Appendix 7A-2: Picayune Strand Restoration Project Baseline Report

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SUMMARY

The main purpose of this appendix is to report on baseline conditions within and around the Picayune Strand Restoration Project Area, specifically detailed baseline information on hydrology, the Florida panther (*Puma concolor couguar*), inland aquatic fauna, estuarine benthic habitat, oyster reef crabs, nekton, and water quality. A partial baseline report, focusing on data analyzed as of the time of the report was provided in Appendix 7A-2 of the *2008 South Florida Environmental Report (SFER) – Volume I*. Baseline information for water quality, wood storks and wading birds, oyster reef crabs, and nekton will be provided in future SFERs. Also provided in this chapter is an annual status of hydrologic response to Phase 1 road removal and filling of the Prairie Canal that was completed in 2007.

Hydrologic monitoring is accomplished at wells and stations along eight transects: five in Picayune Strand Restoration Project Area, two in Fakahatchee Strand Preserve State Park, and one in the coastal marshes into which these two areas drain. Water depth has been recorded at Fakahatchee Strand wells since 1987 and at Picayune Strand wells since mid- and late 2003. Surface water stage has been recorded at gauges in the estuaries since early 2004. Graphs showing water depth/stage are provided for the period of record for these transects. The figures clearly show the partial restoration of hydrology in the eastern areas of Picayune Strand and western areas of Fakahatchee Strand since the filling of the Prairie Canal and removal of roads in the eastern part of the failed Southern Golden Gates Estates subdivision.

Florida panthers and their prey were monitored within the Picayune Strand Restoration Project Area, Florida Panther National Wildlife Refuge, and Fakahatchee Strand Preserve State Park using remote sensing cameras from July 2005 to March 2007. Mean capture rate and range was determined for both panthers and their major prey – white-tailed deer and feral hog. For panthers, the minimum number of adult males, adult females, dependent-aged kittens and unknown adults captured per month were determined. Also included in the baseline reporting are aerial telemetry data and den locations of radio-collared panthers. Qualitative information on smaller prey is also provided.

Aquatic macroinvertebrates and fish provide a food base for larger birds and mammals within freshwater wetlands, including wood storks and black bears. The kinds of macroinvertebrates and their total abundance and percent composition at each site are important in determining the quality of habitat for these larger animals. Baseline information on the macroinvertebrate taxa, total abundance, and percent composition per site were collected in Picayune Strand and, for reference, in Fakahatchee Strand Preserve State Park and Florida Panther National Wildlife Refuge as well. Fish were also monitored in all three areas. Species found, total abundance, and percent species composition per site was determined for fish.

Benthic habitat, including seagrasses and oyster reefs, was mapped in Faka Union and Fakahatchee Bays. Maps of potential benthic habitat, substrate classification, and bathymetry are provided for both bays. Boat prop scars were also recorded and mapped. Differences can be clearly seen between the relatively pristine Fakahatchee Bay and the Faka Union Bay, which receives large point source inputs of freshwater from the Faka Union Canal. Impacts on benthic habitat from boating are also clearly seen.

Overall, the baseline information in this report can be used to compare to data collected following restoration of Picayune Strand. Data collected within Florida Panther National Wildlife Refuge and Fakahatchee Strand Preserve State Park will be used as reference to assist in differentiating restoration effects from environmental effects.

BACKGROUND

The Picayune Strand Restoration Project is a Comprehensive Everglades Restoration Plan (CERP) project that will rehydrate a failed 1960s subdivision, known as Southern Golden Gate Estates, by removing the infrastructure of roads and canals and restoring its predrainage hydrology (**Figure 1**). The Picayune Strand Restoration Project Area is located in southwestern Collier County. It is surrounded by preserves and wildlife areas that will be linked and enhanced by the restored conditions within the project area, creating a combined natural area that will function as a single connected regional ecosystem (**Figure 2**). The regional ecosystem includes estuaries, freshwater wetlands, and uplands. A combination of restored hydrologic and fire regimes along with exotic vegetation control can be expected to return most of Picayune Strand to its predrainage character. A more detailed description of the project area, its predrainage and postdrainage conditions, and the scope of the project was provided in the 2008 SFER – Volume I, Appendix 7A-2.

Figure 1. Aerial views of Picayune Strand Restoration Project Area (photos by the SFWMD). Note the large number of cabbage palms (*Sabal palmetto*) in all areas shown.

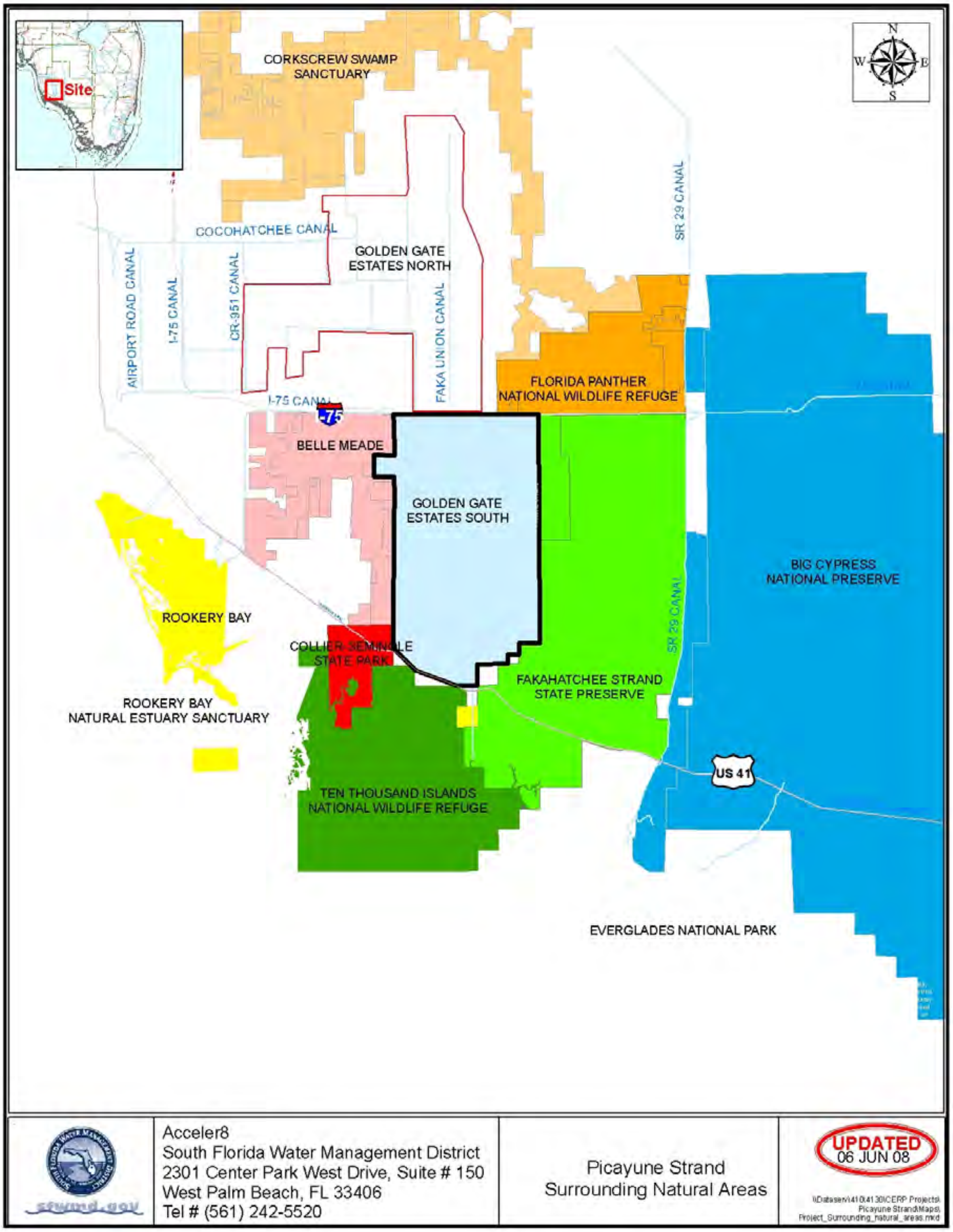

Figure 2. Location of the former Southern Golden Gate Estates subdivision (now the Picayune Strand Restoration Project Area) in relation to other preserved areas and developed areas.

BASELINE CONDITIONS

This report presents the baseline conditions for hydrology, Florida panther (*Puma concolor couguar*), aquatic fauna and refugia, rare plants, and estuarine benthic habitat. Baseline information has also been collected for oyster reef crabs (*Carpiliidae Ortmann* spp.), nekton and water quality, but these data have not yet been analyzed. Baseline data collection is still being done for wood storks and wading birds. The parameters not discussed in this report will be presented in addendums to this baseline report in future SFERs.

HYDROLOGY

Picayune Strand Restoration Project Area

Groundwater well (**Figure 3**) monitoring sites were established along four east-west transects in Picayune Strand (**Figure 4**). These transects will also allow evaluation of north-south trends within Picayune Strand. Transects are indicated north to south by T1, T2, T3, and T4 in the well names. Well sites were located in areas that will be accessible under post-restoration conditions, represent major habitats, and, where feasible, are located in proximity to preexisting wildlife and plant community monitoring sites. Usable data have been collected at most of these wells since October 2003.

Figure 3. Groundwater well (photo by SFWMD).

The predrainage, current, and expected restoration habitat for each groundwater well is presented in **Table 1**. In most cases, the expected habitat after restoration is the same as that for the predrainage system. The exceptions are wells SGT1W1, SGT1W4, SGT1W5, and SGT2W4, which are expected to have different habitat compositions following restoration than what they had prior to drainage.

In addition to monitoring hydrology within the project area, hydrology must also be monitored in the coastal marshes and estuaries to the south of the project, as these areas are expected to be improved by restoration of more natural hydrology in the project area. An additional well transect, T5, was established in 2006 to monitor groundwater south of U.S. 41 (Tamiami Trail) (**Figure 4**) in the coastal marshes that were naturally fed by sheetflow from Picayune Strand (**Figure 5**) and Fakahatchee Strand (see the *Fakahatchee Strand Preserve State Park* section of this appendix). Stage and salinity are measured at these sites. The two western sites (SGT5W1 and SGT5W2) are in areas where the Southern Golden Gates Estates canal system is eliminating much of the upstream freshwater inflows and the one to the east (SGT5W3) is located in an area much less affected by the canal system. This portion of the estuarine system is fed by sheetflow from Fakahatchee Strand Preserve State Park.

Also, surface water stage and salinity are measured at seven stations as water passes under U.S. 41. These are FU#1, TMBR 40, TMBR 45, TMBR 52, TMBR 55, TMBR 66, and TMBR 71 (**Figure 4**). The FU#1, or Faka Union #1, stage gauge is located at the Faka Union Canal weir, where water is discharged from the canal system. TMBR 40, TMBR 45, and TMBR 52 are located in areas that naturally received inflow from Picayune Strand (**Figure 5**). TMBR 55 naturally received inflow from both Picayune Strand and Fakahatchee Strand. TMBR 65 and TMBR 71 receive inflow from Fakahatchee Strand.

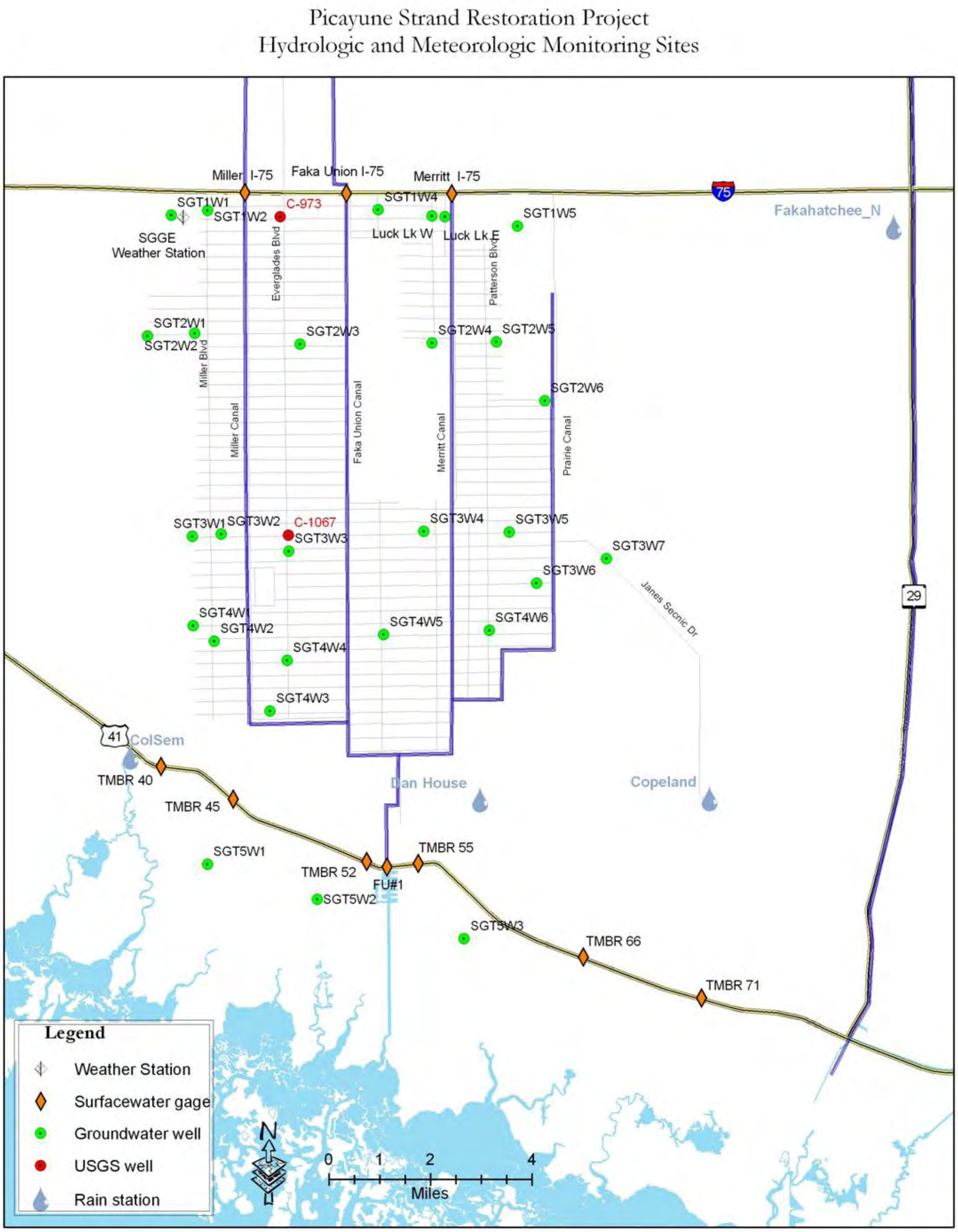

Figure 4. Picayune Strand Restoration Project hydrologic (and meteorologic) monitoring sites.

Table 1. Habitats that occurred at each well location prior to drainage, habitats currently at each well location, and expected habitat after restoration.

Well	Habitat Type		
	Predrainage (1940s)	**Current**	**Restoration**
SGT1W1	dwarf cypress	hydric pine to west dwarf cypress to west old field to east	hydric pine dwarf cypress to west
SGT1W2	mesic hammock hydric flatwoods wet prairie with dwarf cypress	mesic hammock hydric flatwoods wet prairie with dwarf cypress	mesic hammock hydric flatwoods wet prairie with dwarf cypress
SGT1W4	marsh to east cypress to west	marsh to east hydric hammock to west	marsh hydric hammock to west
SGT1W5	wet prairie with pine	hydric flatwoods with palms	hydric flatwoods
SGT2W1	hydric flatwoods wet prairie with dwarf cypress	mesic flatwoods to south wet prairie	hydric flatwoods wet prairie with dwarf cypress
SGT2W2	cypress and hydric flatwoods	mesic flatwoods	cypress and hydric flatwoods
SGT2W3	cypress	palm hammock burned cypress dome to north	cypress
SGT2W4	wet prairie grading to cypress dome	palms and shrubs grading to willow pond	wet prairie grading to pond
SGT2W5	cypress with open water pond	willow pond to south cypress swamp to north	cypress with open water pond
SGT2W6	wet prairie cypress to west	prairie burned cypress to west	wet prairie cypress to west
SGT3W1	tall dwarf cypress wet prairie to east	tall dwarf cypress wet prairie to east	tall dwarf cypress wet prairie to east
SGT3W2	smaller cypress larger cypress to north	hydric hammock with smaller cypress larger cypress to north	smaller cypress larger cypress to north
SGT3W3	cypress	cypress with palms	cypress
SGT3W4	hydric hammock	hydric hammock	hydric hammock
SGT3W5	cypress	hydric hammock	cypress
SGT3W6	wet prairie	wet prairie	wet prairie
SGT3W7	wet prairie with islands of cypress	wet prairie with islands of burned cypress	wet prairie with islands of cypress
SGT4W1	cypress hydric flatwoods to southeast	cypress hydric flatwoods to southeast	cypress hydric flatwoods to southeast
SGT4W2	hydric flatwoods wet prairie with dwarf cypress to south isolated wet prairie to north	hydric flatwoods wet prairie with dwarf cypress to south isolated wet prairie to north	hydric flatwoods wet priaire with dwarf cypress to south isolated wet prairie to north
SGT4W3	wet prairie cypress	wet prairie cypress	wet prairie cypress
SGT4W4	wet prairie	wet prairie	wet prairie
SGT4W5	cypress	cypress with palms to north hydric hammock with cypress to south	cypress
SGT4W6	cypress	palm hammock to east hydric hammock to west	cypress

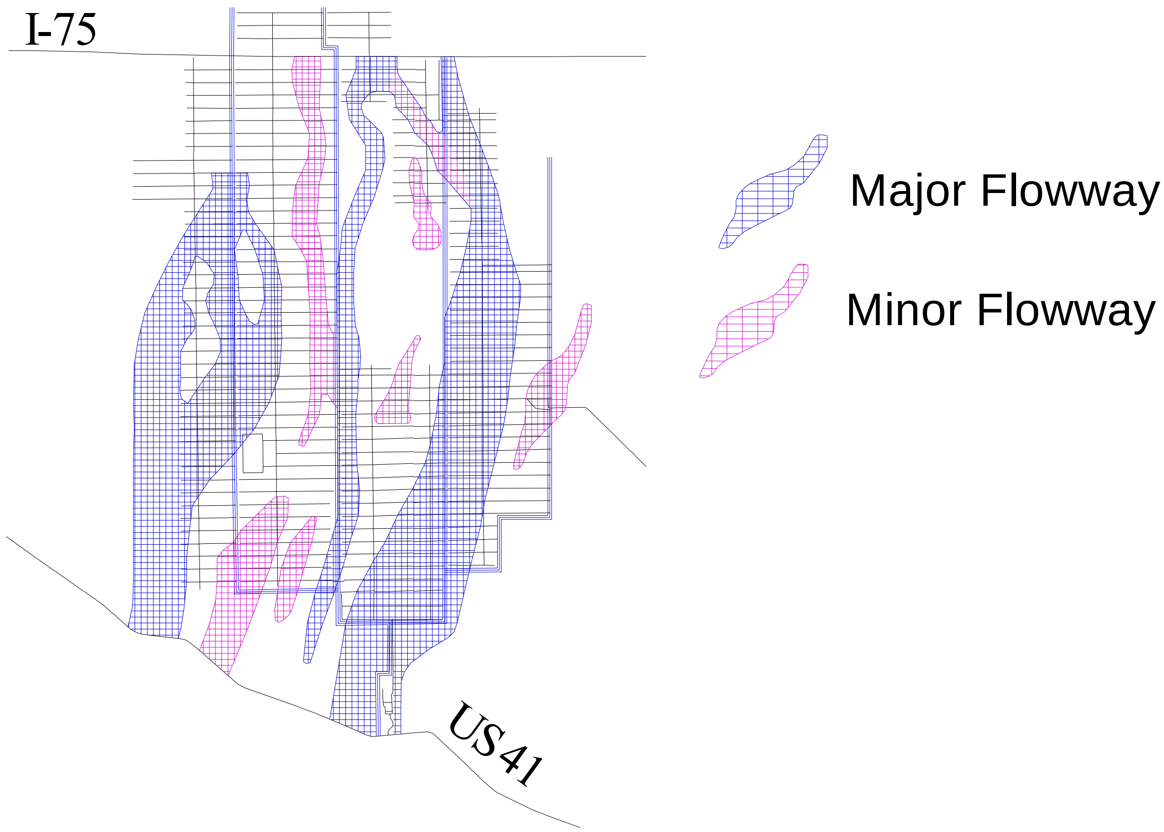

Figure 5. Major and minor natural flow-ways in Picayune Strand Restoration Project Area in relation to the failed subdivision infrastructure.

