and year affect on Lower Strata Cabbage Palms.

Dependent Variable: Lower Strata

Source	Type III Sum of Squares	Degrees of Freedom	Mean Square	F	Significance
Corrected Model	229065.768	5	45813.154	1.105	.387
Intercept	299904.538	1	299904.538	7.234	.014
Mgmt. Regime	98972.570	1	98972.570	2.387	.137
Year	34650.513	2	17325.256	.418	.664
Mgmt. Regime * Year	23556.586	2	11778.293	.284	.756
Error	870629.460	21	41458.546		
Total	1854557.451	27			
Corrected Total	1099695.227	26			

Table 23: Level of Plant Identification in Quadrat Sampling Data in 2011.

Level of Identification	Total Cover	Total No. of Records	% Total Cover	% Total Records
Above family	7	9	0.0%	0.4%
ID to family	16	22	0.1%	1.0%
ID to Genus	31.5	24	0.2%	1.1%
Total Partial ID	54.5	55	0.3%	2.4%
Full ID	18,298	2,230	99.7%	97.6%
Totals	18,407	2,340		

Table 24: Wetland Affinity Index for Control and Restoration Cypress Transects

Dependent Variable: WAI

Year	Management	Mean	Standard Error	95% Confidence Interval	
				Lower Bound	Upper Bound
2008	Control	.793	.031	.726	.860
	Restoration	.624	.022	.583	.665
2009	Control	.758	.033	.692	.825
	Restoration	.662	.020	.621	.703
2011	Control	.742	.029	.676	.809
	Restoration	.670	.023	.629	.710

Table 25: Comparison of Wetland Affinity Index between Control and Restoration, and Between Years, for Cypress Transects. WAI was significantly higher in control than the restoration Cypress sites.

Dependent Variable: WAI

Source	Type III Sum of Squares	Degrees of Freedom	Mean Square	F	Significance
Corrected Model	.097	5	.019	6.121	.001
Intercept	13.129	1	13.129	4140.430	.000
Mgmt. Regime	.000	2	.000	.011	.989
Year	.083	1	.083	26.290	.000
Mgmt. Regime * Year	.011	2	.006	1.741	.194
Error	.086	27	.003		
Total	15.553	33			
Corrected Total	.183	32			

Table 26: Wetland Affinity Index for Control and Restoration Pineland Transects

Dependent Variable: WAI

Year	Management	Mean	Standard Error	95% Confidence Interval	
				Lower Bound	Upper Bound
2008	Control	.642	.071	.490	.794
	Restoration	.553	.045	.457	.649
2009	Control	.624	.071	.473	.776
	Restoration	.610	.045	.514	.706
2011	Control	.536	.071	.385	.688
	Restoration	.649	.045	.553	.745

Table 27: Comparison of Wetland Affinity Index between Control and Restoration, and between Years, for Pineland Transects. No significant effect of management regime was found

Dependent Variable: WAI

Source	Type III Sum of Squares	Degrees of Freedom	Mean Square	F	Significance
Corrected Model	.036	5	.007	.708	.626
Intercept	6.224	1	6.224	613.419	.000
Mgmt. Regime	.000	1	.000	.004	.952
Year	.002	2	.001	.097	.908
Mgmt. Regime * Year	.030	2	.015	1.456	.264
Error	.152	15	.010		
Total	7.828	21			
Corrected Total	.188	20			

Table 28: Wetland Affinity Index for Control and Restoration Wet Prairie Transects

Dependent Variable: WAI

Year	Management	Mean	Standard Error	95% Confidence Interval	
				Lower Bound	Upper Bound
2008	Control	.778	.031	.714	.841
	Restoration	.658	.020	.617	.699
2009	Control	.783	.031	.720	.846
	Restoration	.650	.020	.608	.691
2011	Control	.788	.031	.725	.851
	Restoration	.667	.020	.625	.708

Table 29: Comparison of Wetland Affinity Index between Control and Restoration, and between Years, for Wet Prairie Transects. A significant effect of management regime was observed with greater WAI in control transects. There was an increase in WAI with time in restoration transects but the change was non-significant.

Dependent Variable: WAI

Source	Type III Sum of Squares	Degrees of Freedom	Mean Square	F	Significance
Corrected Model	.099	5	.020	7.057	.000
Intercept	13.082	1	13.082	4652.806	.000
Mgmt. Regime	.098	1	.098	34.857	.000
Year	.001	2	.000	.111	.895
Mgmt. Regime * Year	.000	2	.000	.041	.960
Error	.067	24	.003		
Total	14.680	30			
Corrected Total	.167	29			

Figures

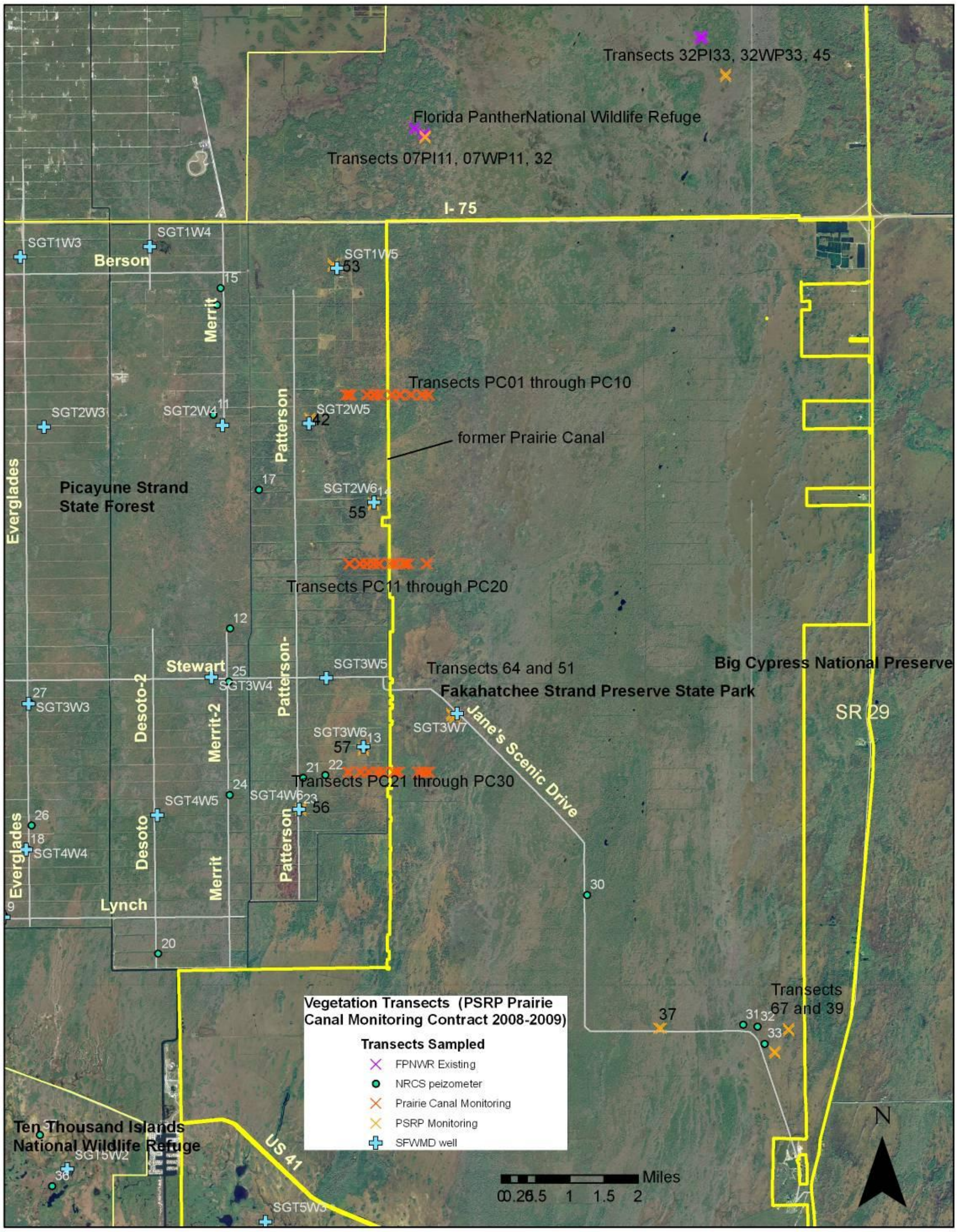

Figure 1. Picayune Strand State Forest Vegetation Monitoring Study Area

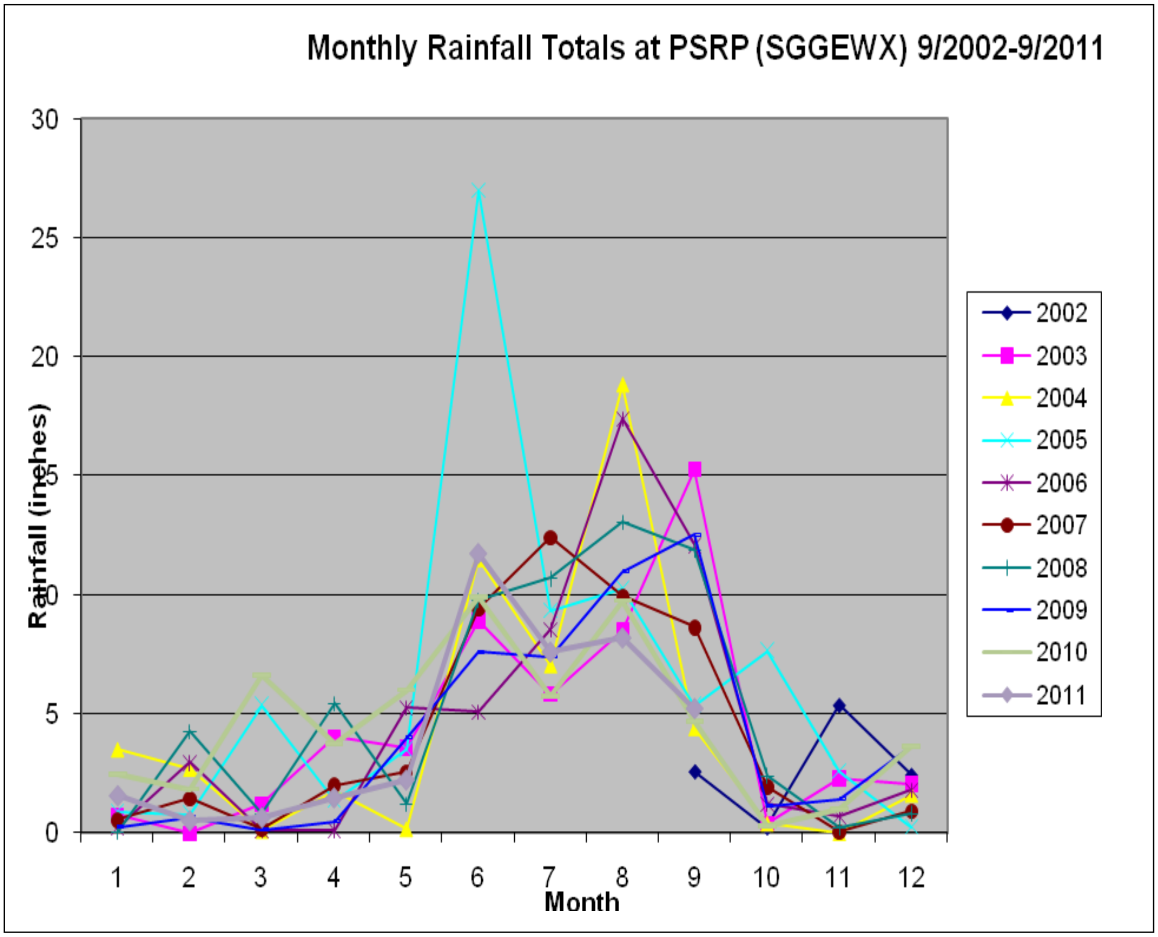

Figure 2. Monthly Rainfall Totals at PSRP (SGGEWX) 2002-2011

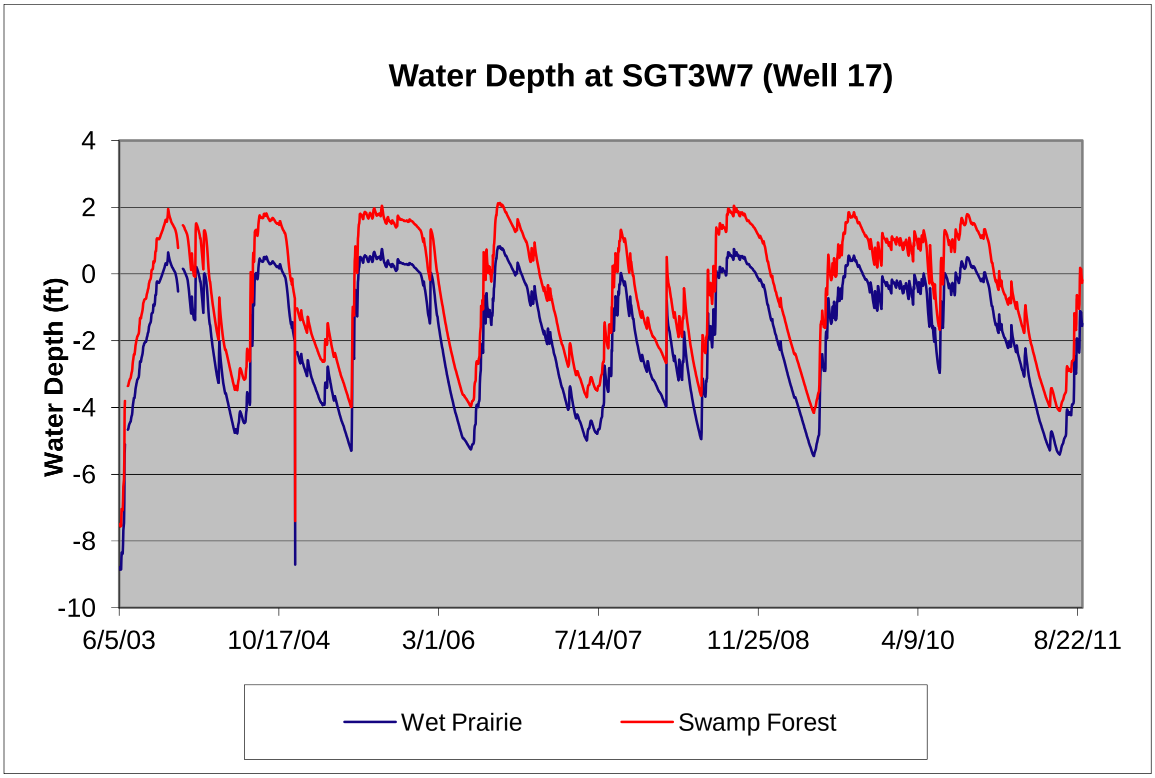

Figure 3. Water Depth at SGT3W7 (Well 17)