Figures 6 through **31** show water levels at each of the groundwater wells (blue line). Elevations are based on feet National Geodetic Vertical Datum (ft NGVD) The horizontal colored lines are average ground surface elevations (ft above mean sea level) along vegetation monitoring transects through specific plant communities that currently exist near the wells. In some cases, these plant communities are expected to change back to what they were prior to drainage after restoration. Each plant community type has a natural range of water levels above and below ground, and a natural average hydroperiod. Plotting the monitored water levels in relation to the ground surface elevation for each plant community will tell us whether we are achieving a natural hydrologic regime in each plant community, which is our restoration target at each site. Due to drainage by the canals, most of the wells currently have water levels well below the surface during all but the wettest periods. The majority of the predrainage plant communities need water above ground for some to almost all of the year. These levels are all expected to rise after the canals are plugged and the pump stations are operating, providing the necessary water levels and hydroperiods for the desired plant communities.

Figures 32 through **38** show water level stages at the surface water gauge sites along U.S. 41. **Figure 32** is the stage recorded at the most downstream weir along the Faka Union Canal. This canal is the discharge point for water drained from both the Northern Golden Gate Estates residential development (**Figure 2**) and the former Southern Golden Gate Estates residential development that is being restored by the Picayune Strand Restoration Project. As expected, the stage at this gauge is always higher than the stage at the other gauges along U.S. 41.

SGT1W1

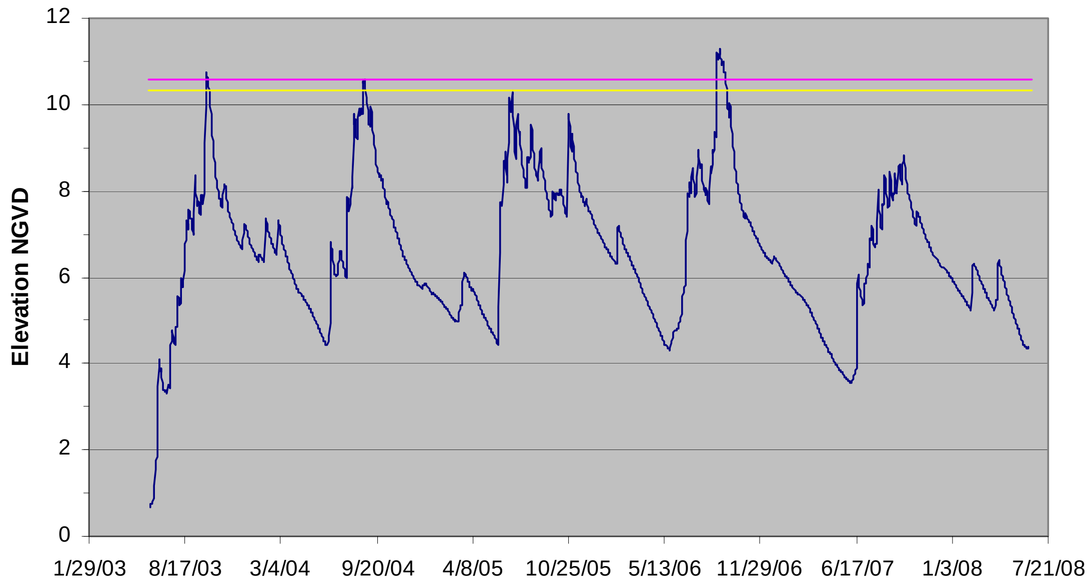

Figure 6. Water levels (blue line) and average ground surface elevations for near plant communities (pink and yellow lines) at the SGT1W1 well.

SGT1W2

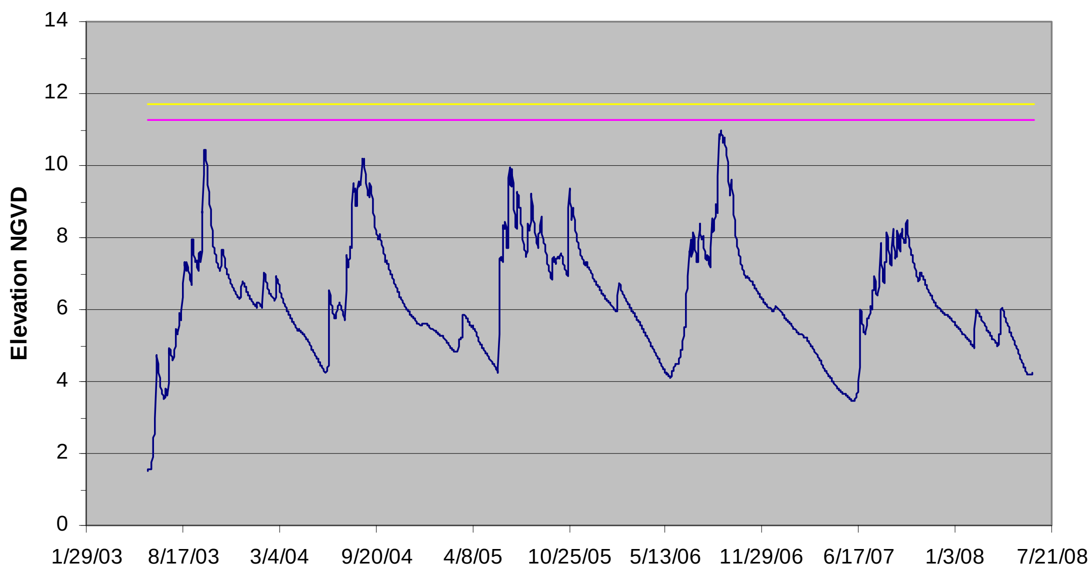

Figure 7. Water levels (blue line) and average ground surface elevations for near plant communities (pink and yellow lines) at the SGT1W2 well.

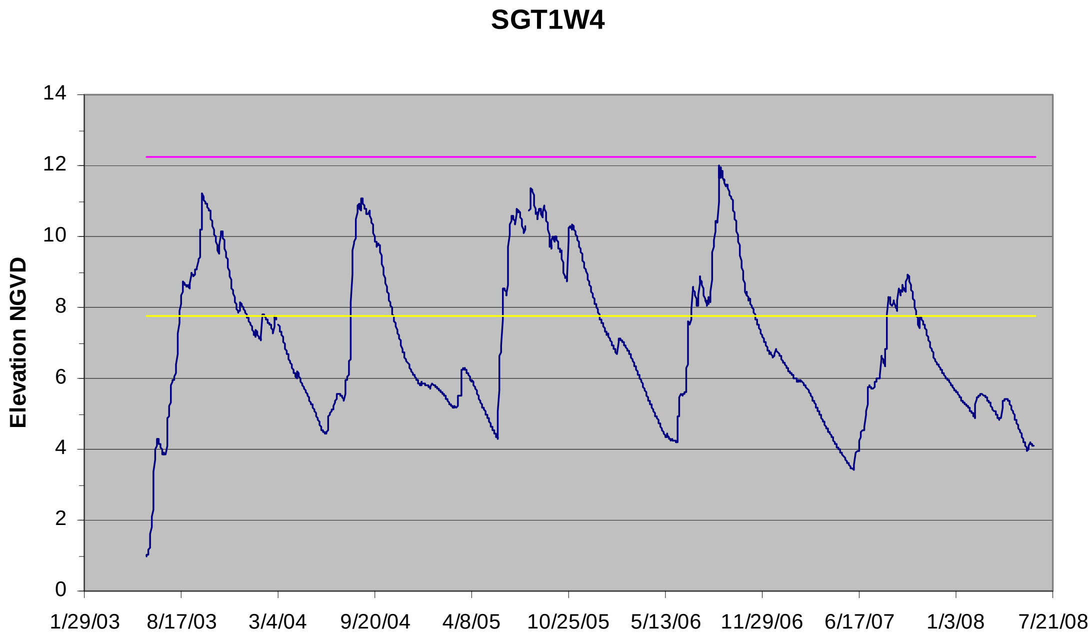

Figure 8. Water levels (blue line) and average ground surface elevations for near plant communities (pink and yellow lines) at the SGT1W4 well.

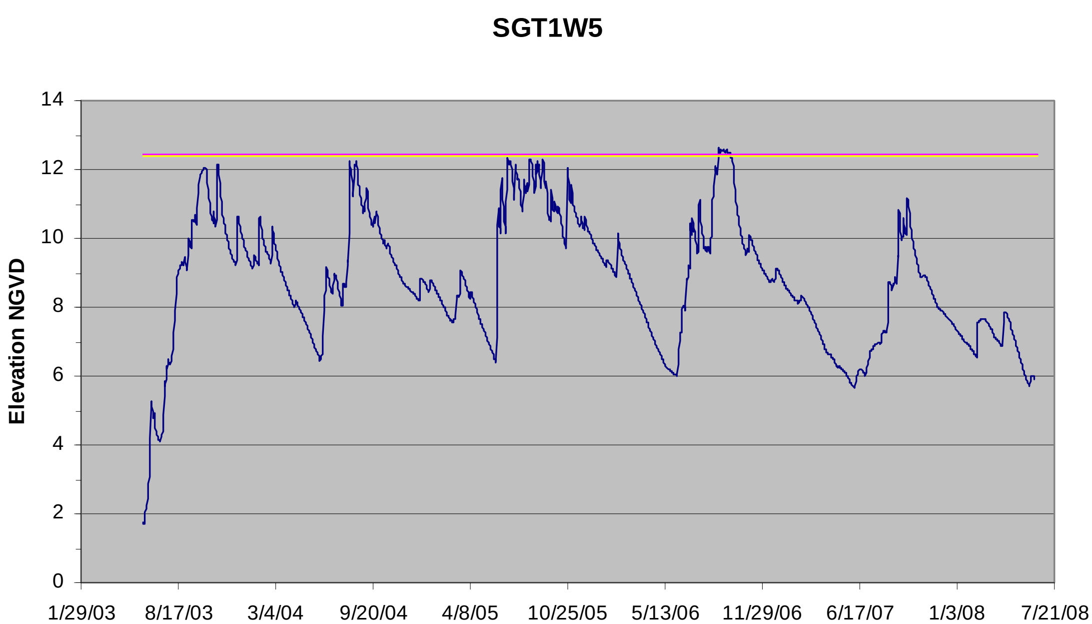

Figure 9. Water levels (blue line) and average ground surface elevations for near plant communities (pink and yellow lines) at the SGT1W5 well.

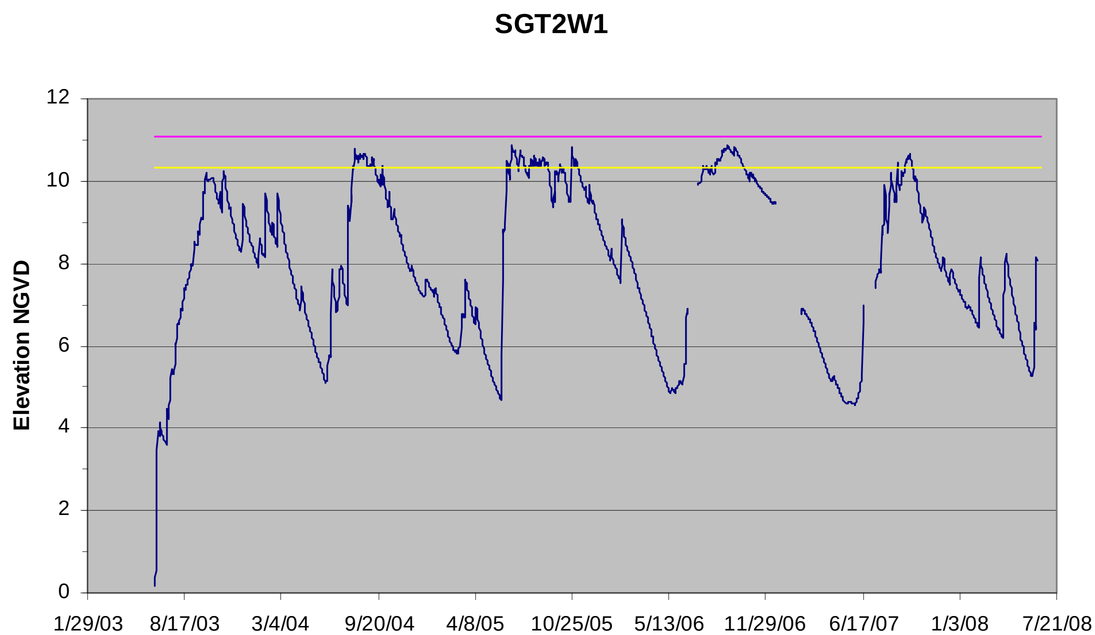

Figure 10. Water levels (blue line) and average ground surface elevations for near plant communities (pink and yellow lines) at the SGT2W1 well.

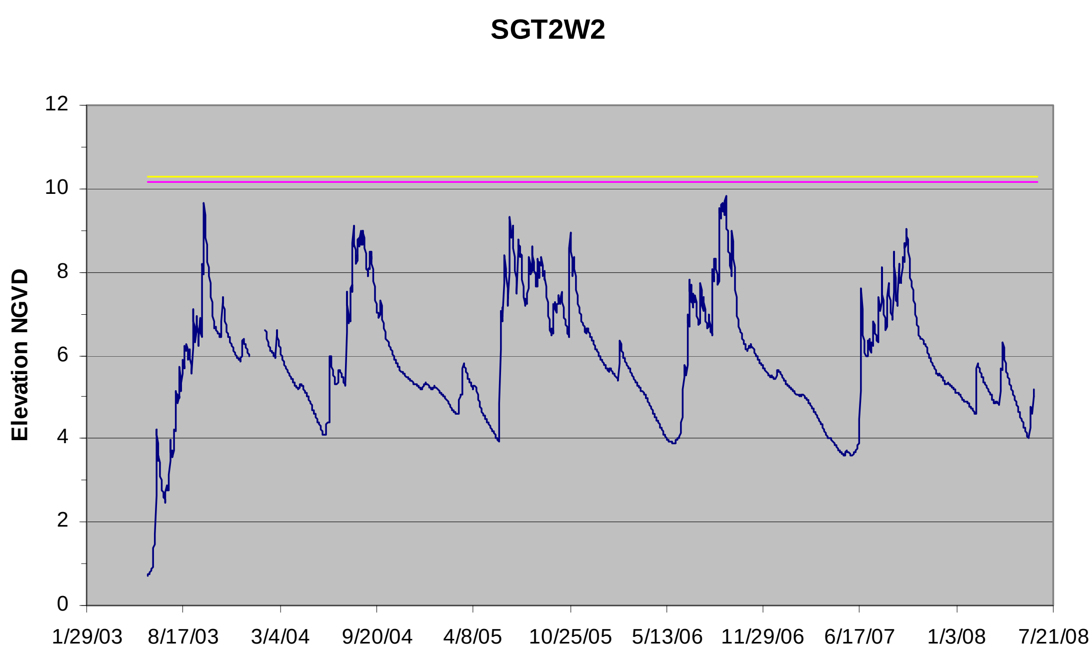

Figure 11. Water levels (blue line) and average ground surface elevations for near plant communities (pink and yellow lines) at the SGT2W2 well.

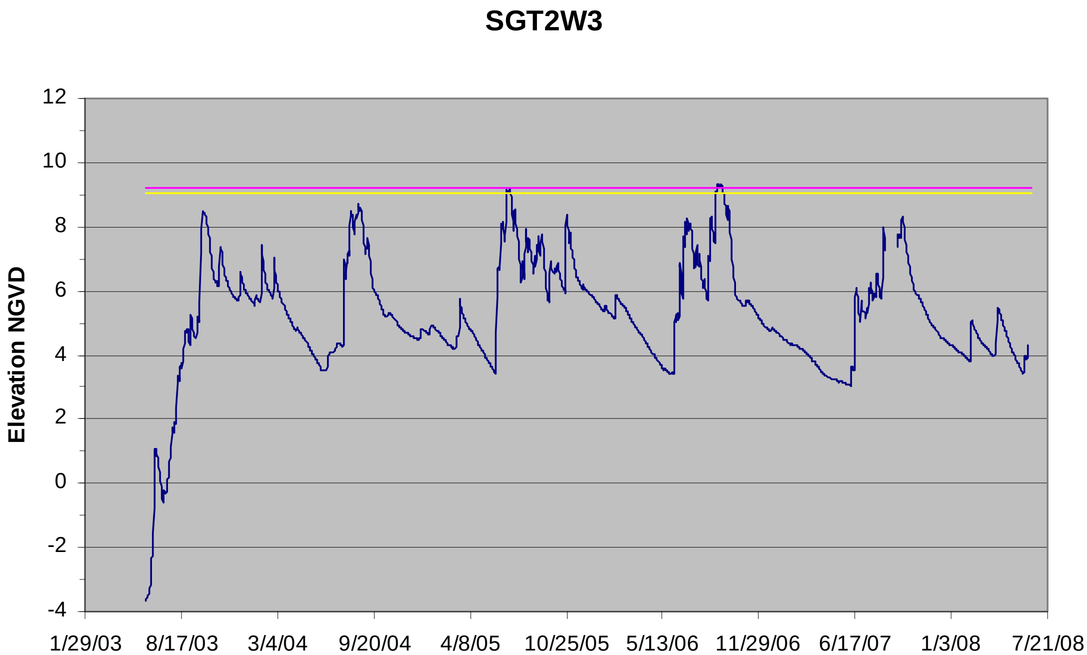

Figure 12. Water levels (blue line) and average ground surface elevations for near plant communities (pink and yellow lines) at the SGT2W3 well.

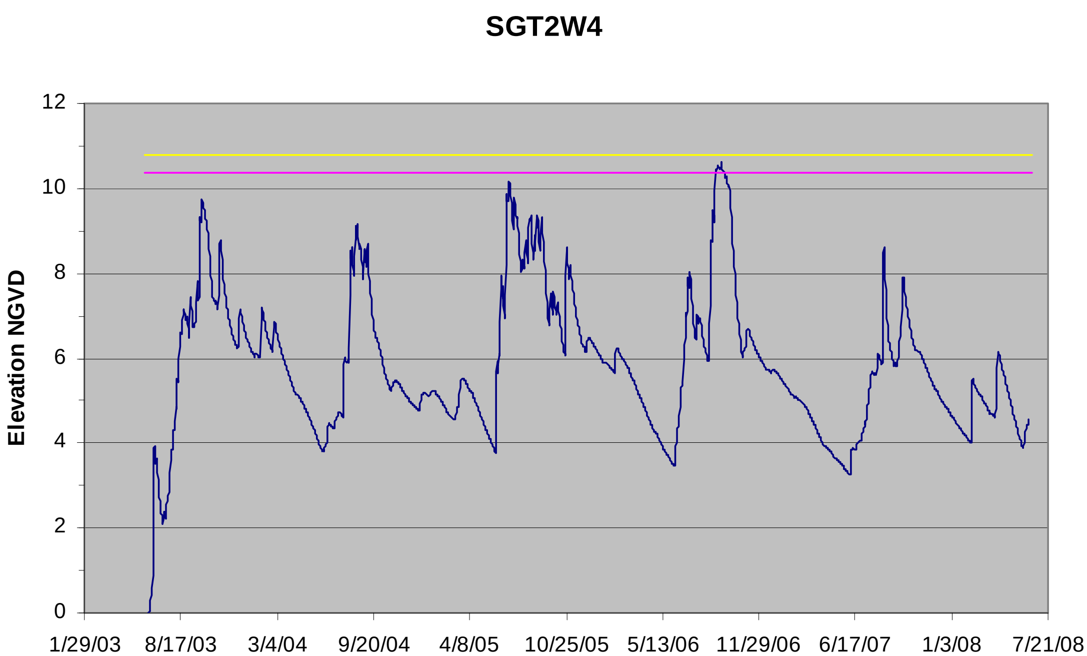

Figure 13. Water levels (blue line) and average ground surface elevations for near plant communities (pink and yellow lines) at the SGT2W4 well.

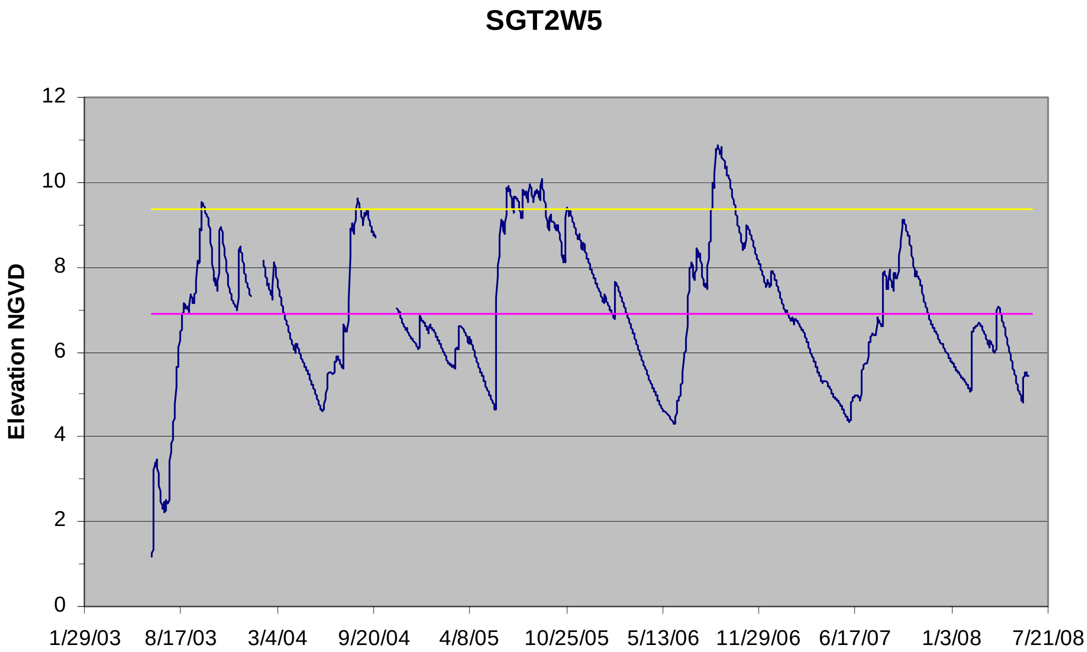

Figure 14. Water levels (blue line) and average ground surface elevations for near plant communities (pink and yellow lines) at the SGT2W5 well.

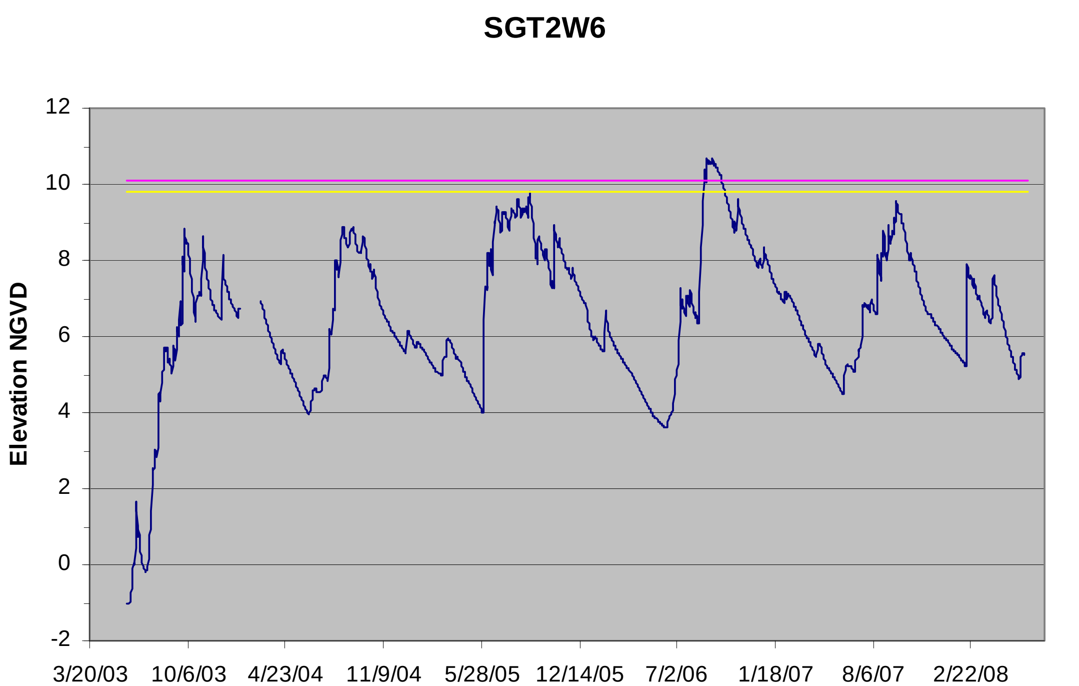

Figure 15. Water level (blue line) and average ground surface elevations for near plant communities (pink and yellow lines) at the SGT2W6 well.

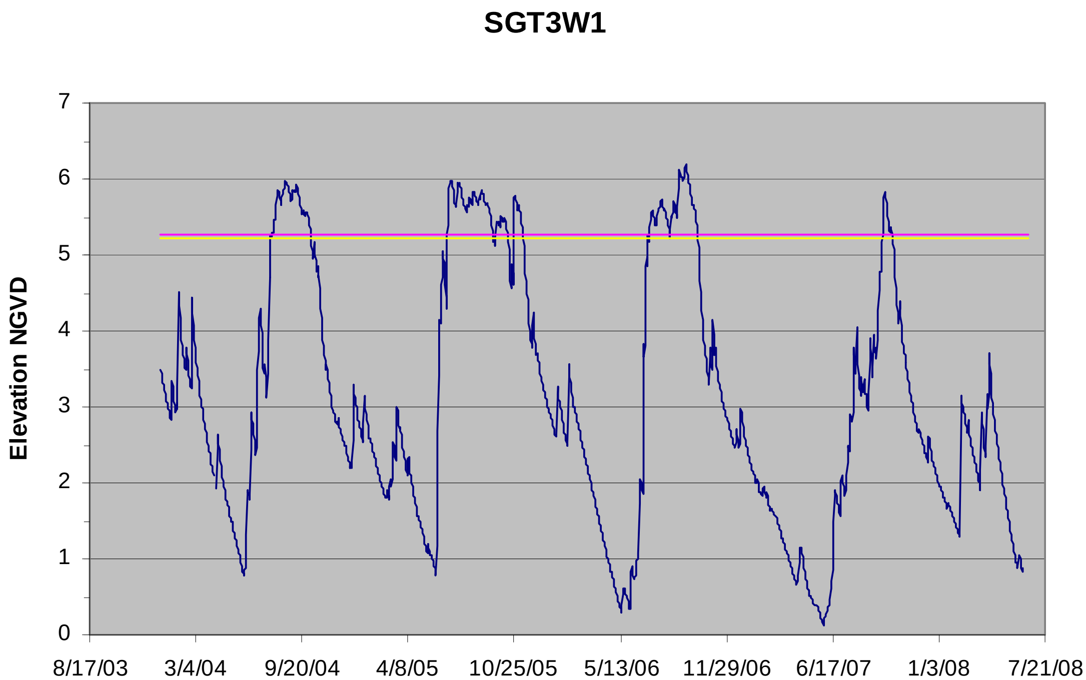

Figure 16. Water levels (blue line) and average ground surface elevations for near plant communities (pink and yellow lines) at the SGT3W1 well.

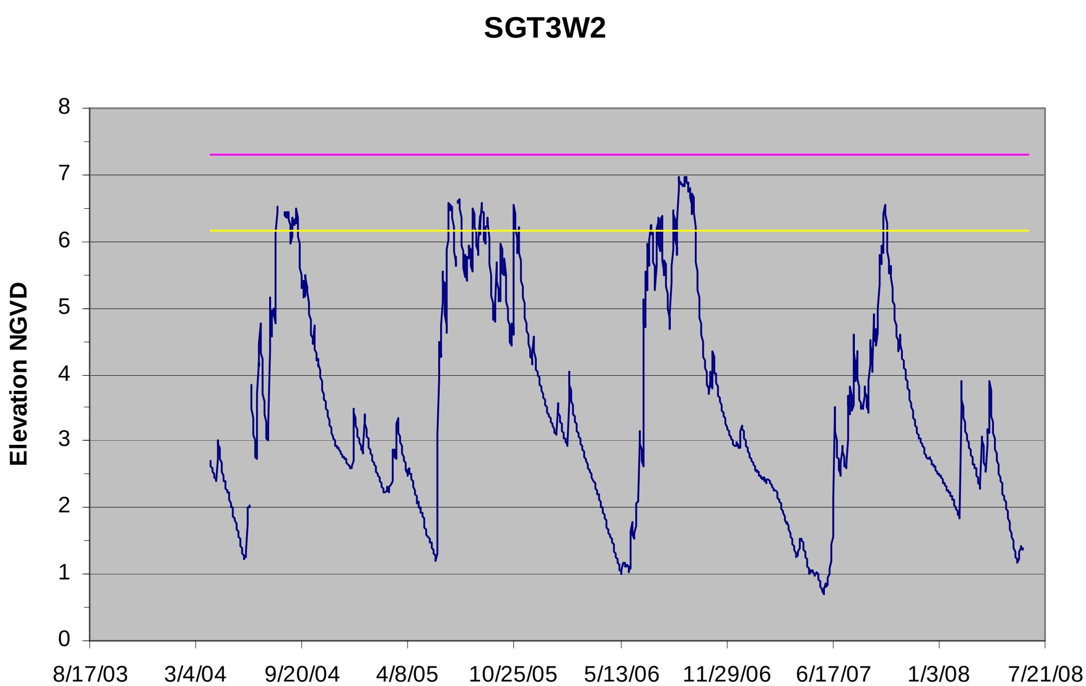

Figure 17. Water levels (blue line) and average ground surface elevations for near plant communities (pink and yellow lines) at the SGT3W2 well.

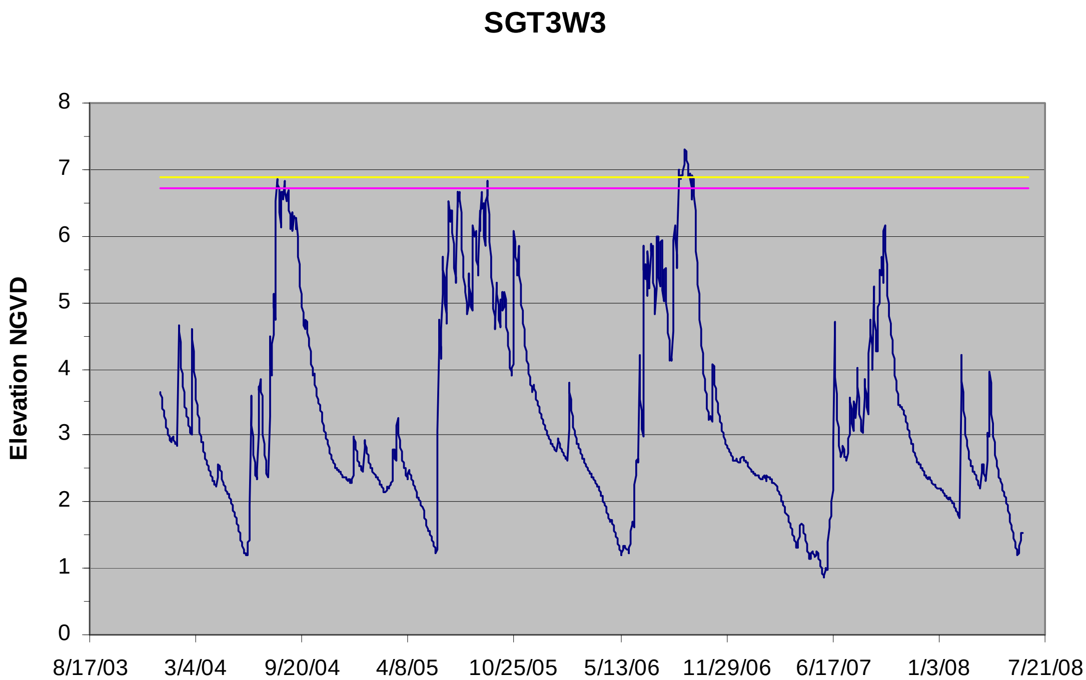

Figure 18. Water levels (blue line) and average ground surface elevations for near plant communities (pink and yellow lines) at the SGT3W3 well.

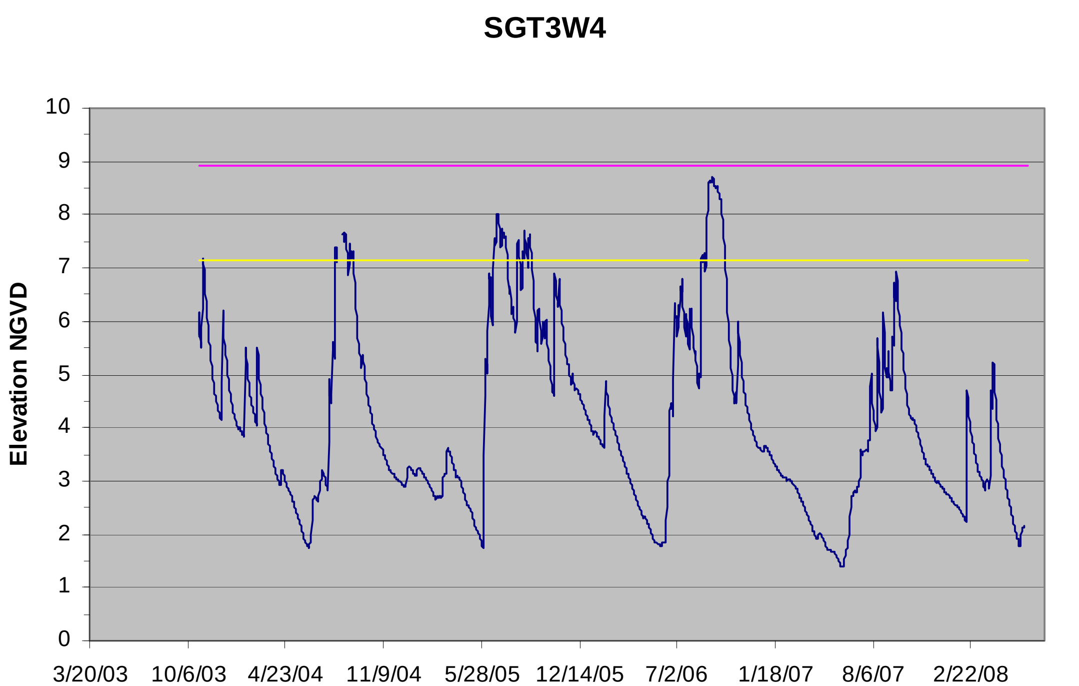

Figure 19. Water levels (blue line) and average ground surface elevations for near plant communities (pink and yellow lines) at the SGT3W4 well.