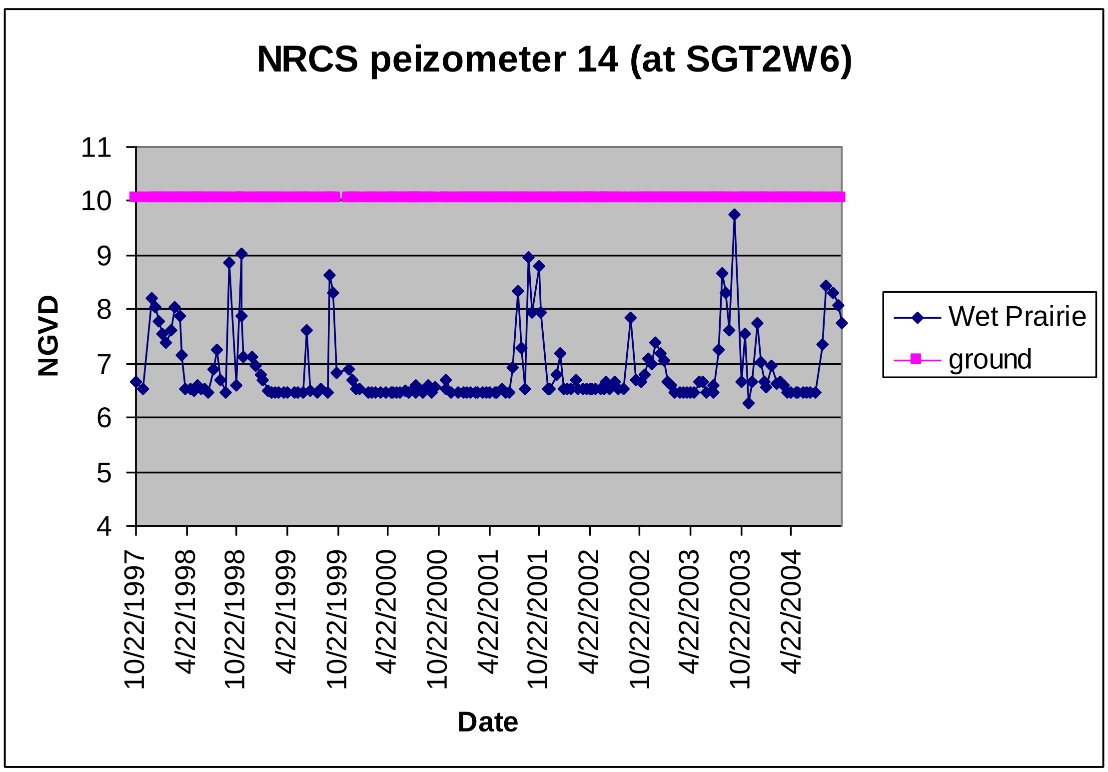

Figure 4. NRCS Piezometer 14 (at SGT2W6)

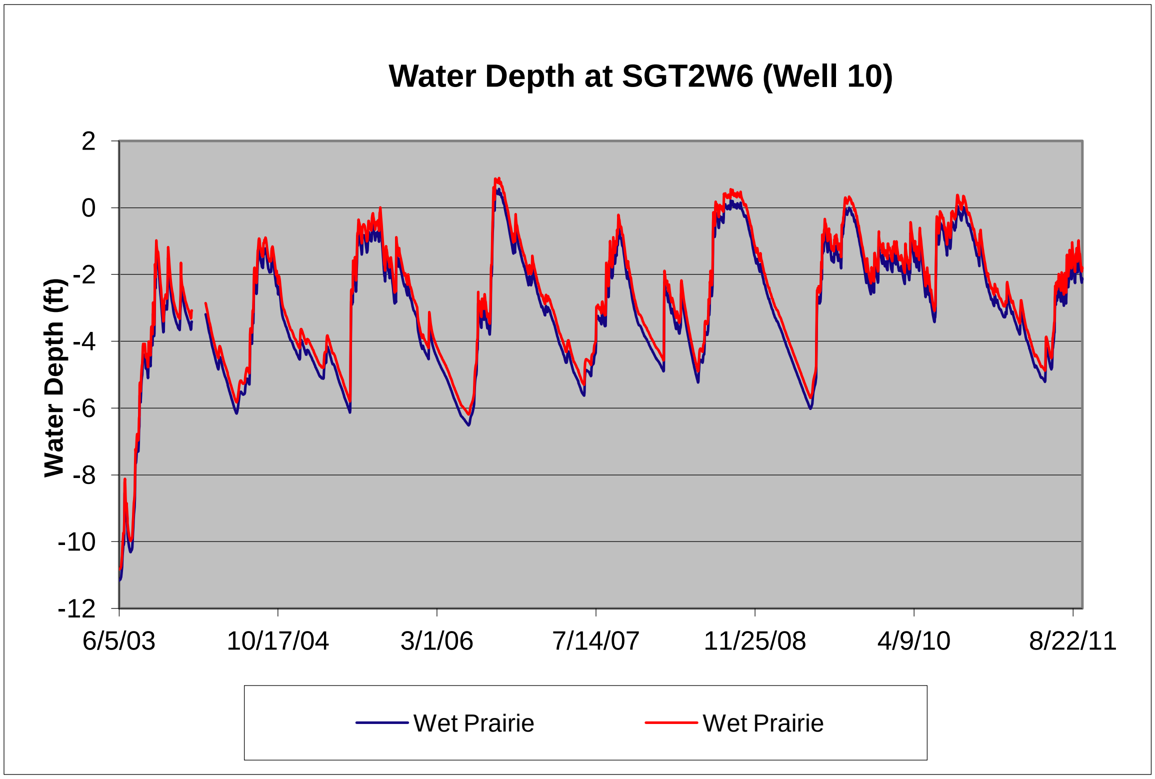

Figure 5. Water Depth at SGT2W6 (Well 11)

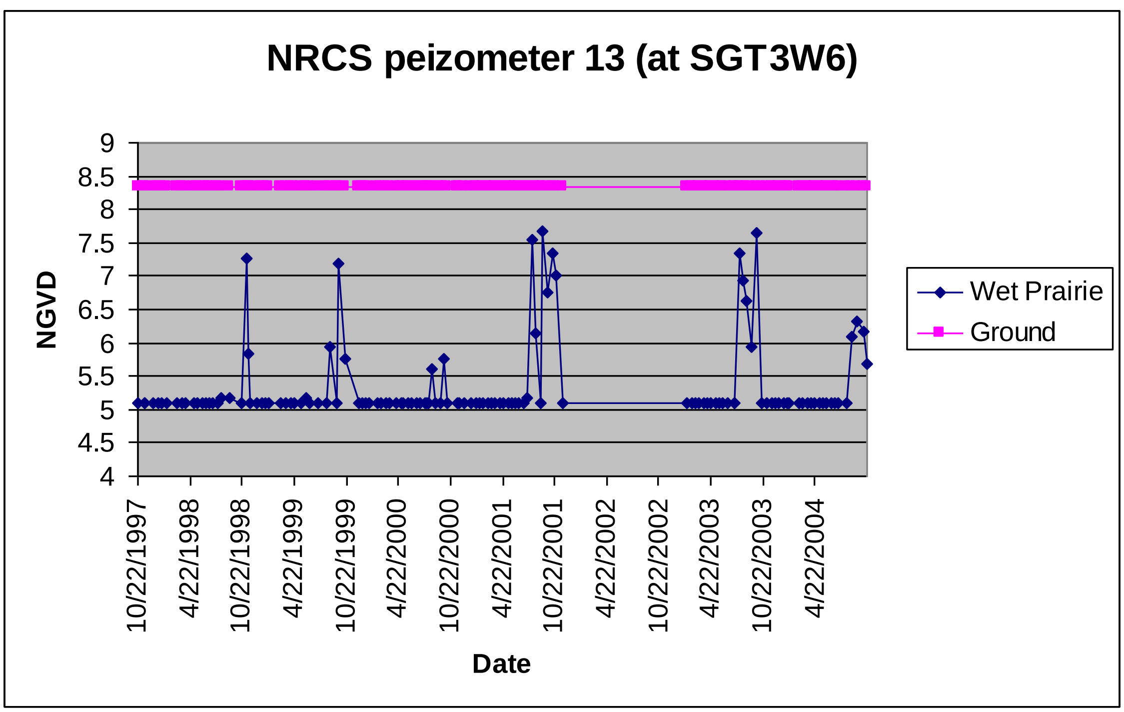

Figure 6. NRCS Piezometer 13 (at SGT3W6)

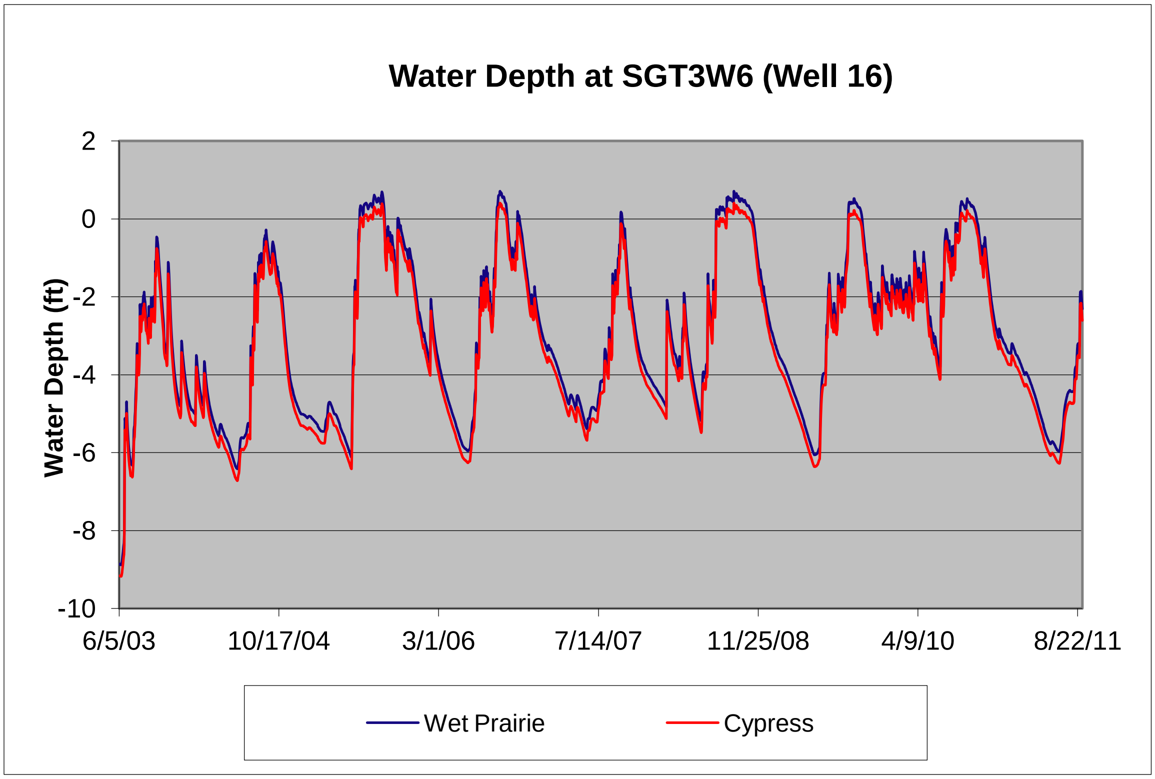

Figure 7. *Water Depth at SGT3W6 (Well 23)*

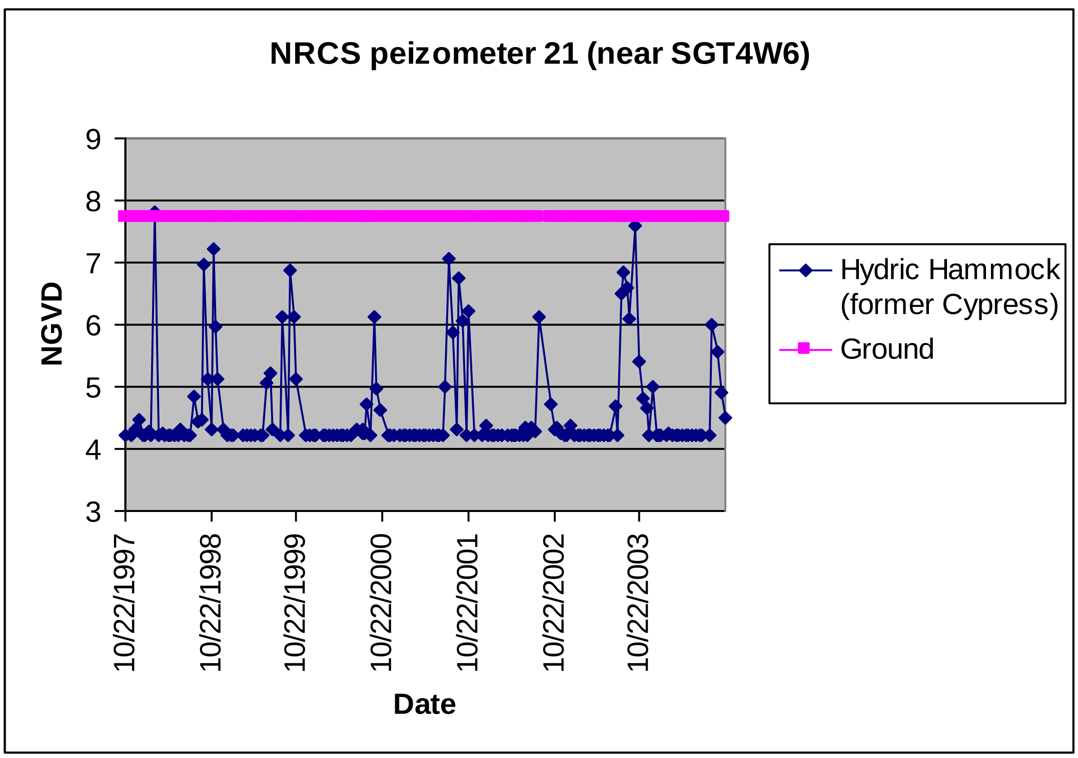

Figure 8. *NRCS Piezometer 21 (near SGT4W6)*

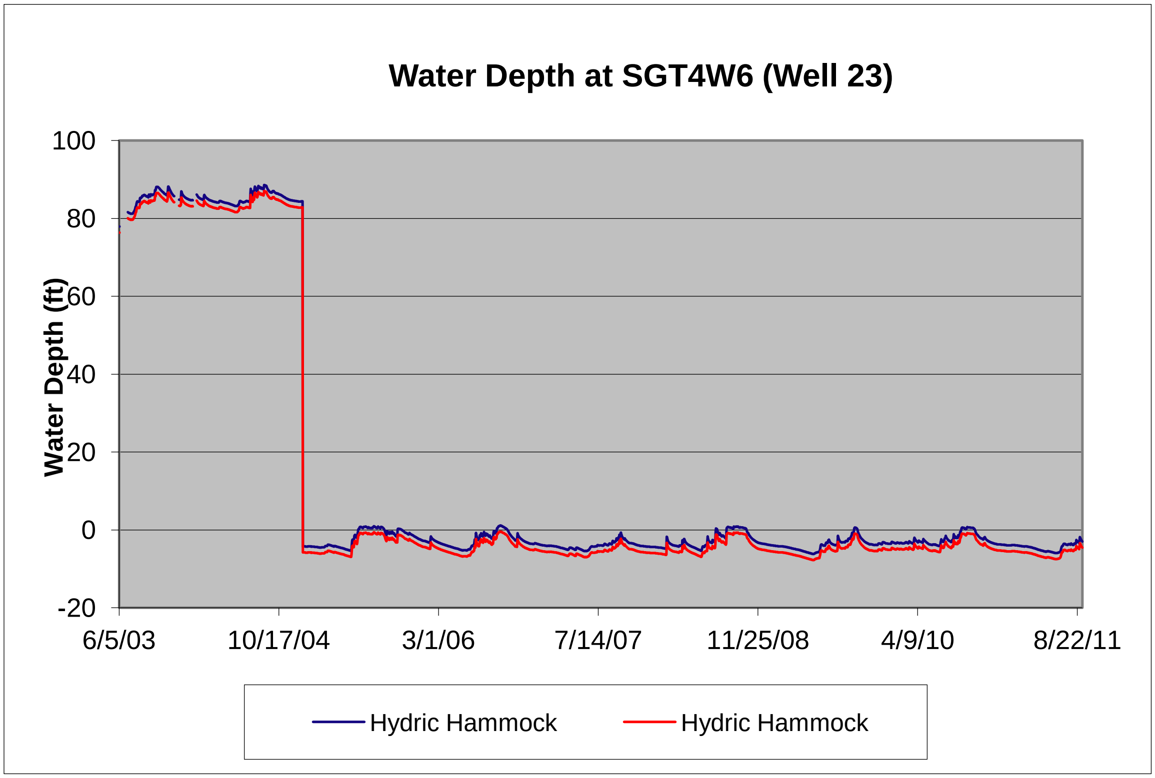

Figure 9. Water Depth at SGT4W6

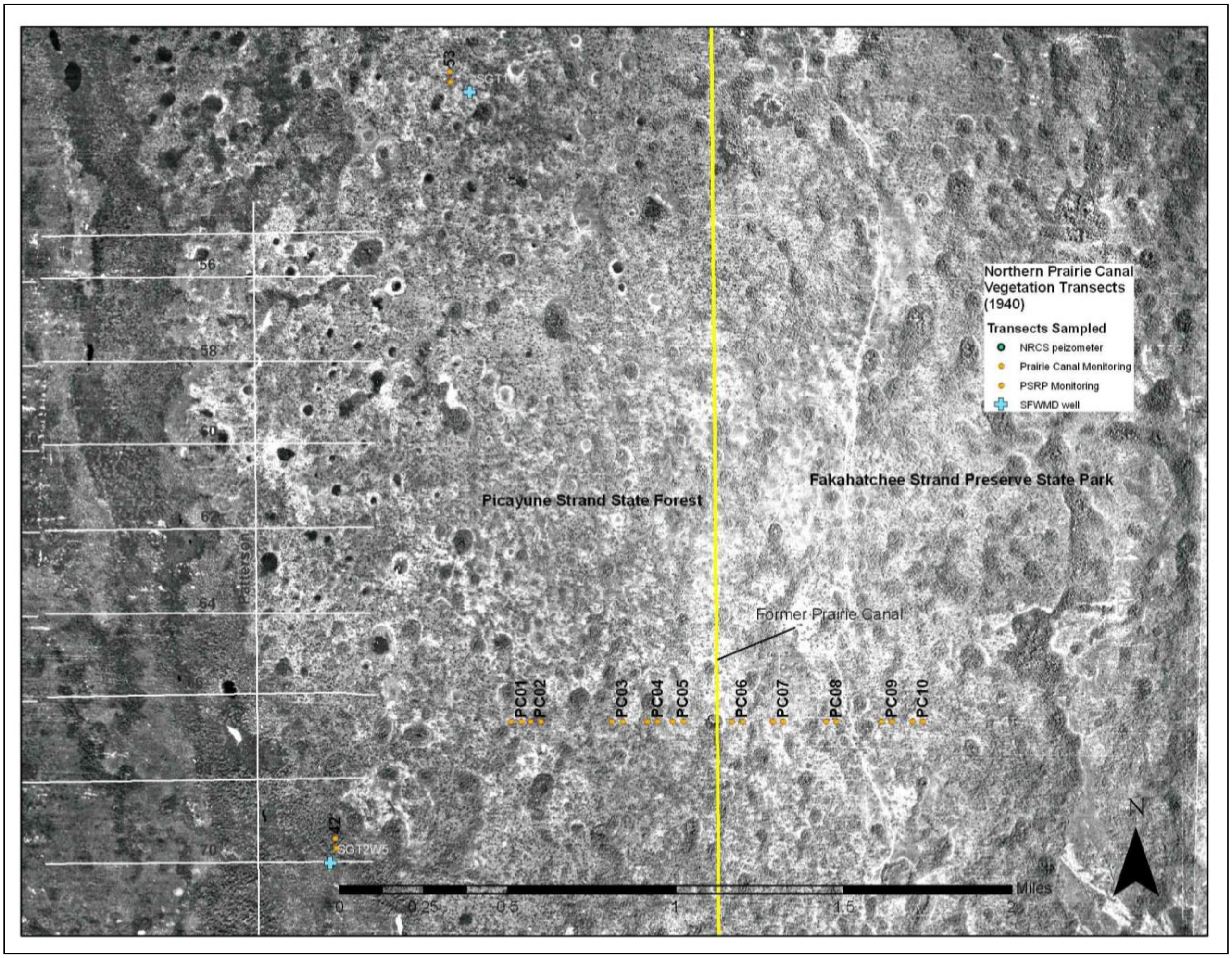

Figure 10. Northern Prairie Canal Vegetation Transects (1940)

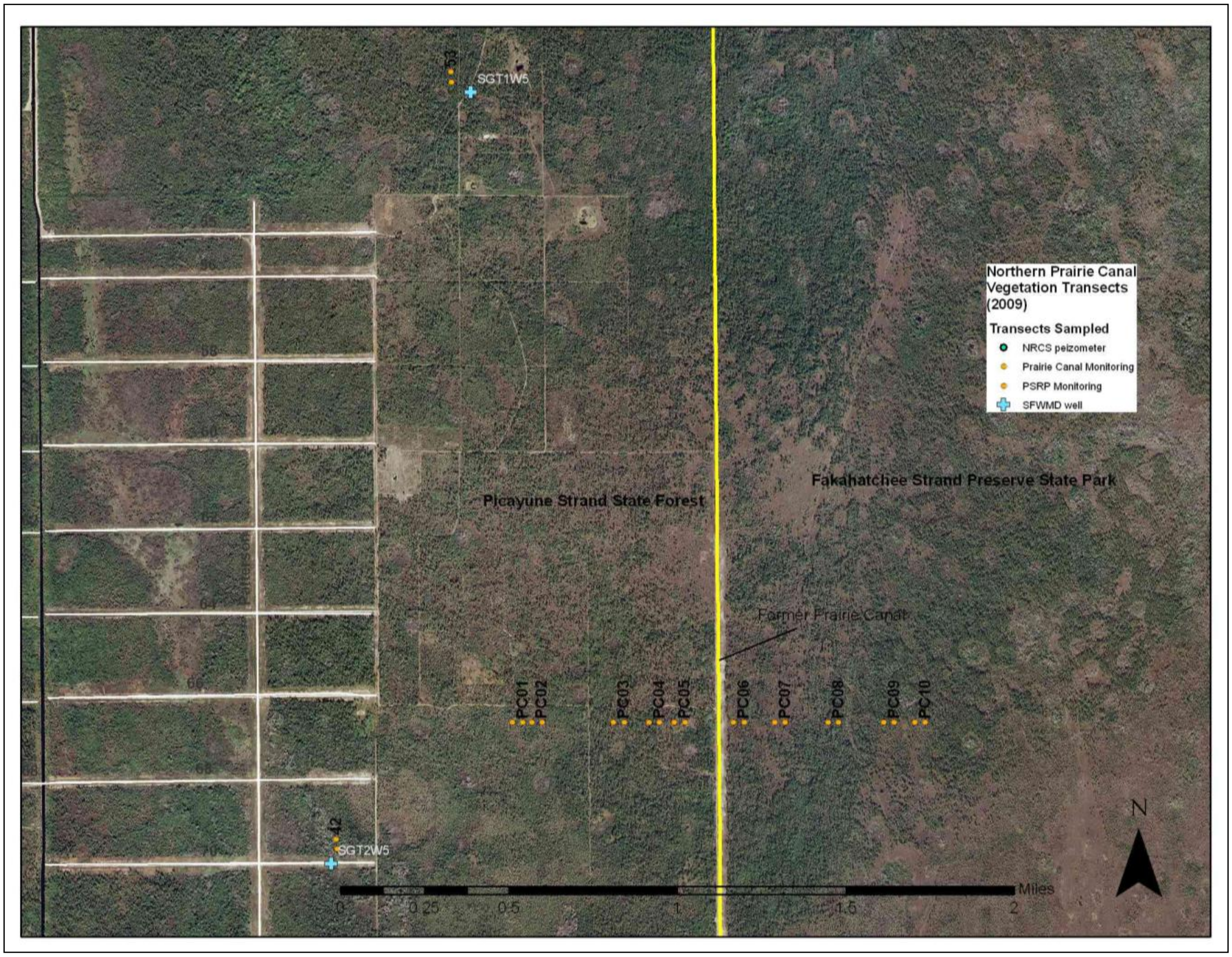

Figure 11. Northern Prairie Canal Vegetation Transects (2009)