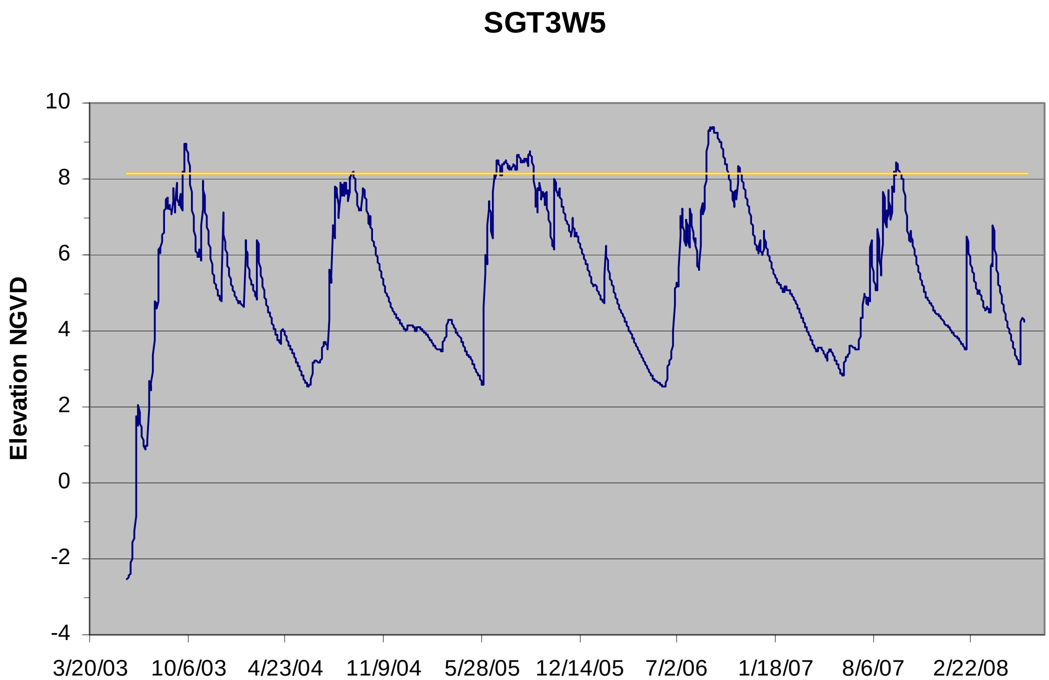

Figure 20. Water levels (blue line) and average ground surface elevations for near plant communities (yellow line) at the SGT3W5 well.

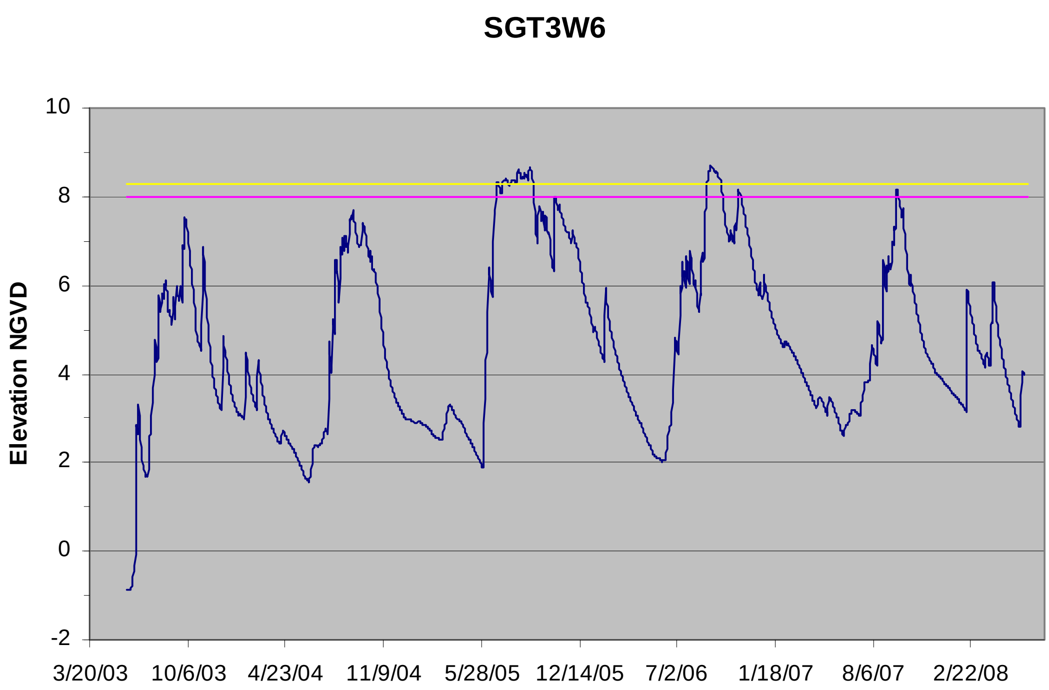

Figure 21. Water levels (blue line) and average ground surface elevations for near plant communities (pink and yellow lines) at the SGT3W6 well.

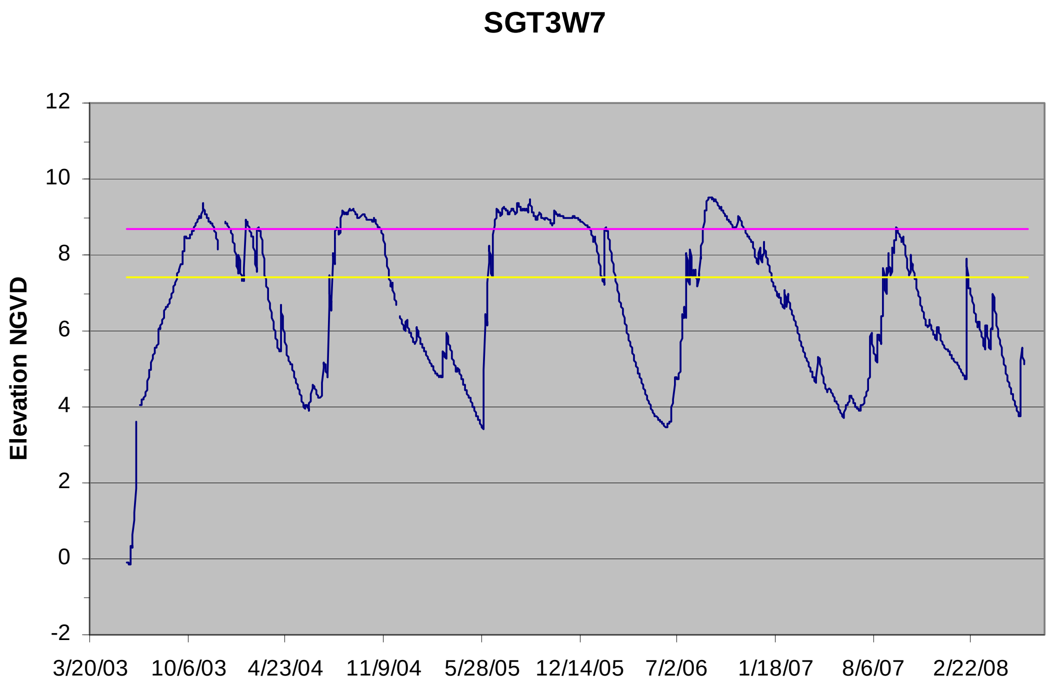

Figure 22. Water levels (blue line) and average ground surface elevations for near plant communities (pink and yellow lines) at the SGT3W7 well.

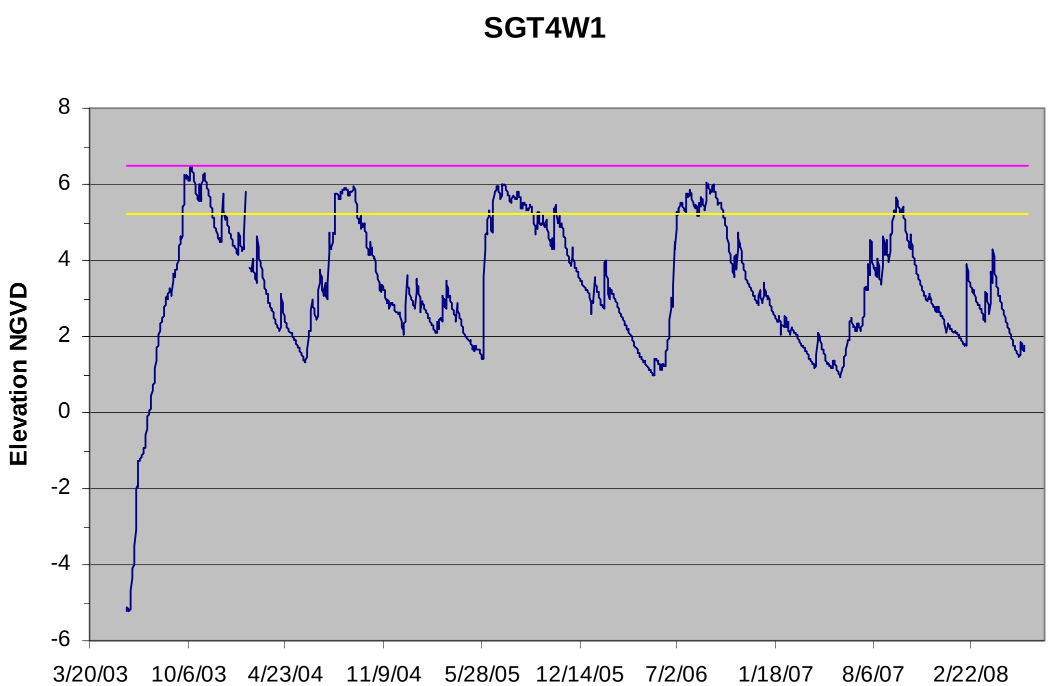

Figure 23. Water levels (blue line) and average ground surface elevations for near plant communities (pink and yellow lines) at the SGT4W1 well.

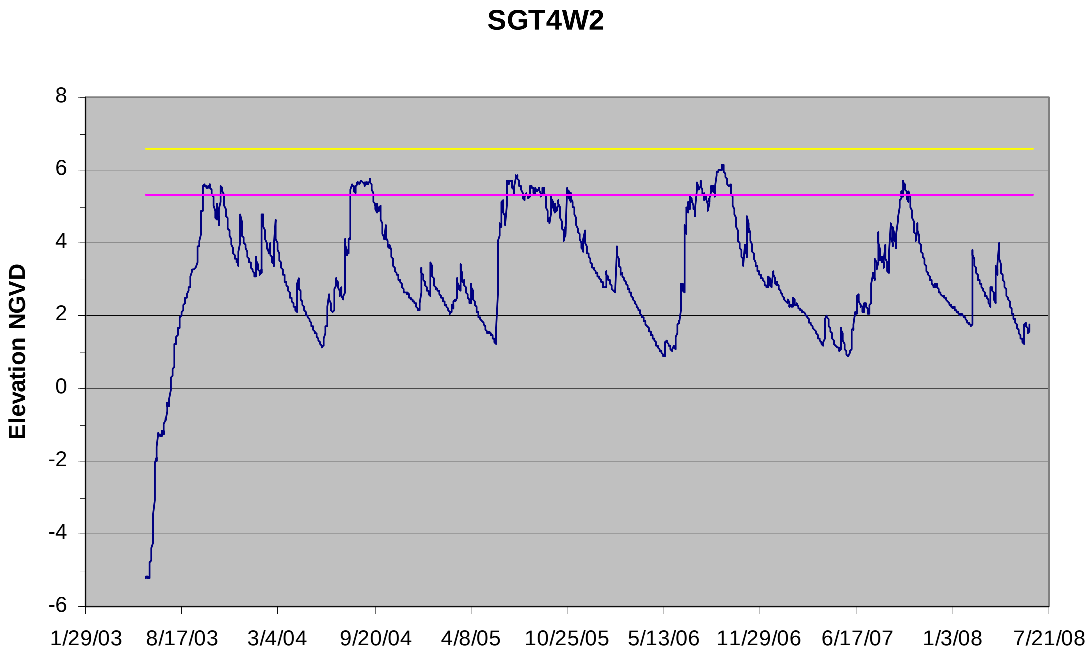

Figure 24. Water levels (blue line) and average ground surface elevations for near plant communities (pink and yellow lines) at the SGT4W2 well.

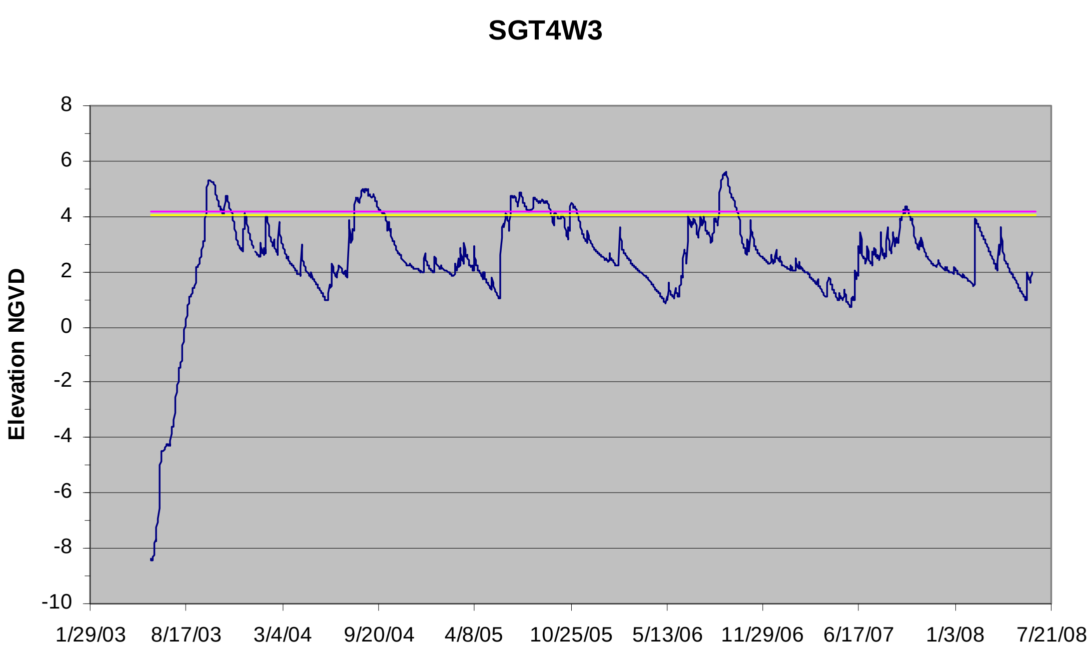

Figure 25. Water levels (blue line) and average ground surface elevations for near plant communities (pink and yellow lines) at the SGT4W3 well.

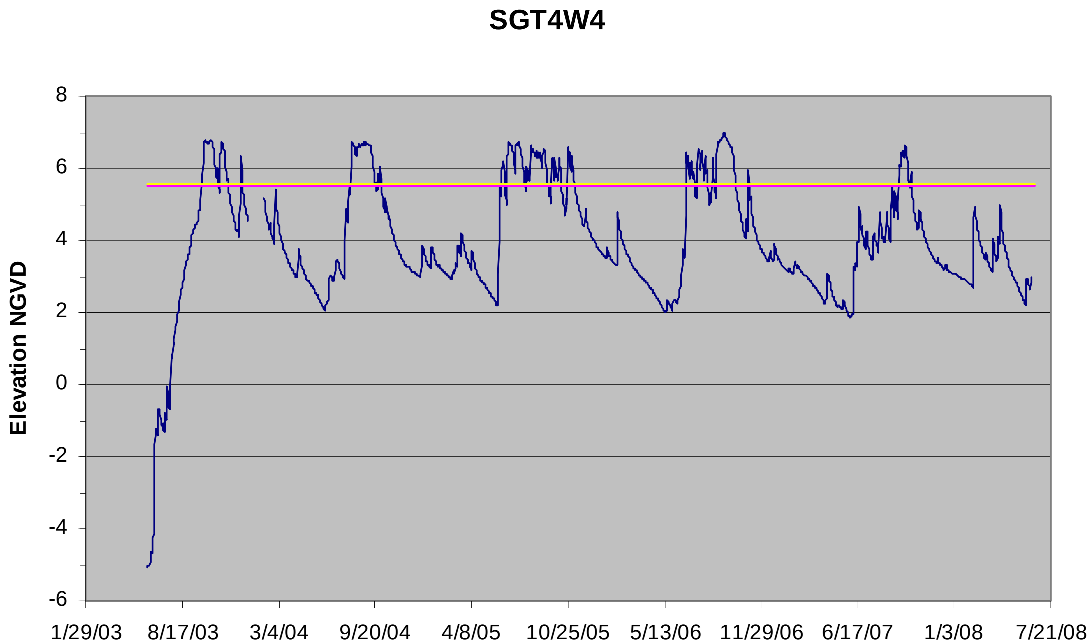

Figure 26. Water levels (blue line) and average ground surface elevations for near plant communities (pink and yellow lines) at the SGT4W4 well.

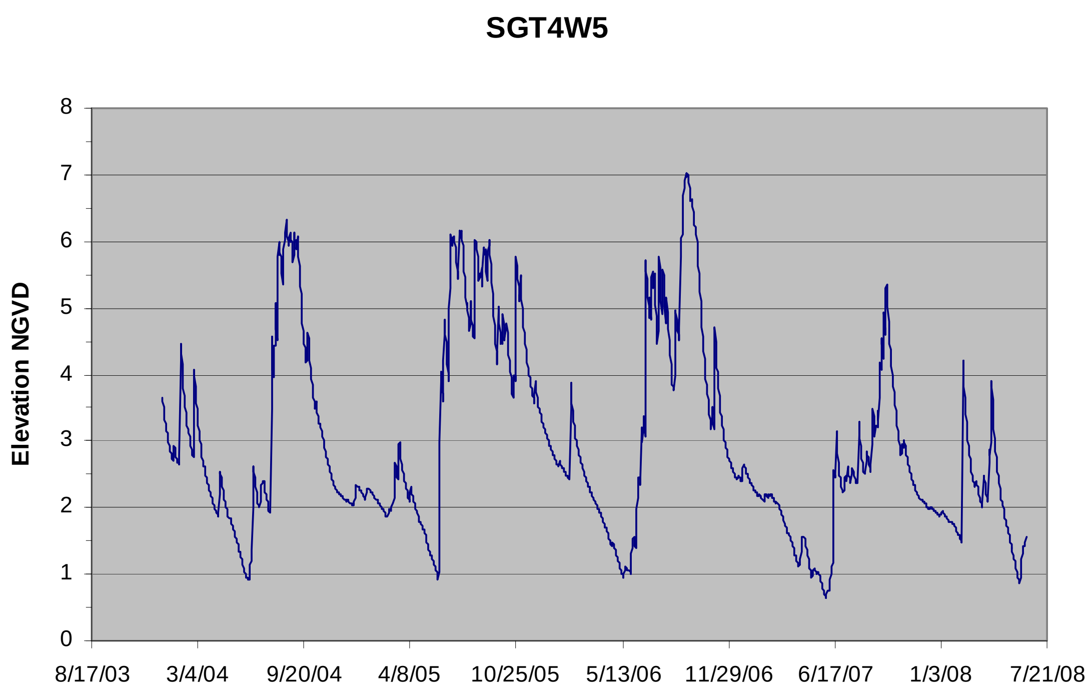

Figure 27. Water levels (blue line) at the SGT4W5 well.