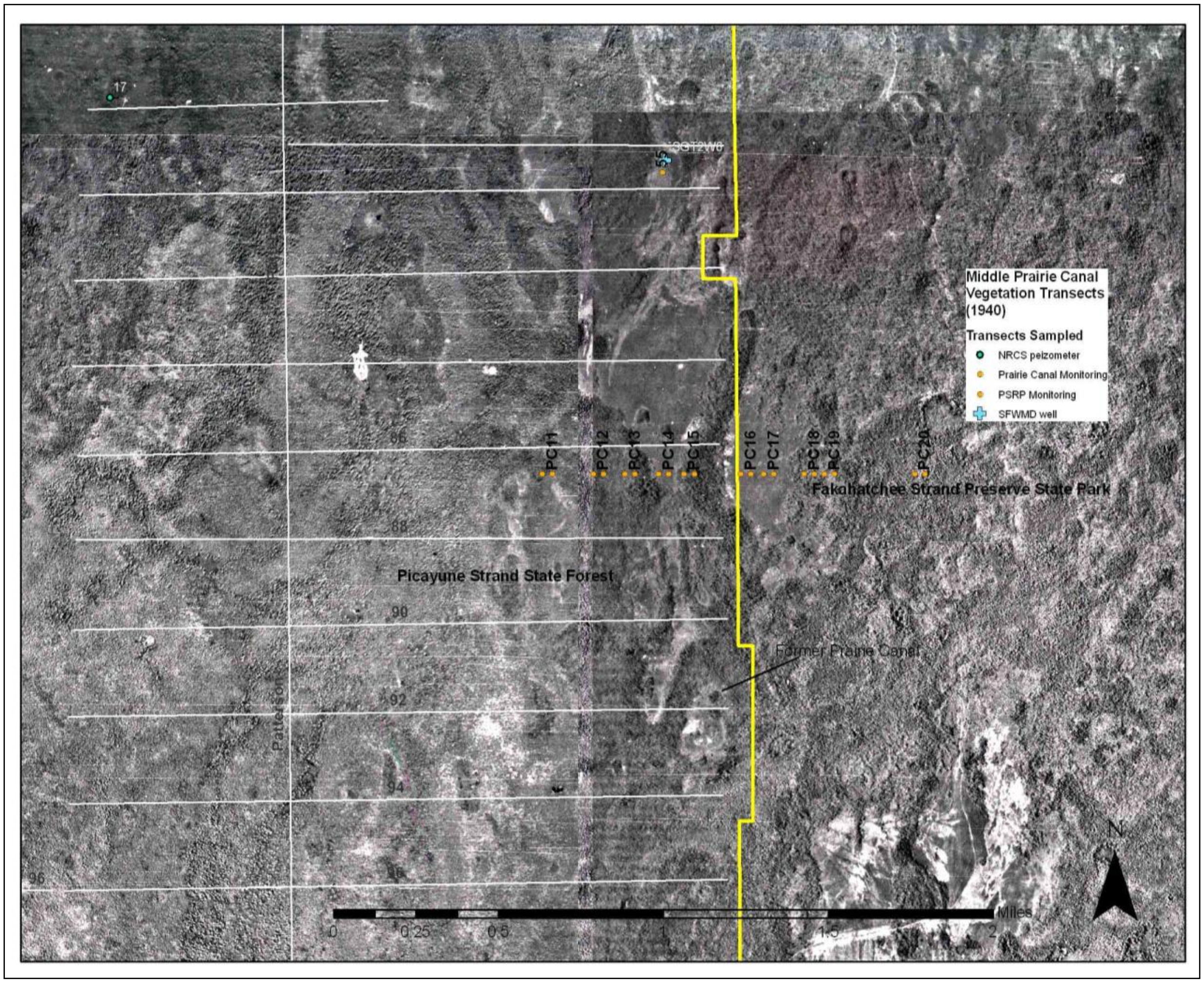

Figure 12. Middle Prairie Canal Vegetation Transects (1940)

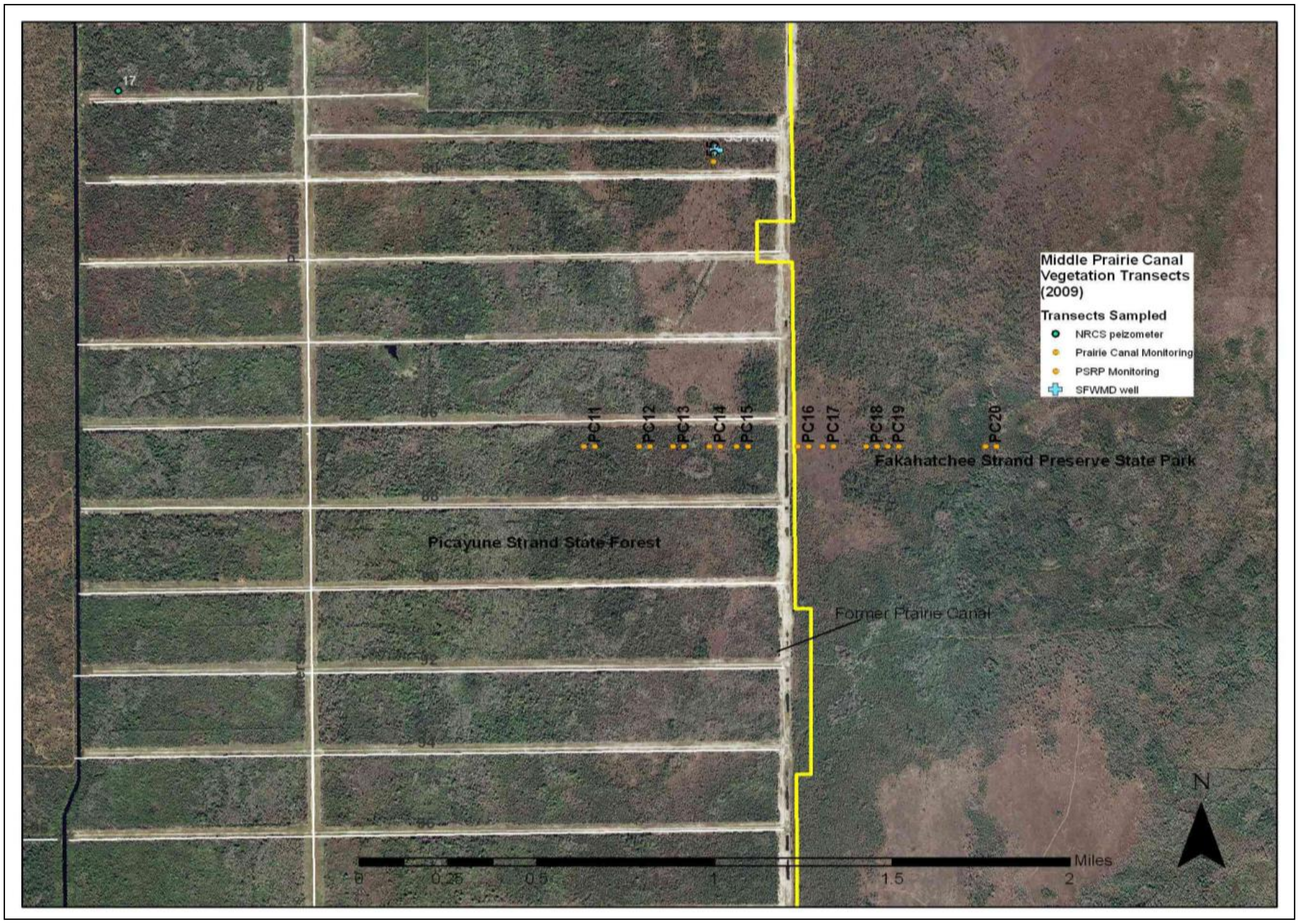

Figure 13. Middle Prairie Canal Vegetation Transects (2009)

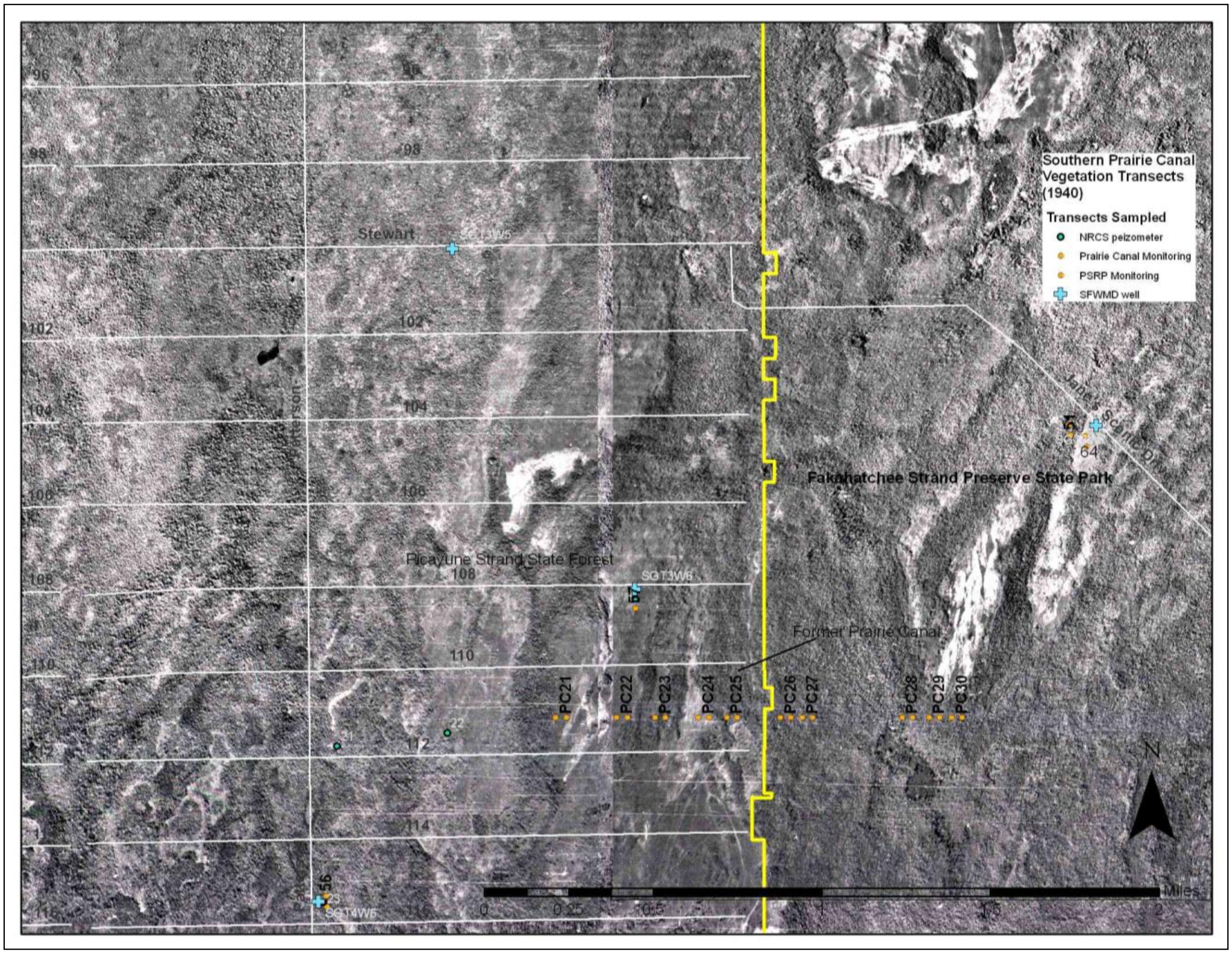

Figure 14. Southern Prairie Canal Vegetation Transects (1940)

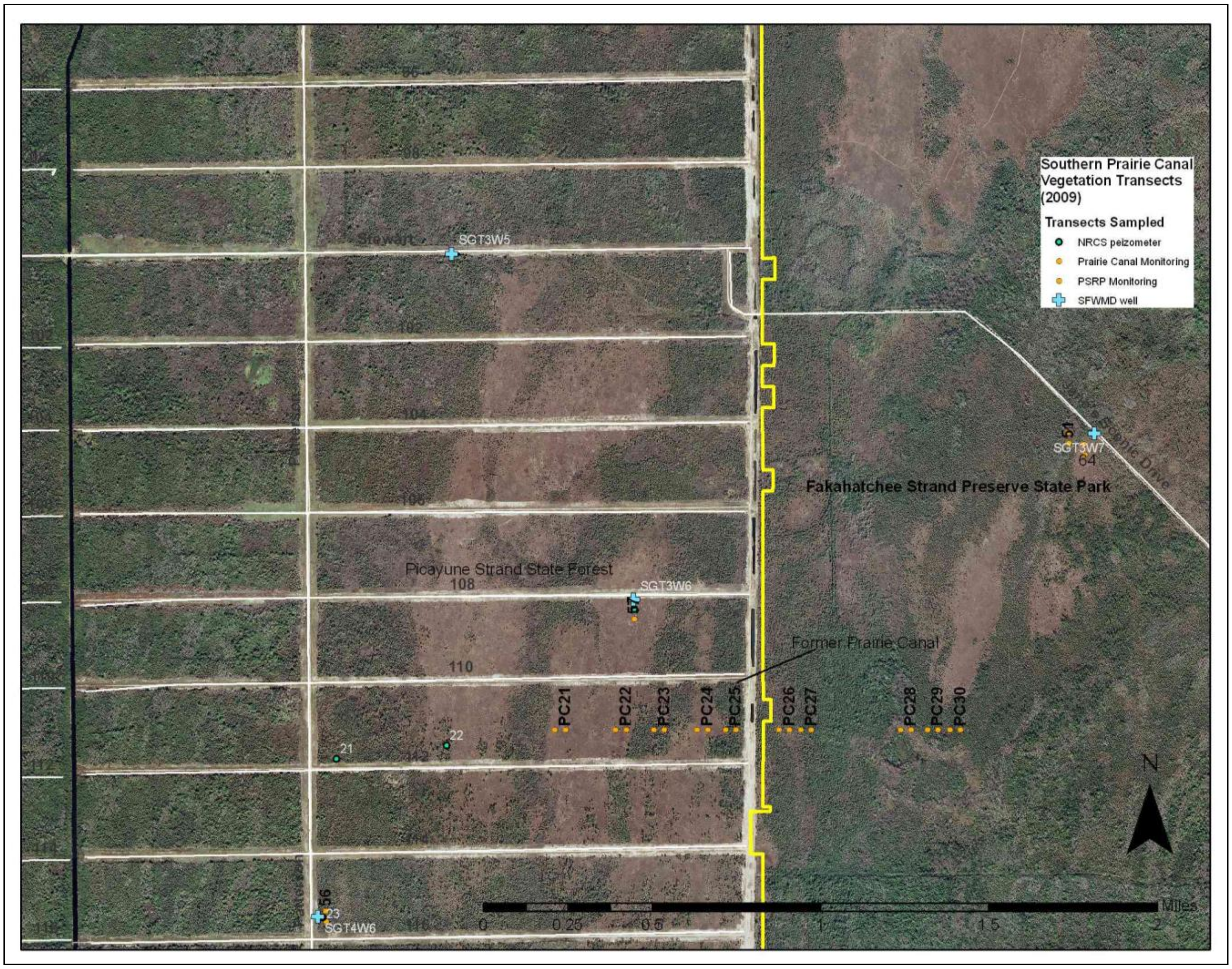

Figure 15. Northern Prairie Canal Vegetation Transects (2009)