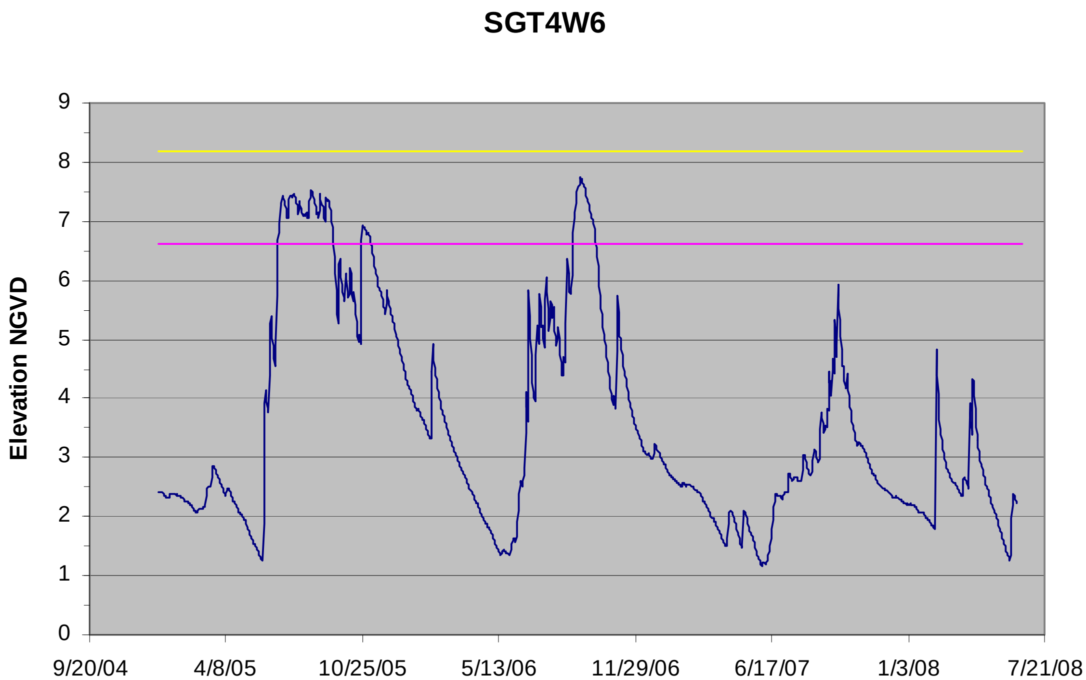

Figure 28. Water levels (blue line) and average ground surface elevations for near plant communities (pink and yellow lines) at the SGT4W6 well.

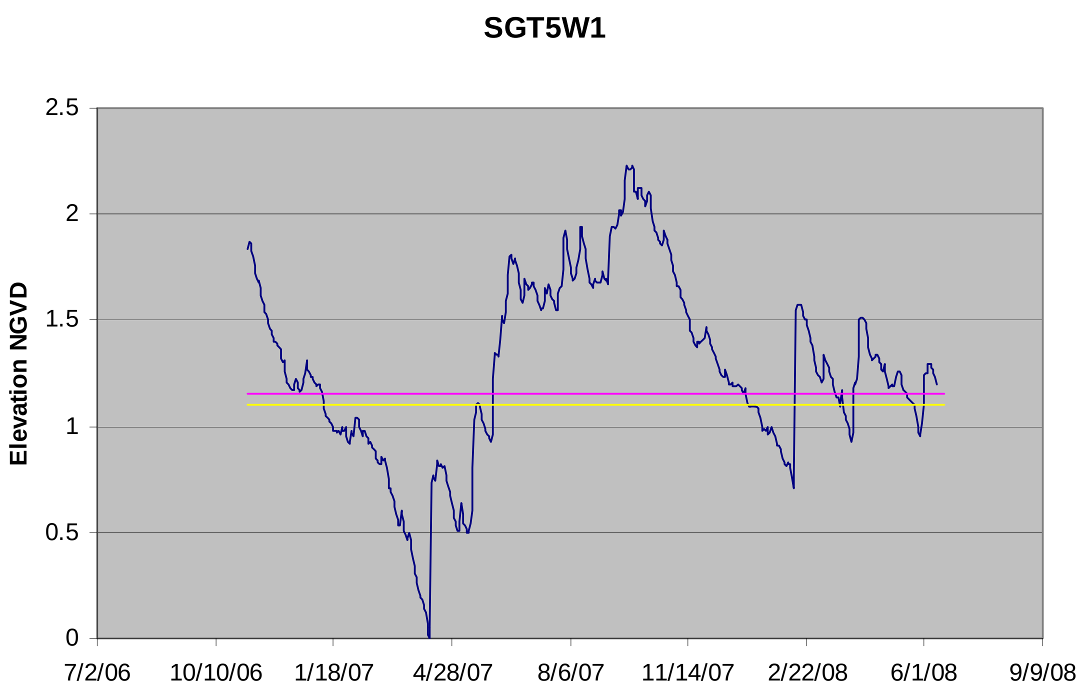

Figure 29. Water levels (blue line) and average ground surface elevations for near plant communities (pink and yellow lines) at the SGT5W1 well.

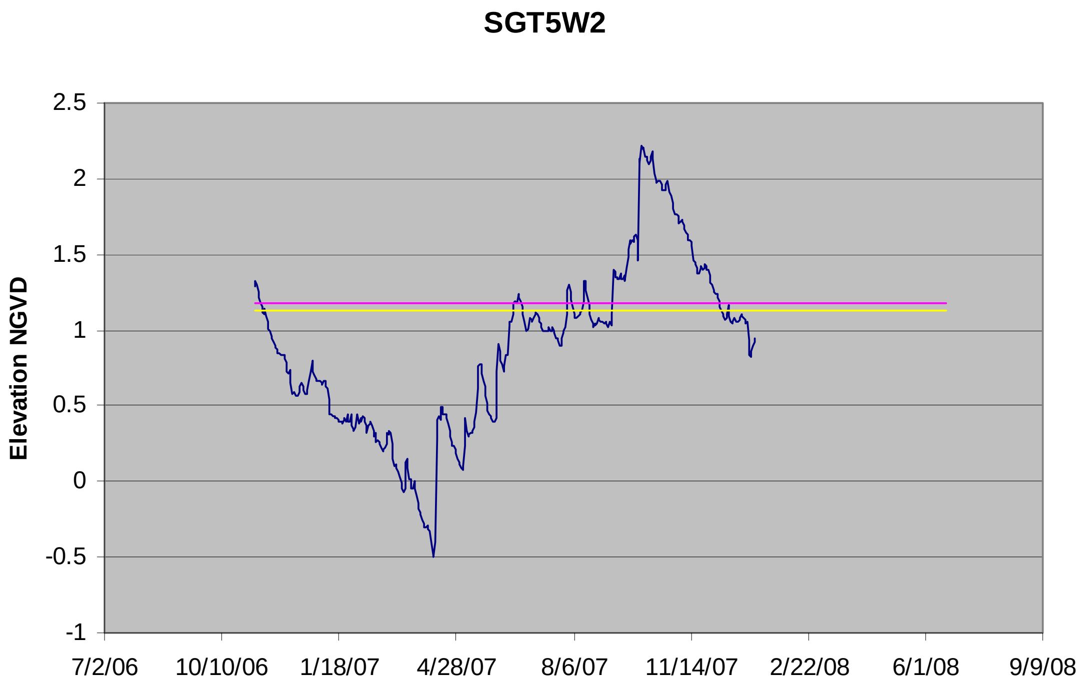

Figure 30. Water levels (blue line) and average ground surface elevations for near plant communities (pink and yellow lines) at the SGT5W2 well.

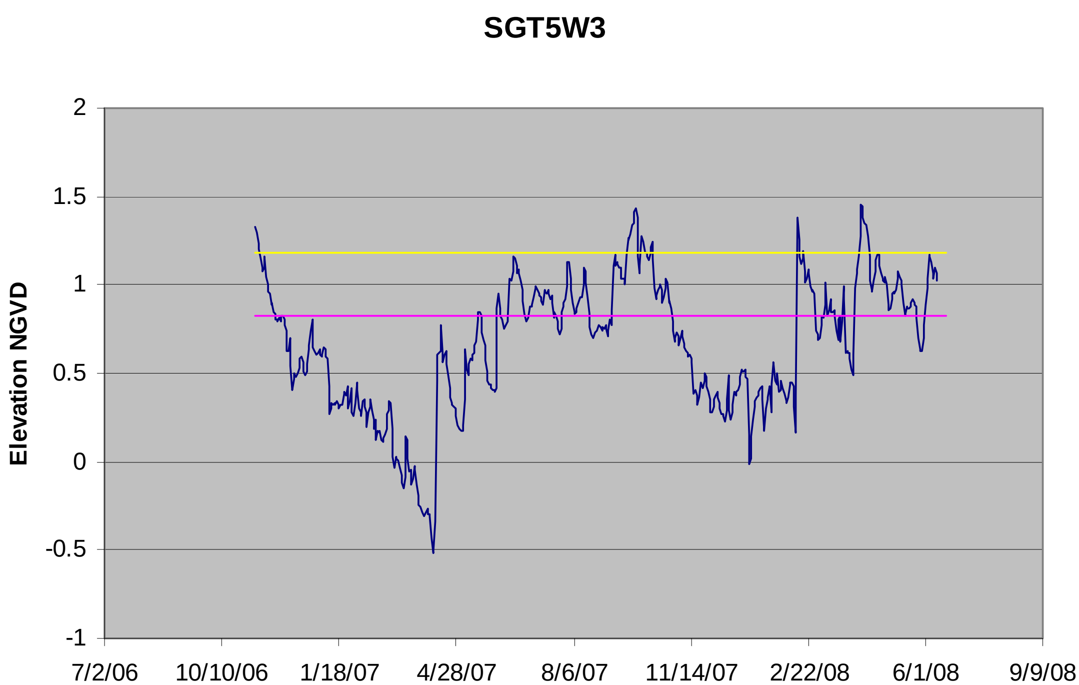

Figure 31. Water levels (blue line) and average ground surface elevations for near plant communities (pink and yellow lines) at the SGT5W3 well.

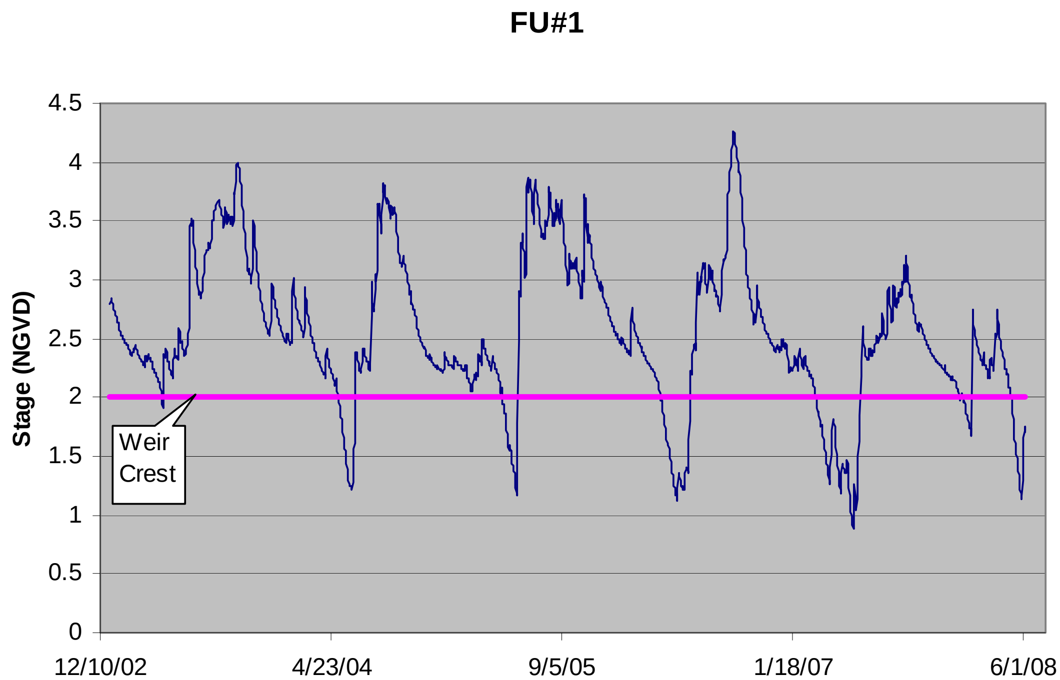

Figure 32. Surface water stage at FU#1.

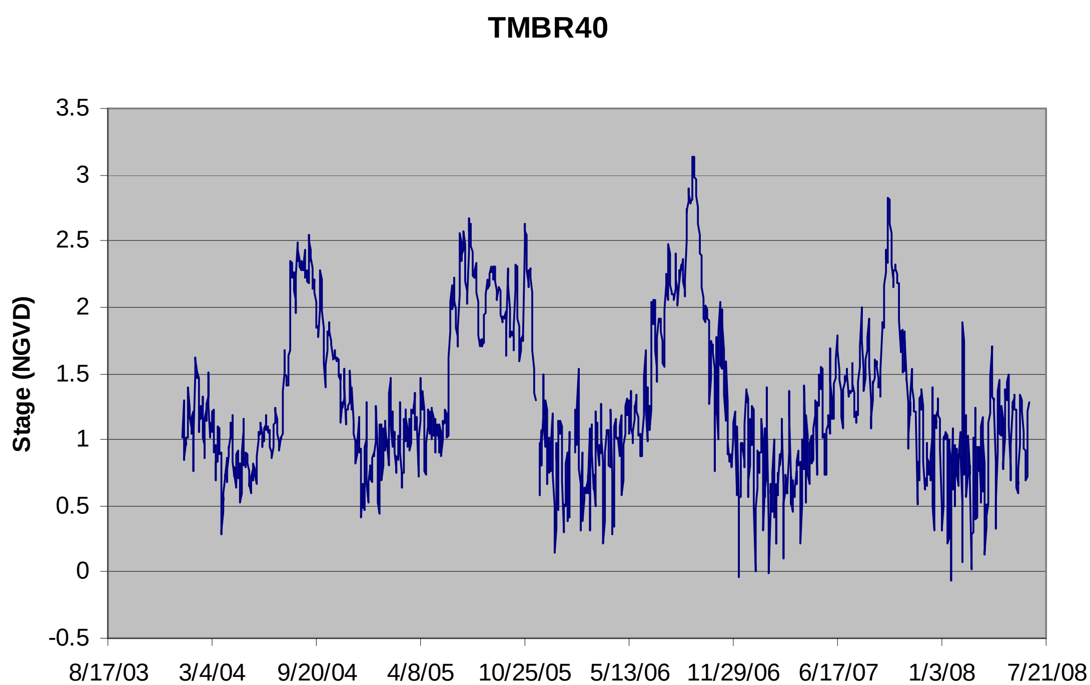

Figure 33. Surface water stage at TMBR 40.

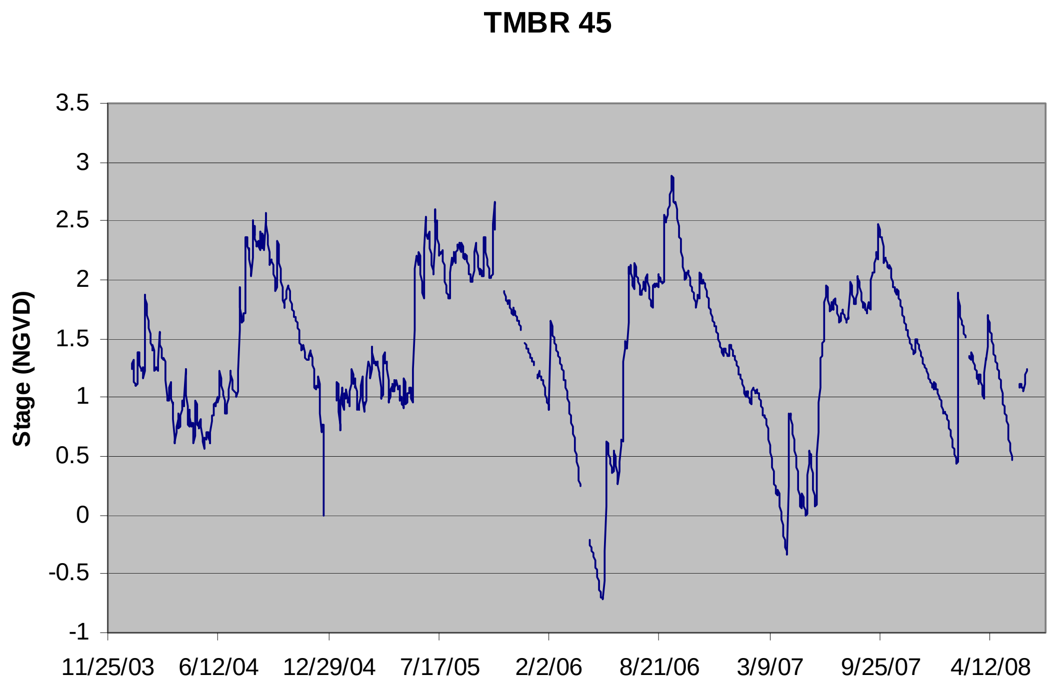

Figure 34. Surface water stage at TMBR 45.

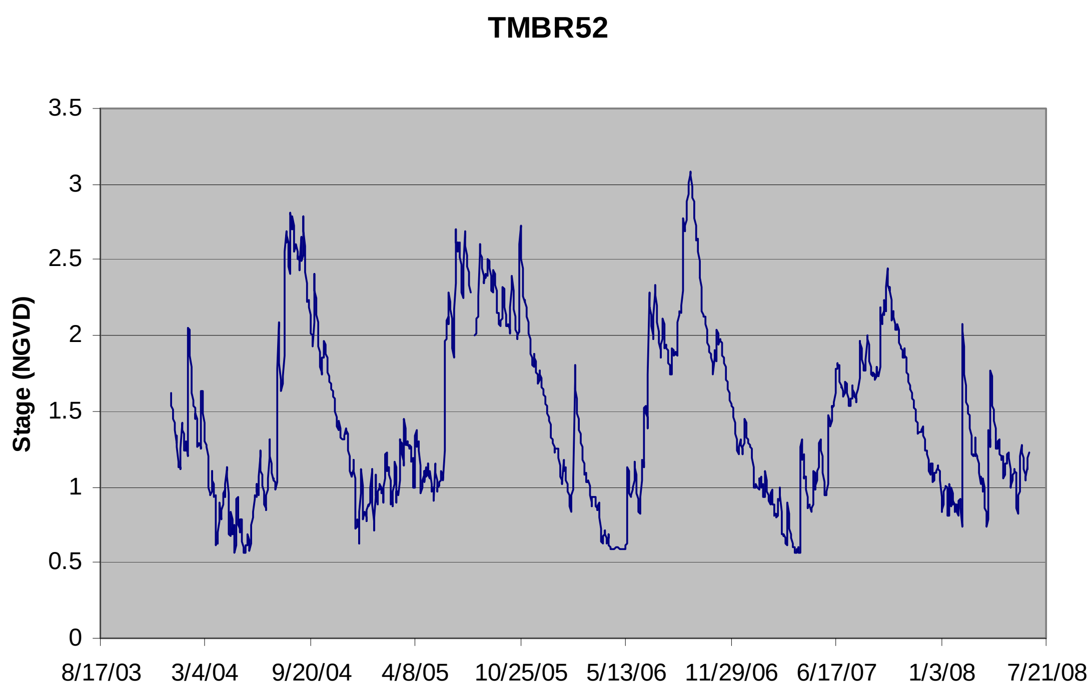

Figure 35. Surface water stage at TMBR 52.

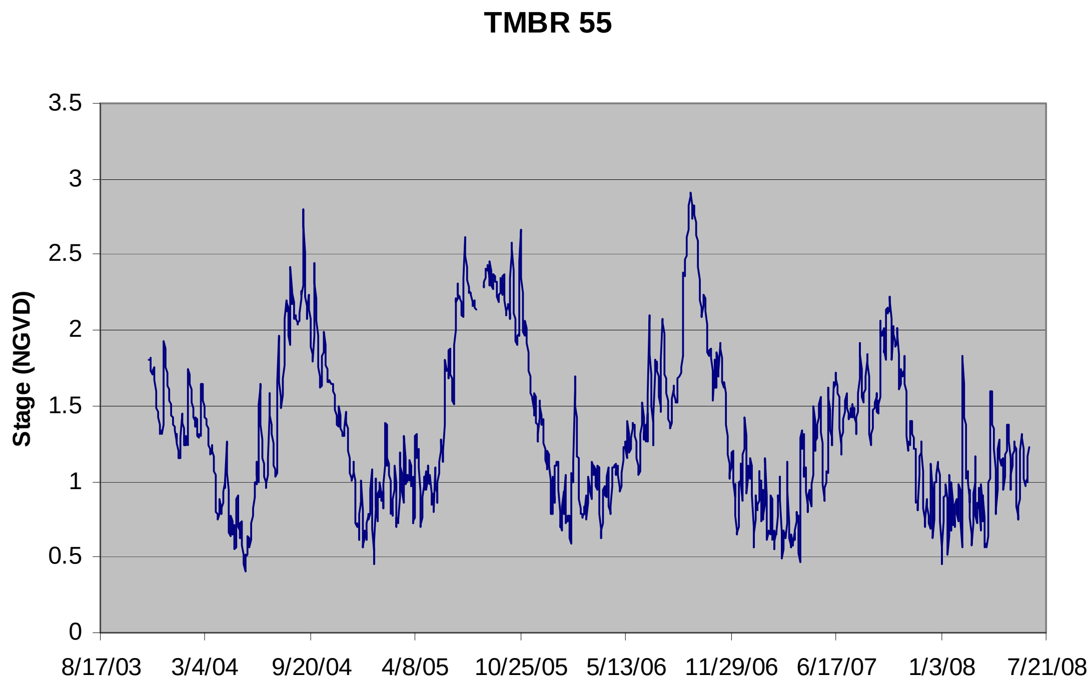

Figure 36. Surface water stage at TMBR 55.

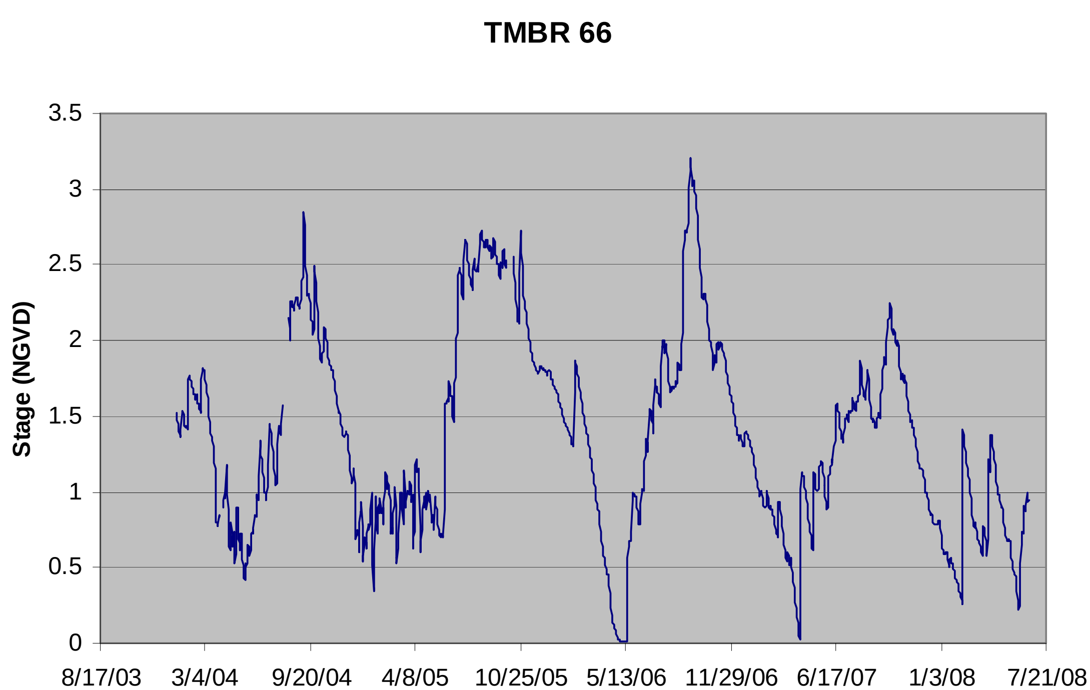

Figure 37. Surface water stage at TMBR 66.

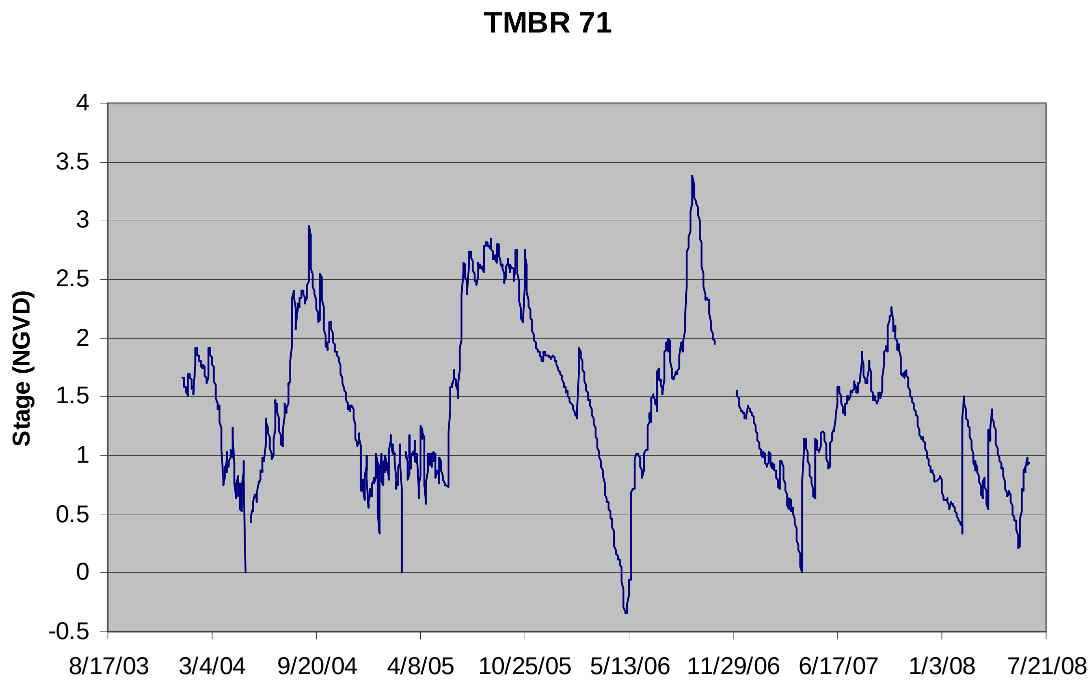

Figure 38. Surface water stage at TMBR 71.

Fakahatchee Strand Preserve State Park

Restoration of natural hydroperiods and flow patterns within Picayune Strand are expected to provide hydrologic benefits to Fakahatchee Strand Preserve State Park, especially at the western edge of the park. Therefore, water levels within the park are measured at 24 wells placed along two transects (**Figure 39**). These wells will also serve as reference sites, especially those in the center of the park, to help separate climatic effects from restoration affects within Picayune Strand. Data have been collected at these wells from 1987 to the present. **Figures 40** to **81** present water level profiles along each transect during each year.

Water levels along the North Transect in the vicinity of the Southern Golden Gates Estates canal system were up to 2 feet (ft) lower in the summer wet season and up to 5 ft in the spring dry season compared to water levels in the central portion of Fakahatchee Strand Preserve State Park. Canal drainage effects extend 1 to 3 miles (mi) into Fakahatchee Strand.

A similar pattern of monthly drawdowns were found along the South Transect, although it was not as dramatic. The South Transect is closer to sea level, which reduces the ability of a drainage canal to lower water levels. Also, the South Florida Water Management District (SFWMD or District) was not able to install wells closer than within about 2 mi from the Faka Union Canal because at the time of installation, these lands were not publicly owned. In the absence of the Southern Golden Glades Estates canals, these profiles would parallel the ground surface profile or, at most, have a shallow gradient towards Picayune Strand because of the south-southwest direction of water flow in the area. Drawdowns extending from about 5–6.5 mi from the eastern boundary of Fakahatchee Strand Preserve State Park are associated with the Barron River Canal, located along State Road 29 on the eastern boundary of the park (see **Figure 2**).

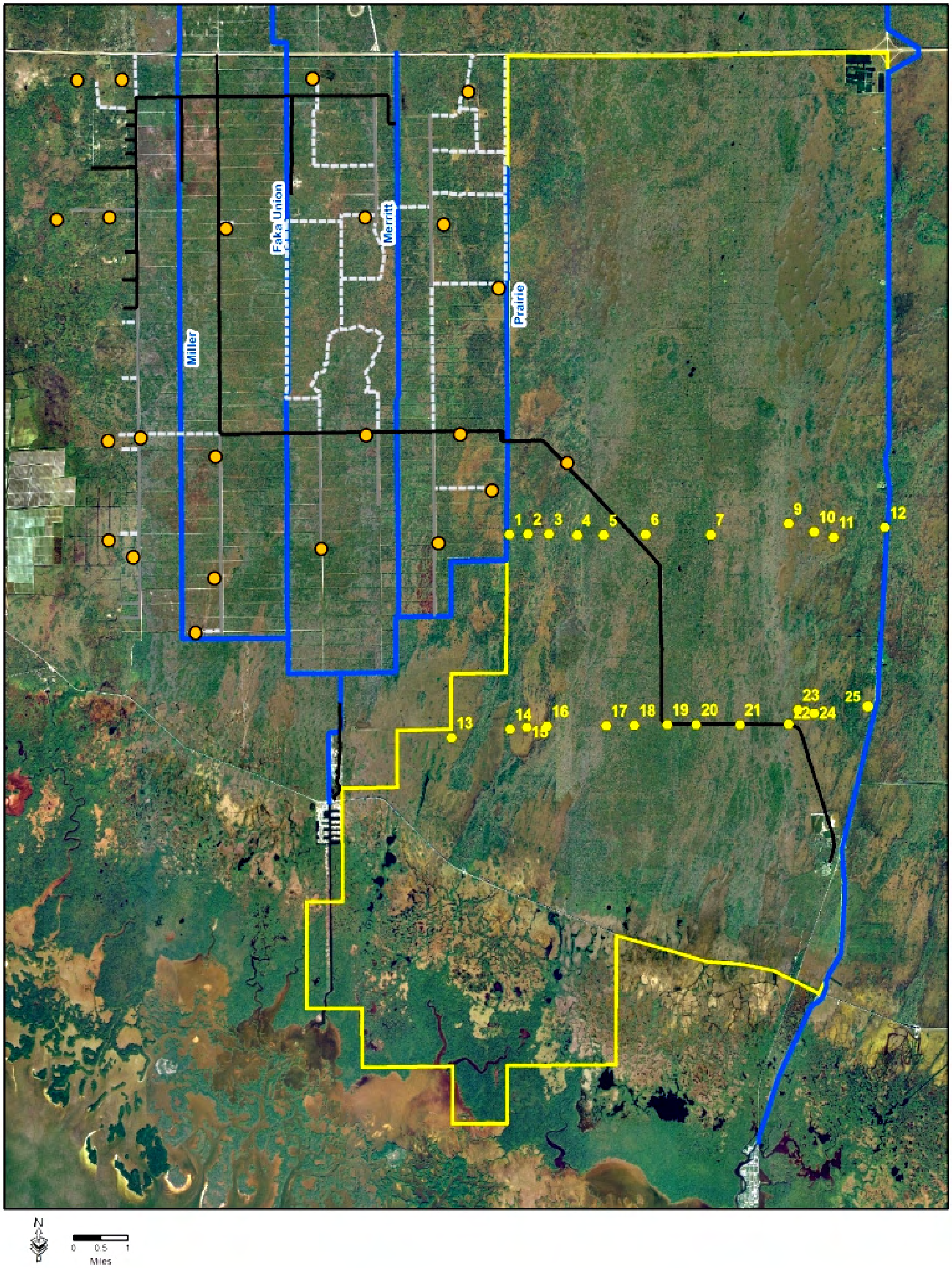

Figure 39. Yellow dots indicate groundwater wells within Fakahatchee Strand Preserve State Park. Orange dots indicate a groundwater well in Picayune Strand (see **Figure 3** for numbering).

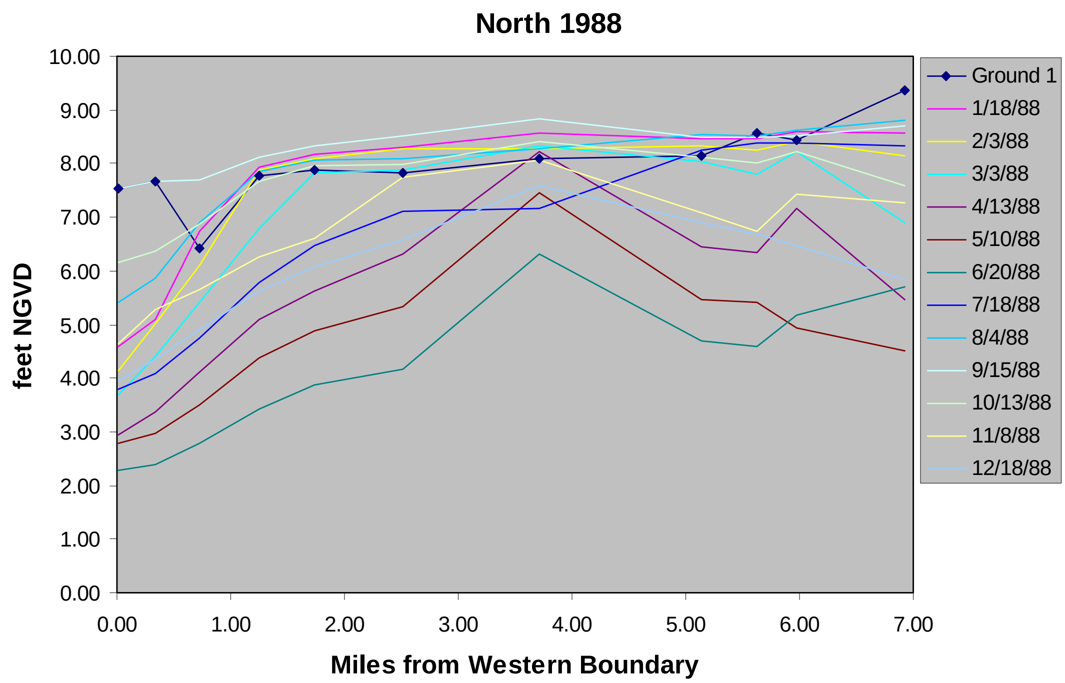

Figure 40. 1988 monthly water profiles for Fakahatchee Strand Preserve State Park North Transect.

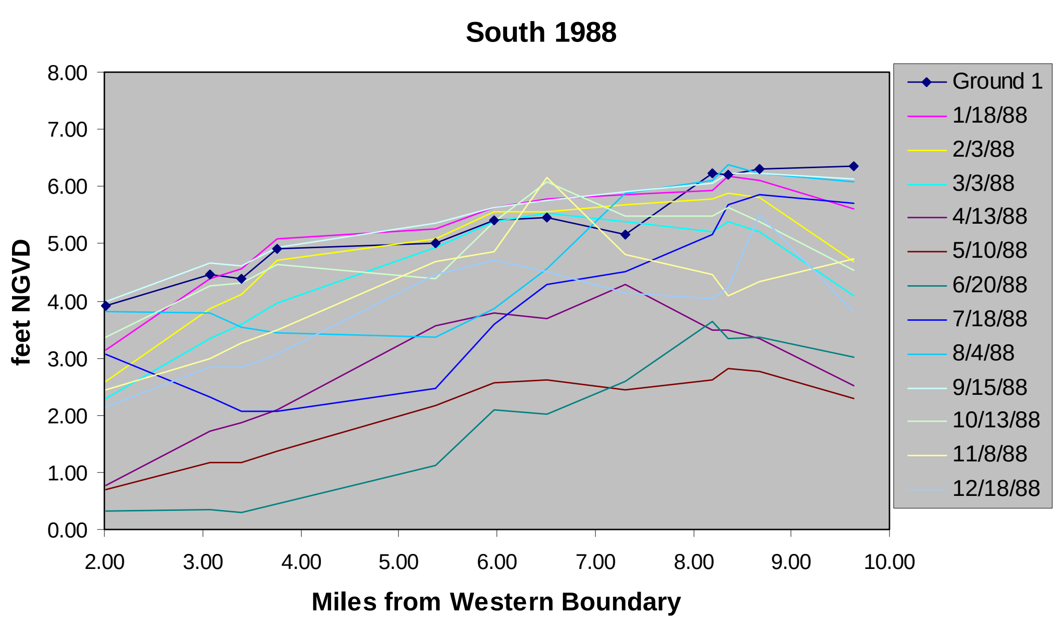

Figure 41. 1988 monthly water profiles for Fakahatchee Strand Preserve State Park South Transect.