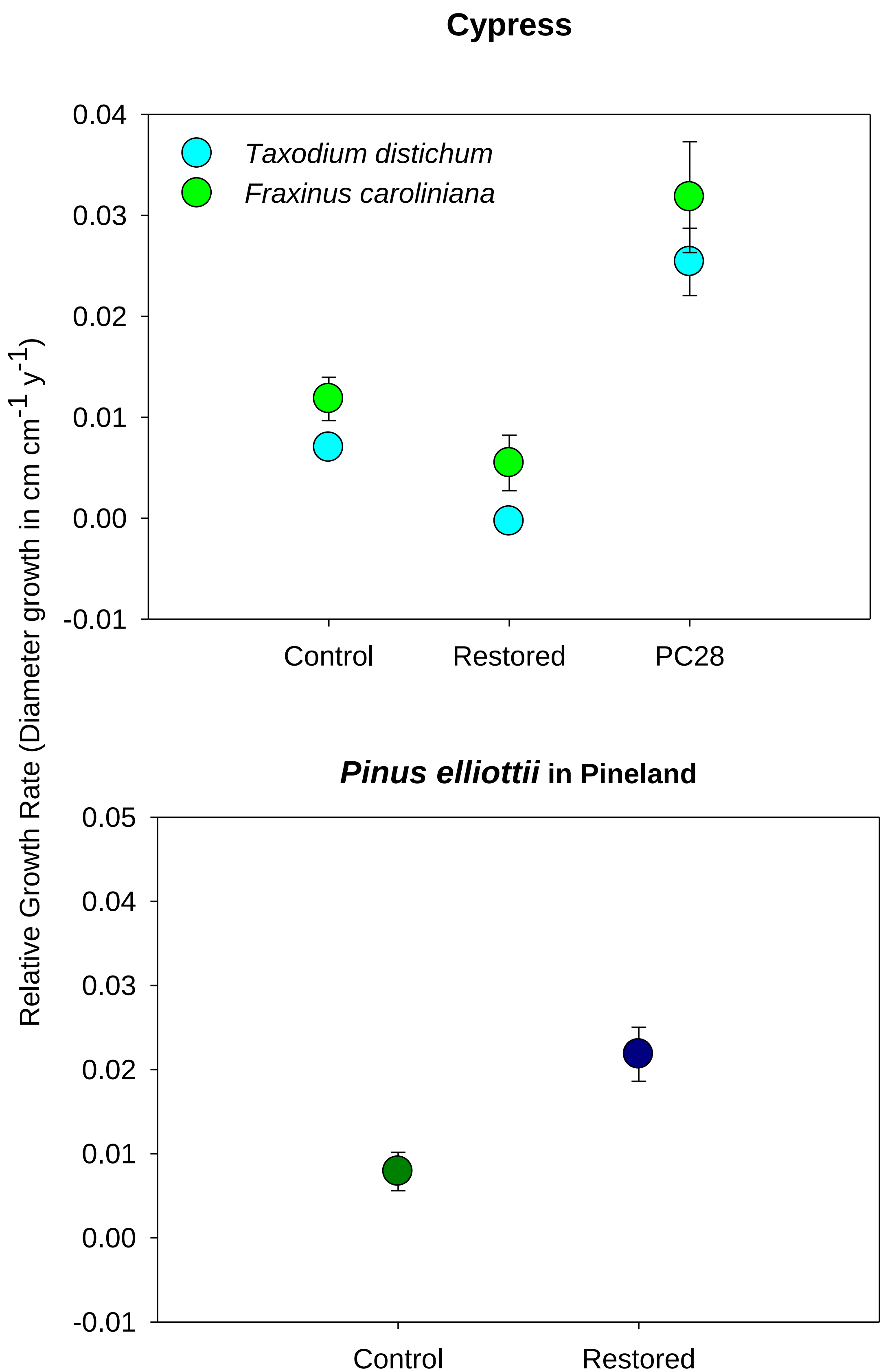

Figure 16. Relative Growth Rates of Slash Pine, Cypress, and Pop Ash

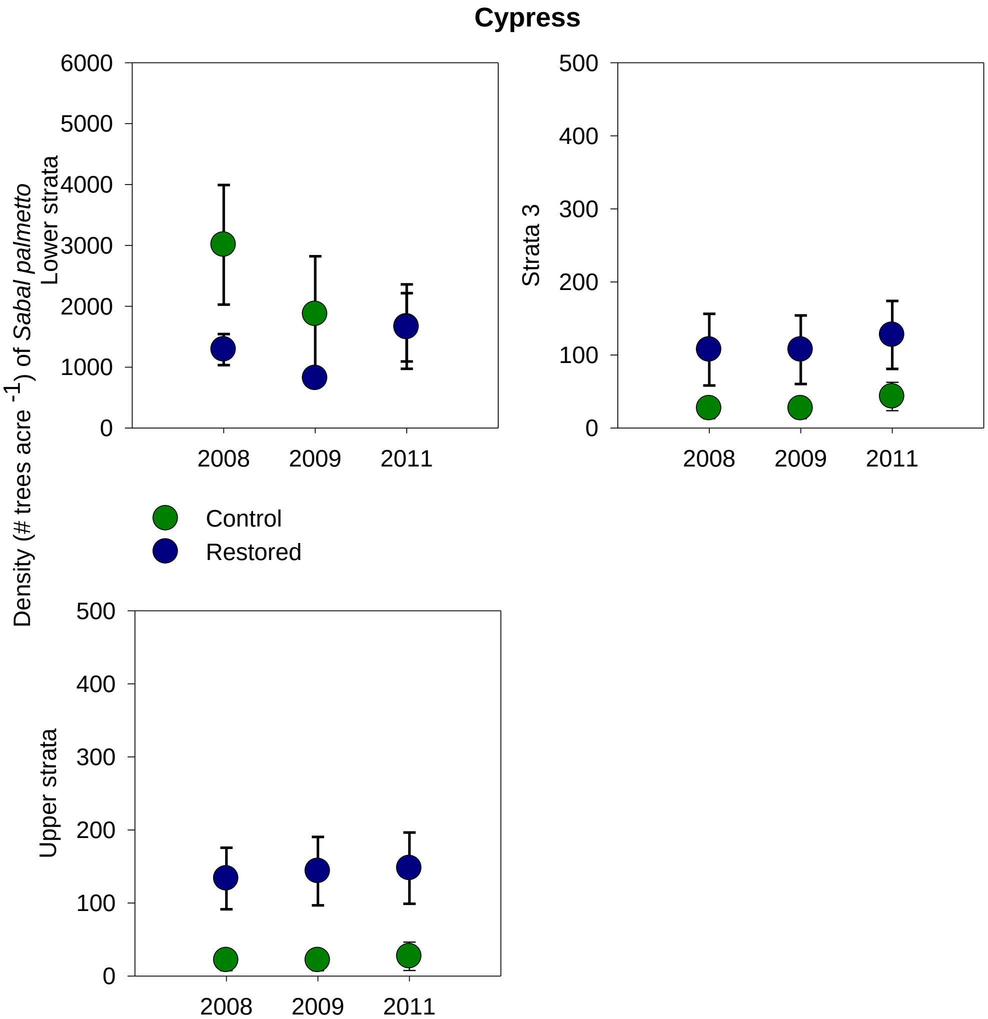

Figure 17. Cabbage Palm Density in Cypress Transects

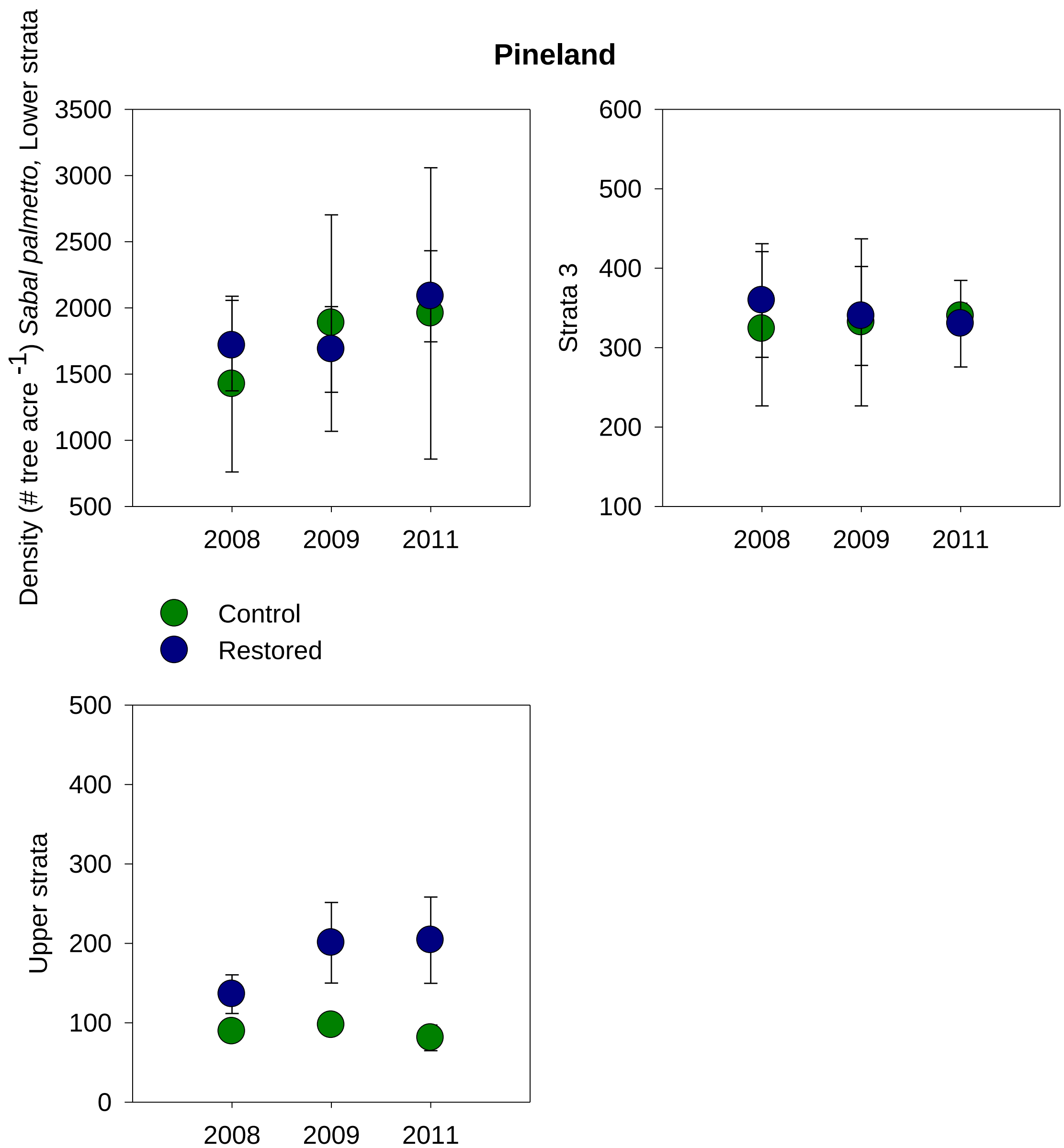

Figure 18. Cabbage Palm Density in Pineland Transects

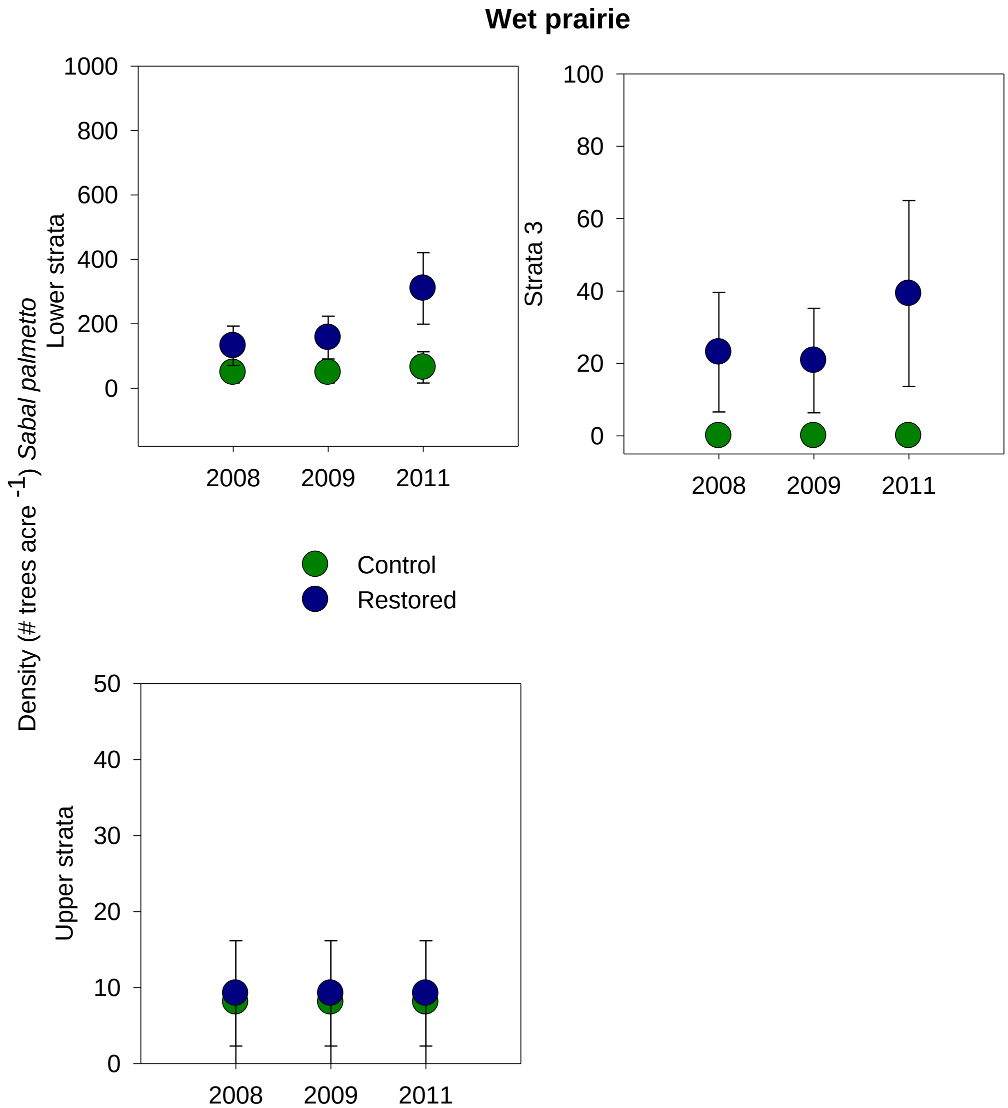

Figure 19. Cabbage Palm Density in Wet Prairie Transects

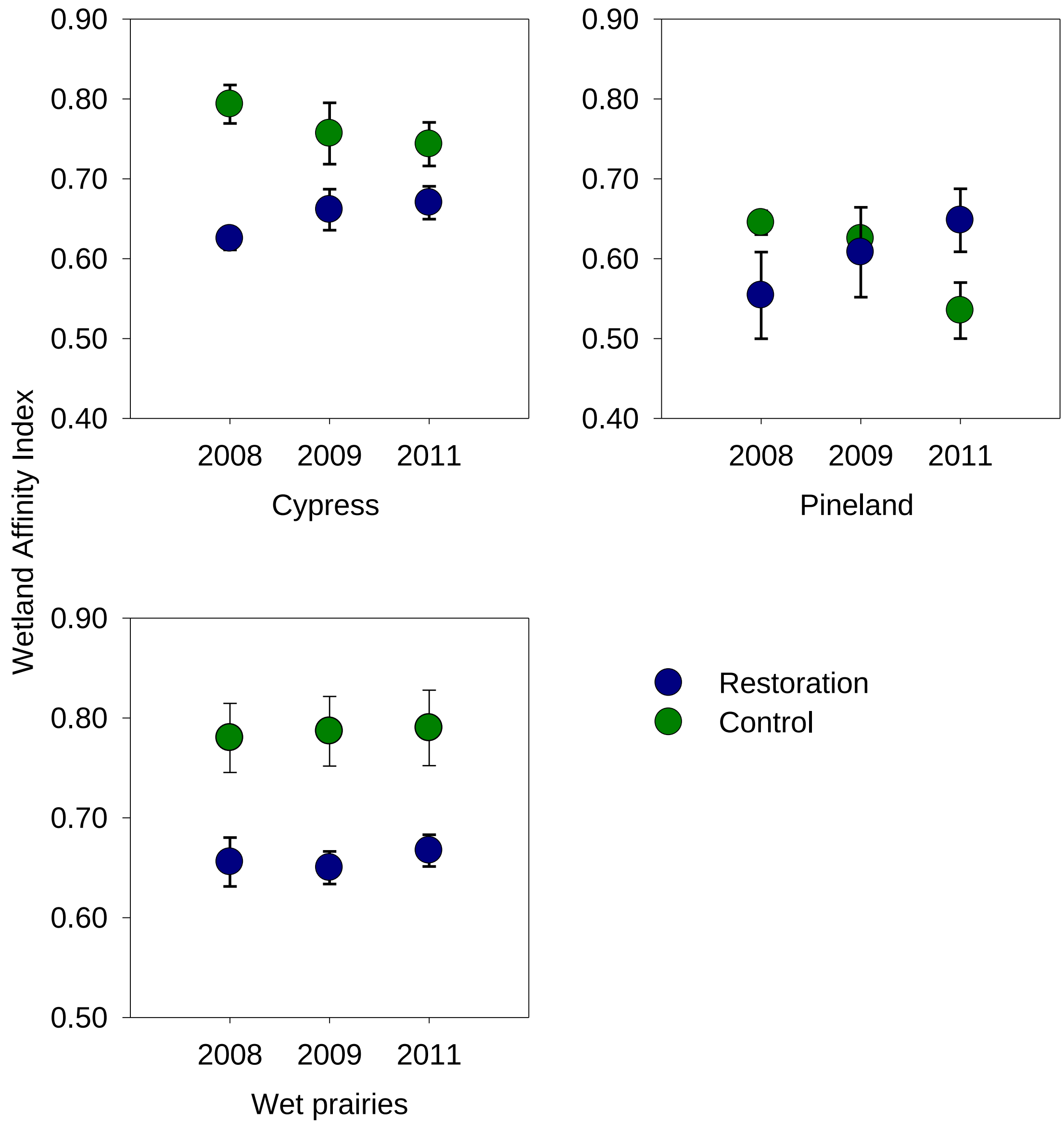

Figure 20. Wetland Affinity Index by Habitat Group