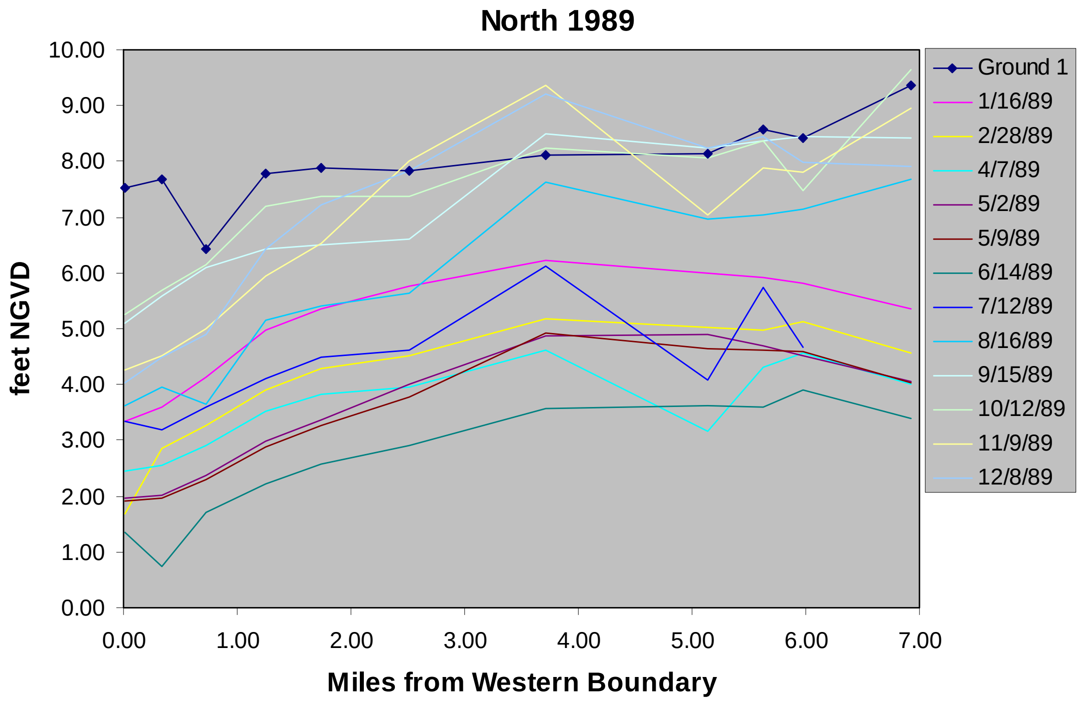

Figure 42. 1989 monthly water profiles for Fakahatchee Strand Preserve State Park North Transect.

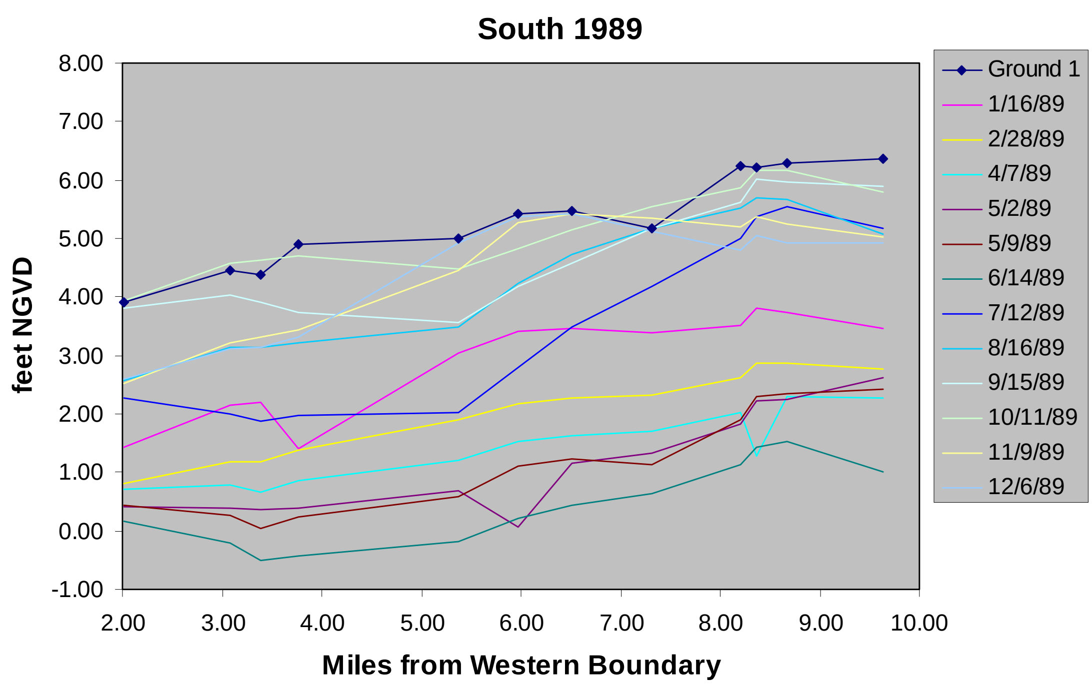

Figure 43. 1989 monthly water profiles for Fakahatchee Strand Preserve State Park South Transect.

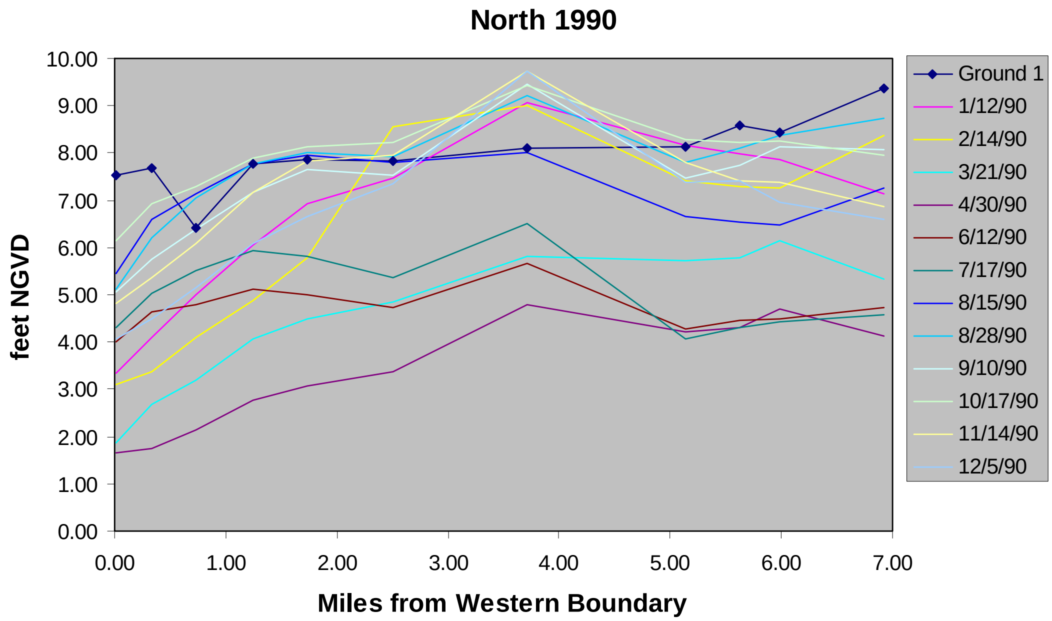

Figure 44. 1990 monthly water profiles for Fakahatchee Strand Preserve State Park North Transect.

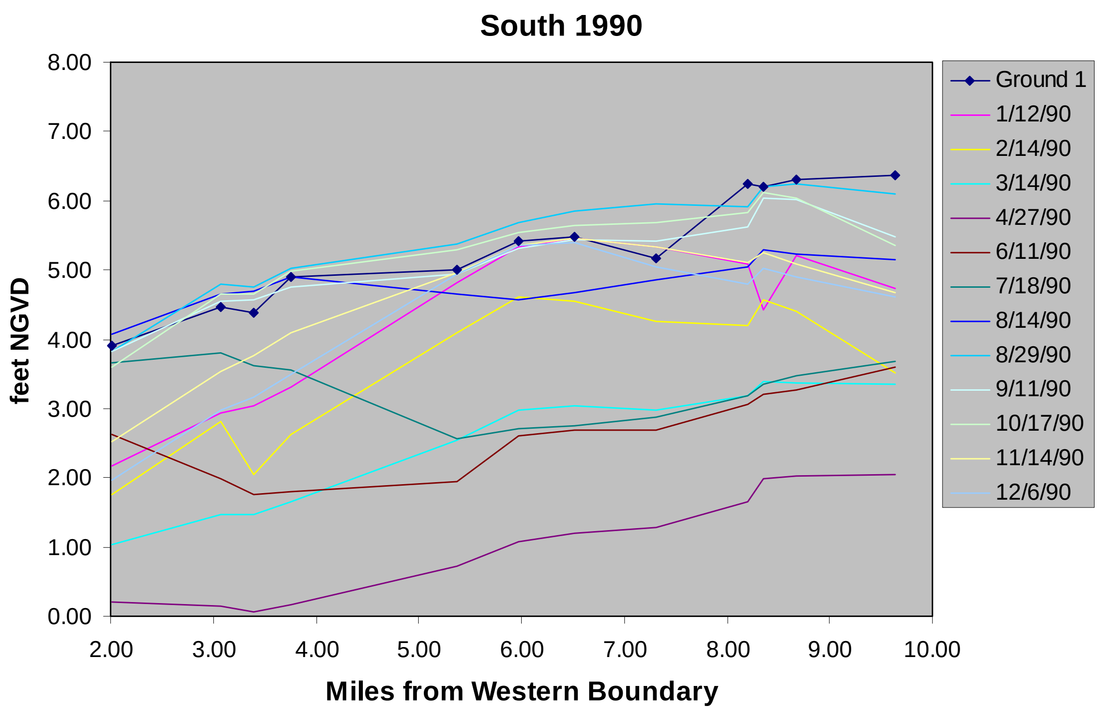

Figure 45. 1990 monthly water profiles for Fakahatchee Strand Preserve State Park South Transect.

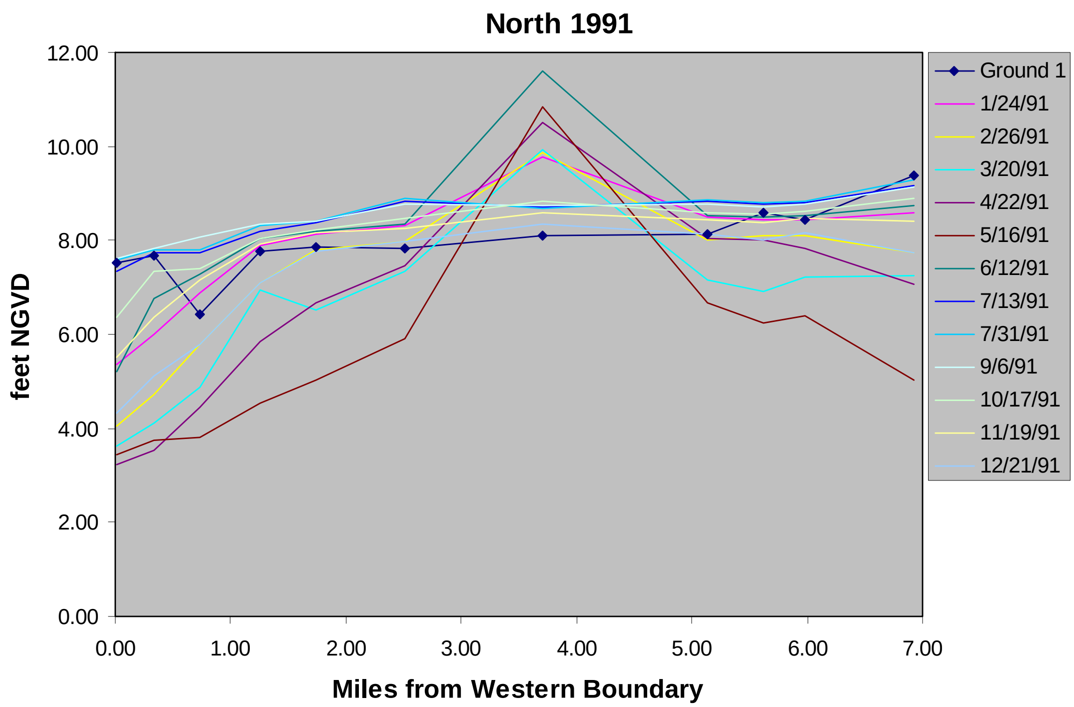

Figure 46. 1991 monthly water profiles for Fakahatchee Strand Preserve State Park North Transect.

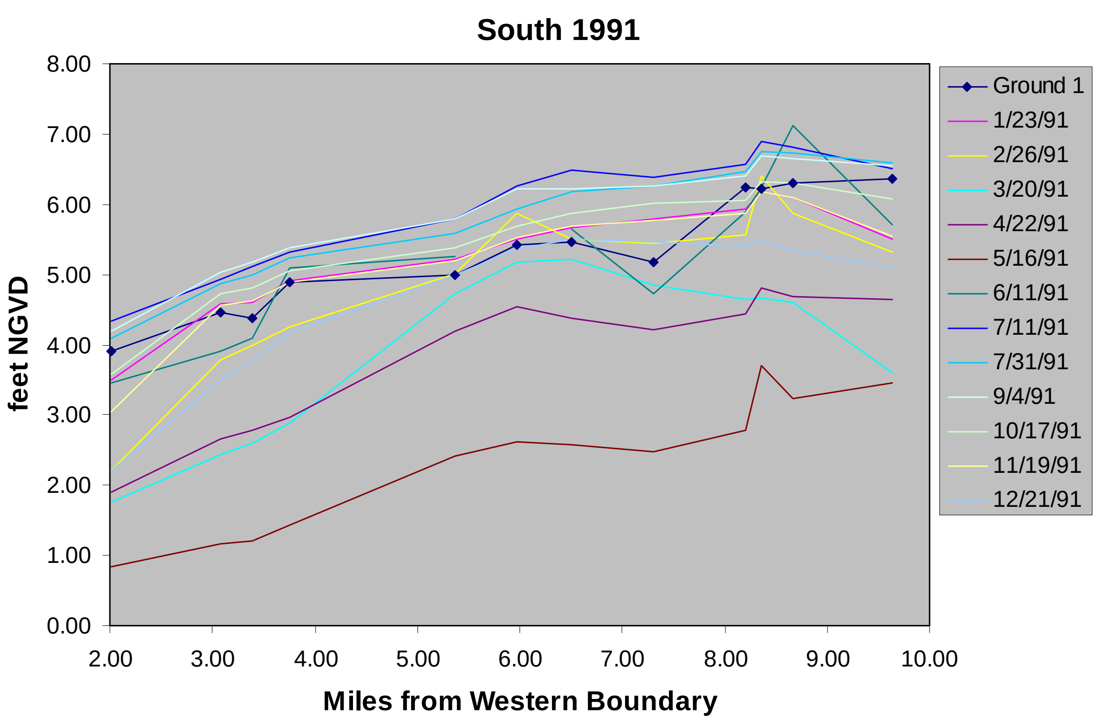

Figure 47. 1991 monthly water profiles for Fakahatchee Strand Preserve State Park South Transect.

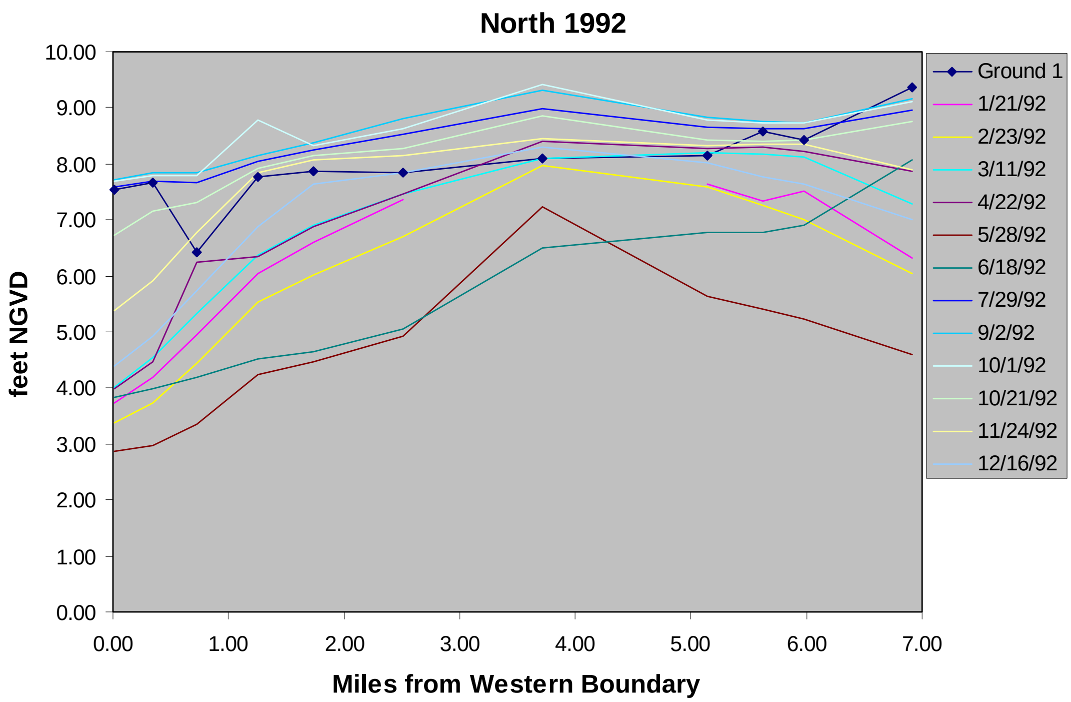

Figure 48. 1992 monthly water profiles for Fakahatchee Strand Preserve State Park North Transect.

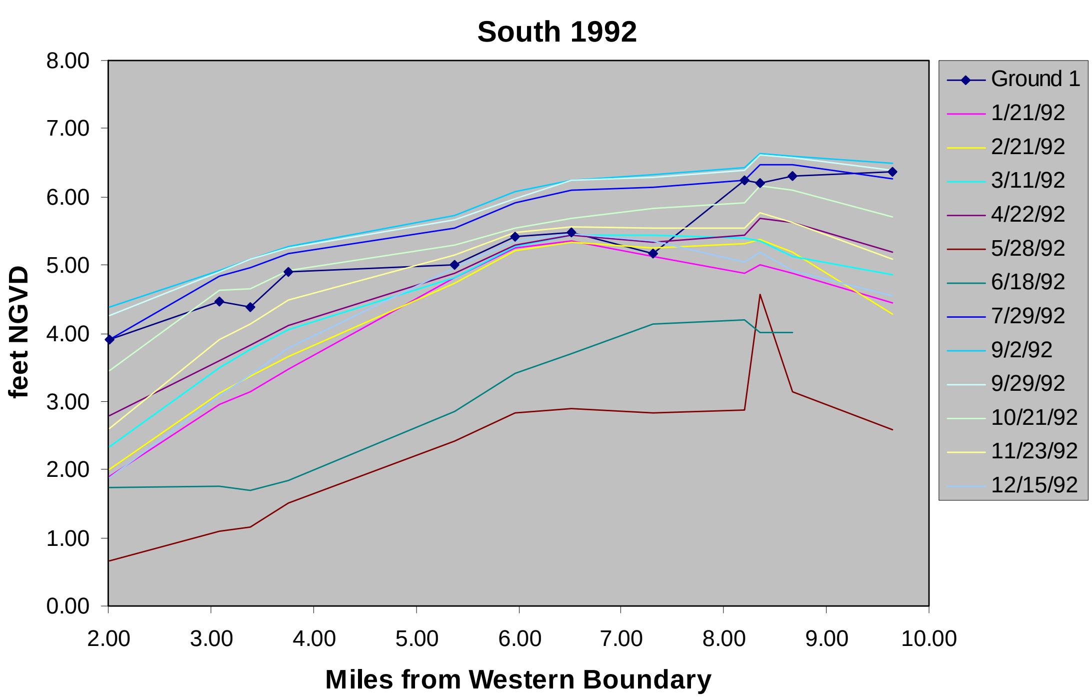

Figure 49. 1992 monthly water profiles for Fakahatchee Strand Preserve State Park South Transect.