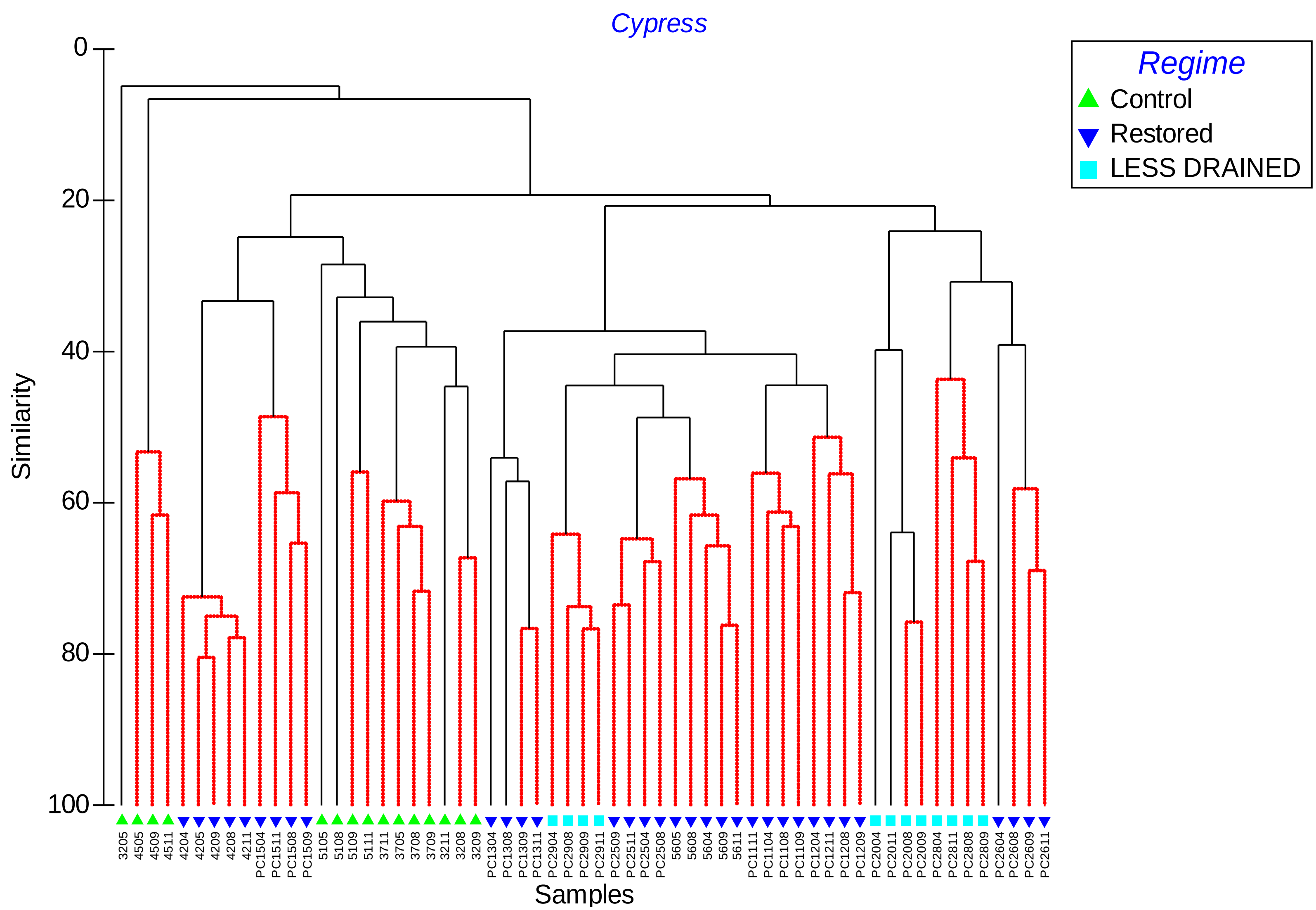

Figure 21. Cluster Diagram of Cypress Transects, by Sampling Event and Management Regime. Significant groups are identified by black lines. Groups in red are not significantly different from the SIMPROF random permutation test.

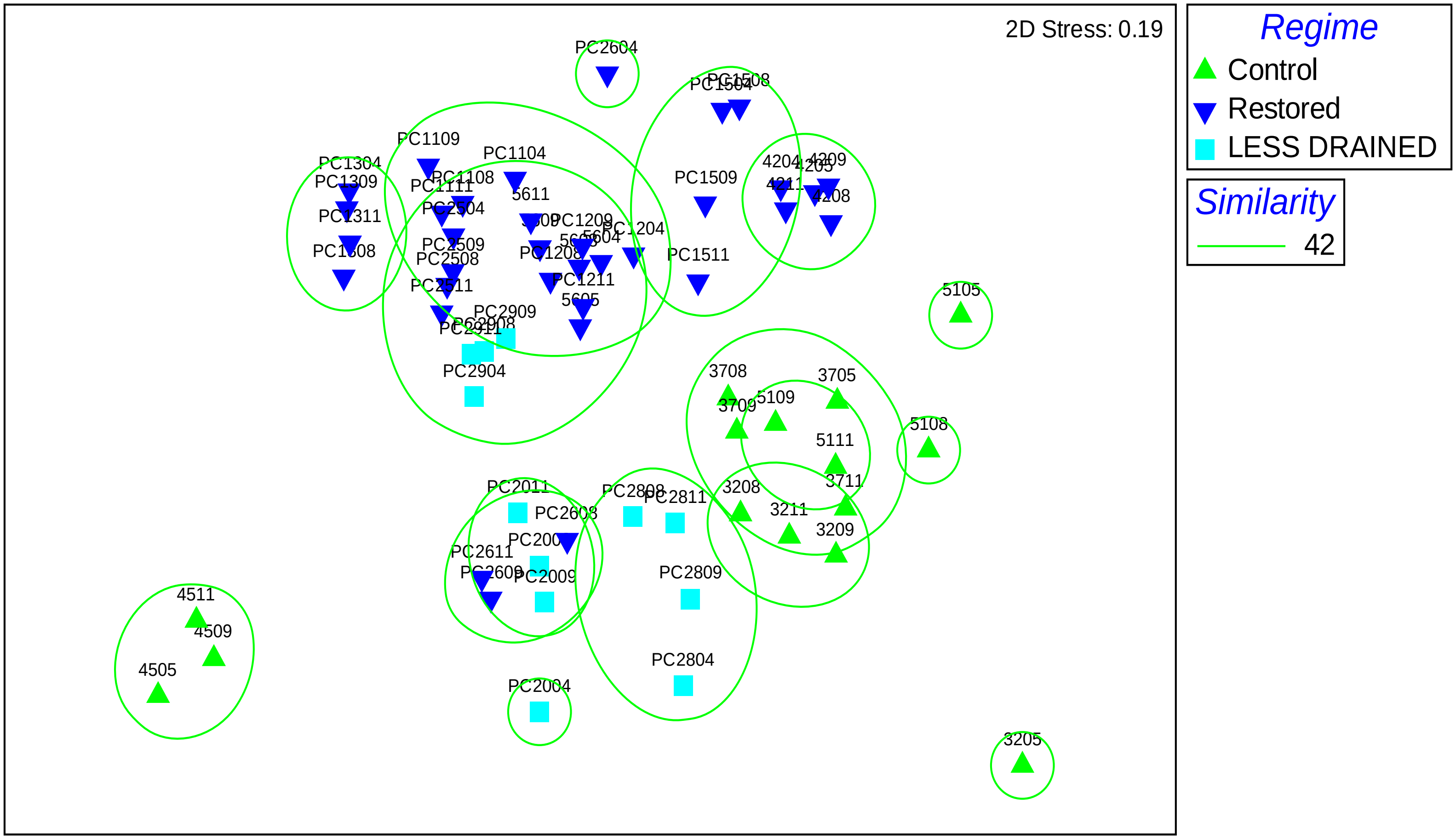

Figure 22. MDS of Cypress Sites, by Sampling Event and Management Regime with Bubble Overlay of Major Groups at 42% Similarity from the Cluster Analysis and SIMPROF Test.

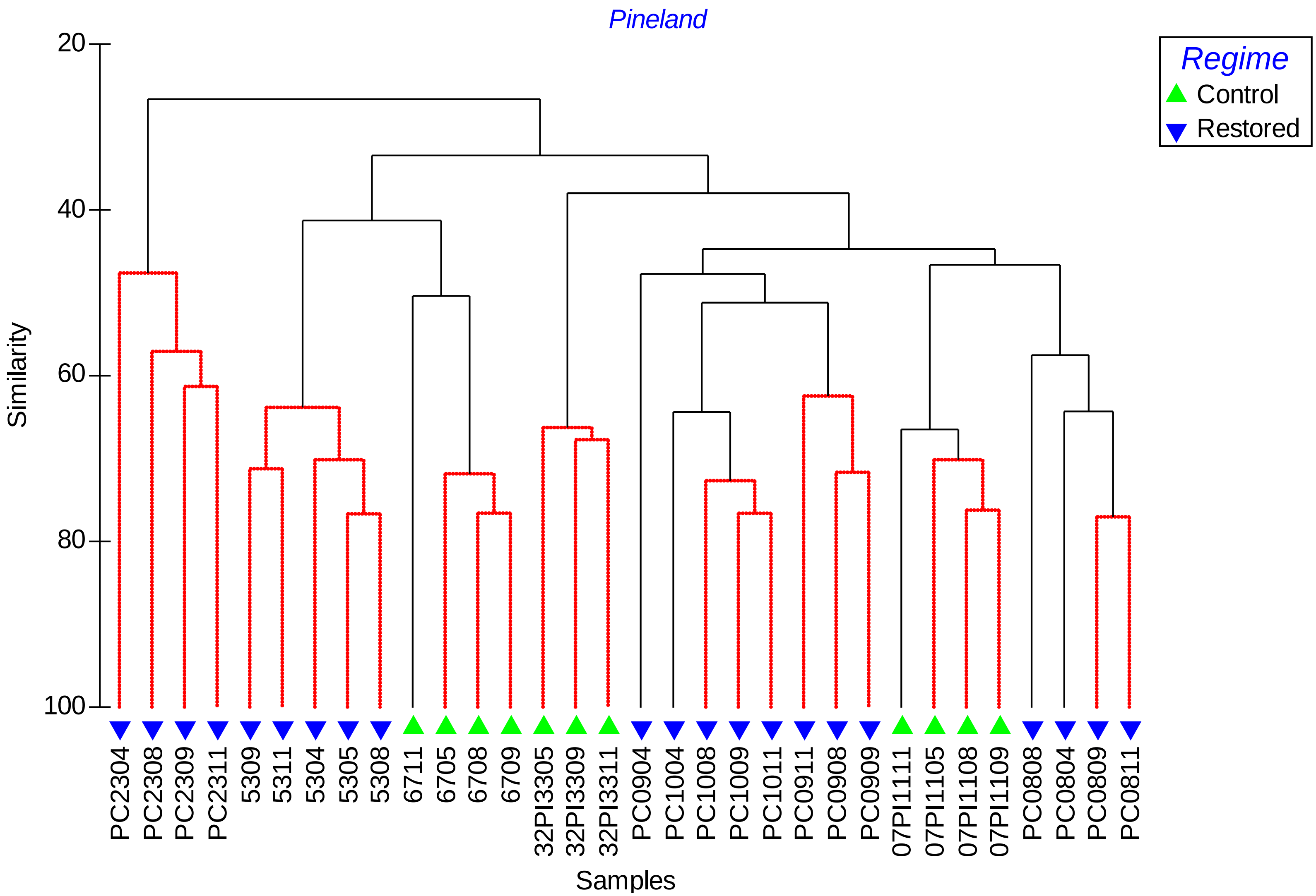

Figure 23. Cluster Diagram of Pineland Transects, by Sampling Event and Management Regime. Significant groups are identified by black lines. Groups in red are not significantly different from the SIMPROF random permutation test.

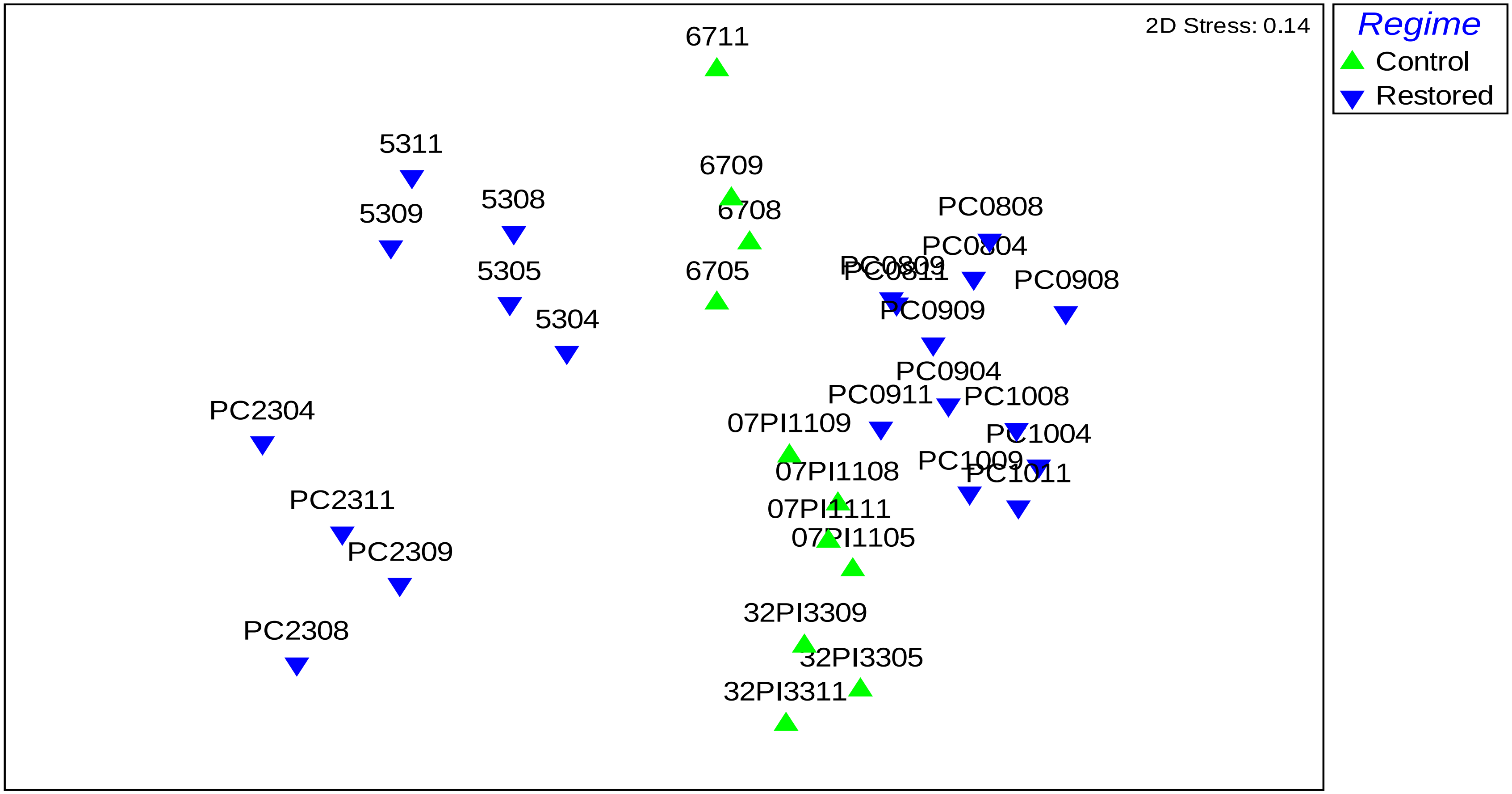

Figure 24. MDS of Pineland Sites, by Sampling Event and Management Regime.

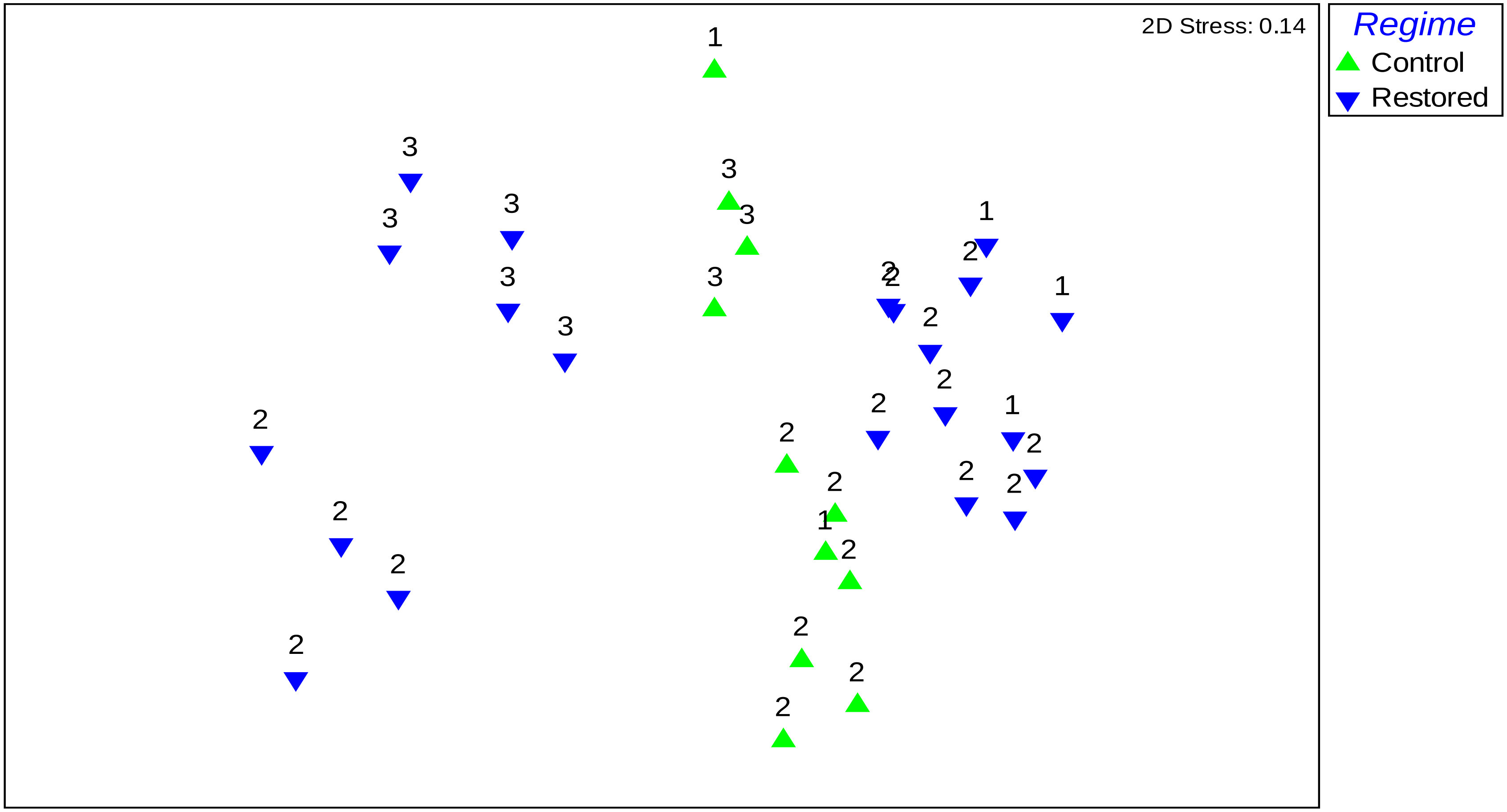

Figure 25. MDS of Pineland Sites, by Time since Fire and Management Regime. Influence of fire frequency is clearly evident in influencing ordination position of both control and restored sites. (1= <1 year, 2= 1-7 years, 3= >7 years).

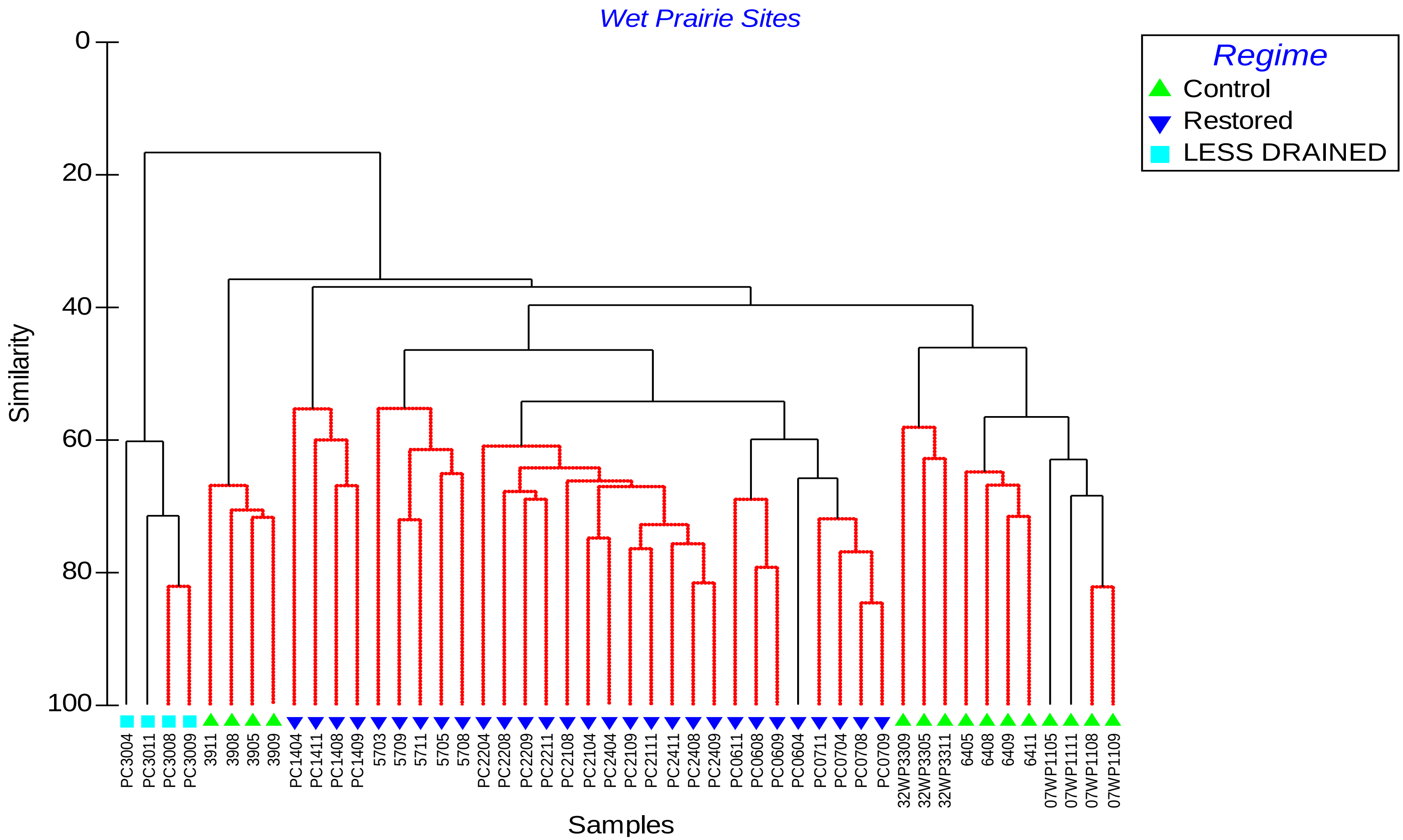

Figure 26. Cluster Diagram of Wet Prairie Transects, Sampling Event, and Management Regime. Significant groups are identified by black lines. Groups in are red not significantly different from the SIMPROF random permutation test.

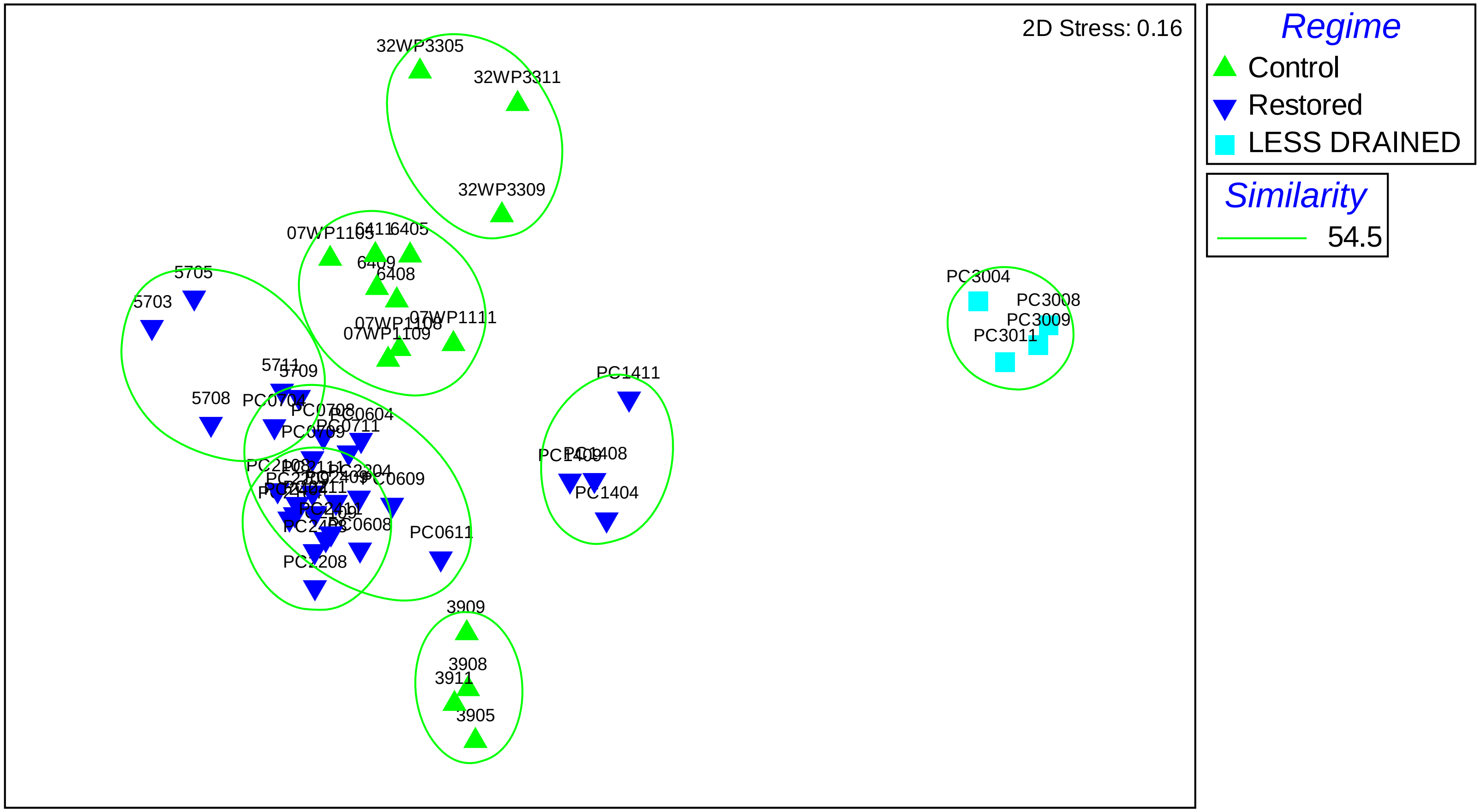

Figure 27. MDS of Wet Prairie Sites, by Sampling Event and Management Regime, with Bubble Overlay of Major Groups at 54.5% Similarity from the Cluster Analysis and SIMPROF Test.

Appendices

Appendix 1
Picayune Vegetation Monitoring Methods
Field Measurement Guide

Appendix 1:
Picayune Vegetation Monitoring Methods
Field Measurement Guide
Revised September 7, 2011

Equipment:
50-meter tape; 2.5-meter stick; flagging tape; compass; 0.5 m^2 quadrat; camera; hand lens; tree tags; hammer and nails; DBH tape (in cm); pen/pencil; clipboard; previous year data sheet; field notebook; GPS; field safety equipment, including water

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Set-up:

Avoid stepping on quadrat locations. Locate transect ends. Set tape alignment on transect. N. or E. = start, unless noted otherwise. Follow previous line (not necessarily straight) with guidance from flagging on vegetation and field notes from previous years. Flagging tape <u>knot</u> = transect tape location. Refresh flagging on ends, and within transect as needed.

Photos:

Consult field notebook identifying transect, date, time, researchers. First Photo - Start of transect: from ~2 meter away, take photo of end-post and tape showing 1st quadrat. Vertical photo preferred. Photos 2+ additional photos as needed (e.g., treetops to show live specimens vs. snags); if view of whole transect is obstructed, take general photo facing away from transect end. Final Photo - end of transect & final quad

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Belt Transect 1:

Avoid stepping on quadrat locations - Using 2.5 m pole as guide for belt boundary, walk along each side of tape to record canopy and sub-canopy. Stems are "in" belt, if >50% of the trunk base is within belt boundary. Record data on data sheet with previous year information.

<u>Canopy (≥10 cm dbh): measure DBH -</u> trees are numbered and tagged; measure just above nail; make sure dbh tape is level; check notes about vines or obstructions; tag any trees that have grown to be ≥10 cm dbh

<u>Sub-canopy (dbh 2.5 – 10 cm): count no. of stems for each species -</u> "sub-canopy" = woody plants that could become trees(e.g., bay, dahoon holly, sapling pine, sapling cypress, etc.); exclude shrub species: (e.g., Brazilian-pepper, willow, saltbush, wax myrtle, palmetto, dogwood, myrsine); see notes below.

<u>Count Sabal Palm Trees in Strata 1 and 2</u> - apical meristem >8ft; Strata 1.5 - old growth (bootless, no leaf scars, adventitious roots); Strata 2 - apical meristem 4.5 – 8 ft;

Belt Transect 2:

Avoid stepping on quadrat locations
<u>Count Sabal Palm in each of strata 3 through 5</u>
Strata 3 - trunk above ground to 4.5 ft tall

Strata 4- palmate leaves; no trunk
Strata 4 – simple; 4 or more simple leaves
Strata 5 - ≤ 3 leaves (including old leaf stems); largest leaf ≤ 3 folds

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Quadrats Numbers 0 – 5.

Short side of quadrat placed along tape at 0-0.5 m, 10-10.5, 20-20.5, 30-30.5, 40-40.5, 50-50.5 meters on north or west side of tape (unless noted otherwise); when standing at 0 m, facing transect, quadrat is always located to the RIGHT of transect line. Record data in field notebook.

Identify all species within quadrat. Record 8-letter species code. For herbaceous groundcover spp., exclude plants, if stem is outside of quadrat.
Include vines & epiphytes
Include trees <2.5 cm dbh
Include shrubs (see notes below) overhanging quadrat
Include Sabal Palm strata 3–5

Record "cover class" for each species.
0.5 (0-1%), 37.5 (25-50%), 3 (1-5%), 62.5 (50-75%), 15 (5-25%), 85 (75-95%), 97.5 (95-100%).

Record notes:
SE=seedling, SA=sapling, ?=unsure, FL=flowering, FR=fruit, B=deer-browsed. For palms, record number of seedlings in quadrat. Label unknown species "P_[family or genus]" + description

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Line Intercept:

Avoid stepping on quadrat locations
Record % cover of shrubs, young trees, and Sabal Palm strata 3–5 that are directly over transect tape. Use 0.1 meter increments. Record all data in field notebook.
Include all woody plants <2.5 cm dbh
Include all "shrub" species regardless of dbh. (See notes below)
Include seedlings & saplings of woody plants
Include Sabal palm strata 3–5 (lumped together)
Exclude perennial forbs, suffructescent (e.g., *Hypericum*, *Stillingia*, *Lythrum*…)

Follow-up: scan/photo data for back-up

SHRUB NOTES:

"Shrubs" = multi-stem woody species; stem numbers and % cover varies much year-to-year. (e.g., Brazilian-pepper, dogwood, wax myrtle, saltbush, willow, myrsine, shiny blueberry, *Psychotria* spp., gallberry)

Sereno arepens is always considered to be a shrub.

ERM

Shrubs = plants that could become sub-canopy trees (e.g., bay, dahoon, popash, strangler fig, pond apple, magnolia, oak) when DBH is <2.5cm.

NOT shrubs = perennial, suffructescent forbs (e.g., *Stillingia*, *Hypericum*, *Lythrum*, *Urena*).

ERM

Appendix 2 (a-c)
Belt Transect Data by Transect

Appendix 3 (a-f)
Line Intercept Data by Transect

Appendix 4
Mean Quadrat Percent Cover and Frequency by Transect

Appendix 5 (a-d)
Mean Quadrat Species Richness by Transect and Habitat

Appendix 6 (a-d)
Wetland Affinity Index by Transect