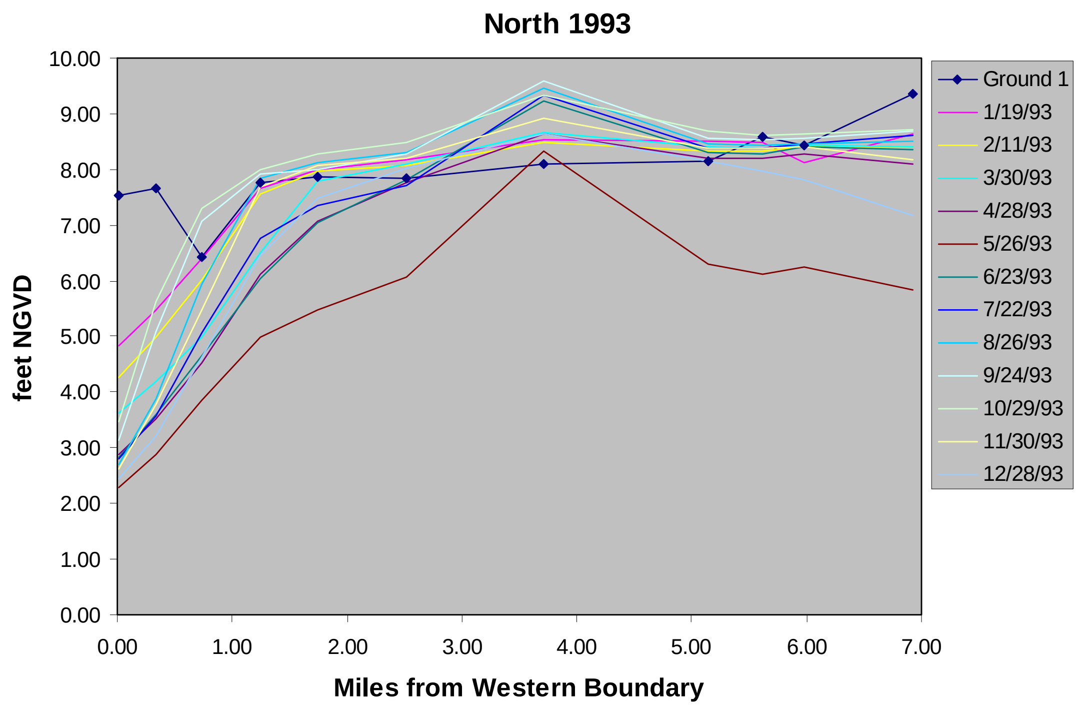

Figure 50. 1993 monthly water profiles for Fakahatchee Strand Preserve State Park North Transect.

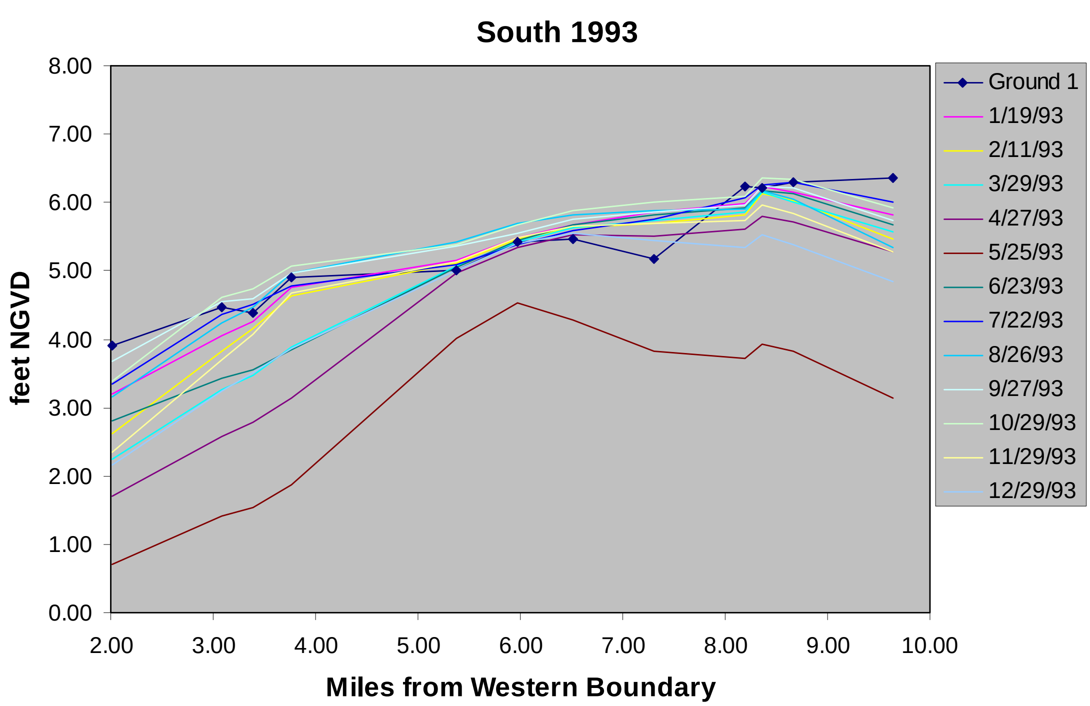

Figure 51. 1993 monthly water profiles for Fakahatchee Strand Preserve State Park South Transect.

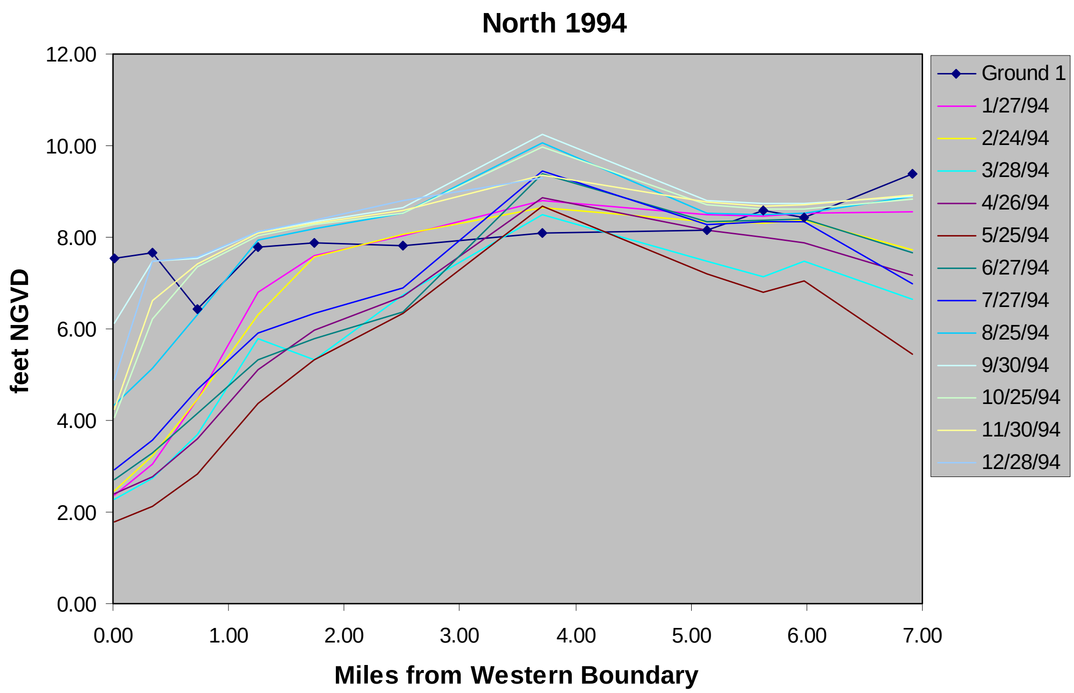

Figure 52. 1994 monthly water profiles for Fakahatchee Strand Preserve State Park North Transect.

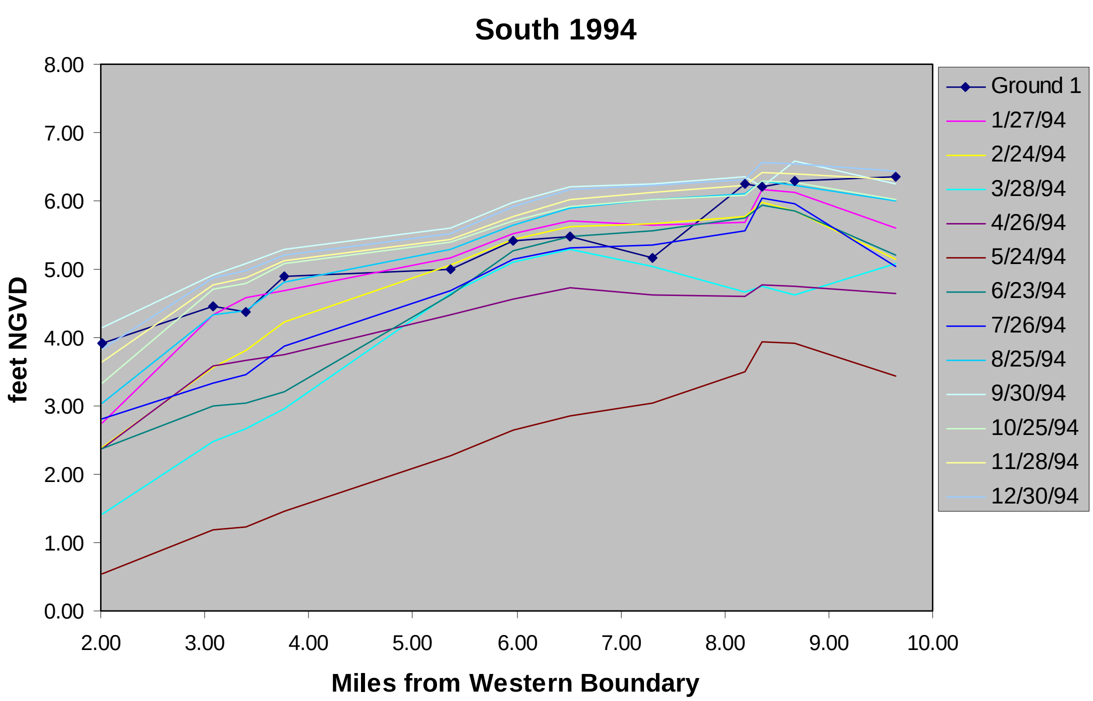

Figure 53. 1994 monthly water profiles for Fakahatchee Strand Preserve State Park South Transect.

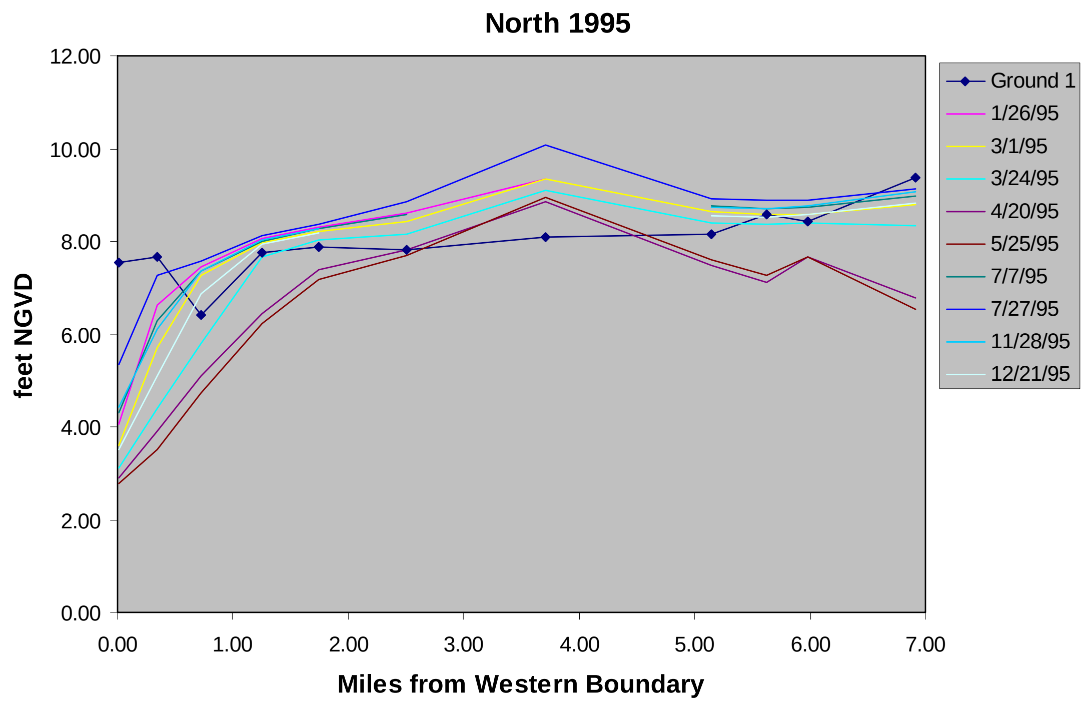

Figure 54. 1995 monthly water profiles for Fakahatchee Strand Preserve State Park North Transect.

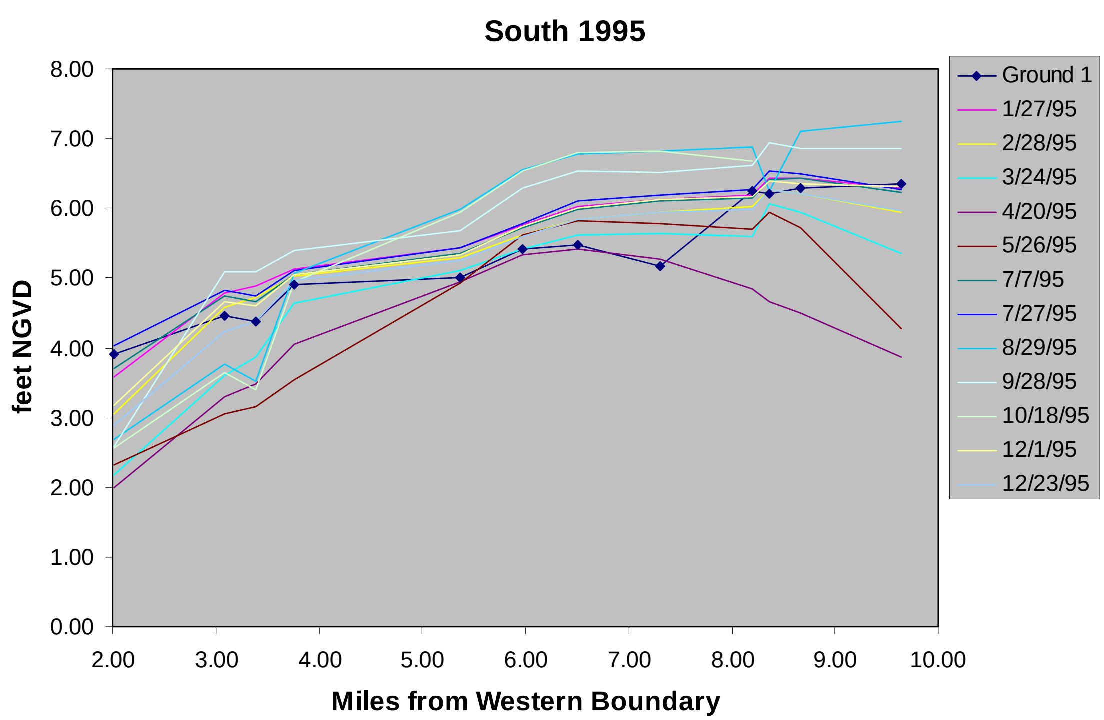

Figure 55. 1995 monthly water profiles for Fakahatchee Strand Preserve State Park South Transect.

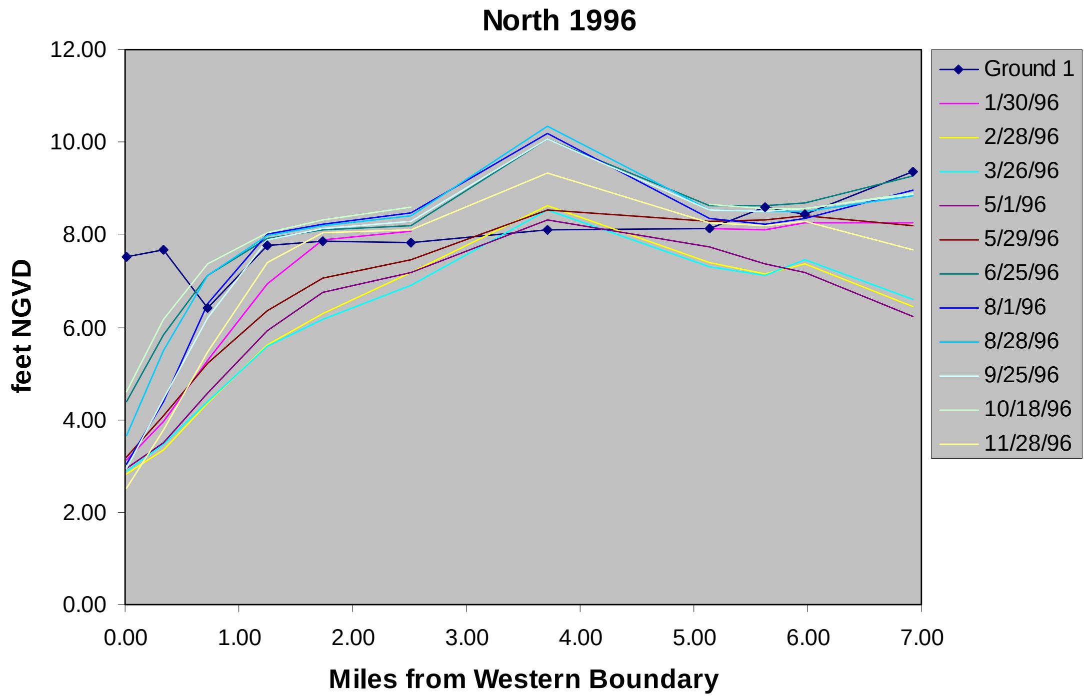

Figure 56. 1996 monthly water profiles for Fakahatchee Strand Preserve State Park North Transect.

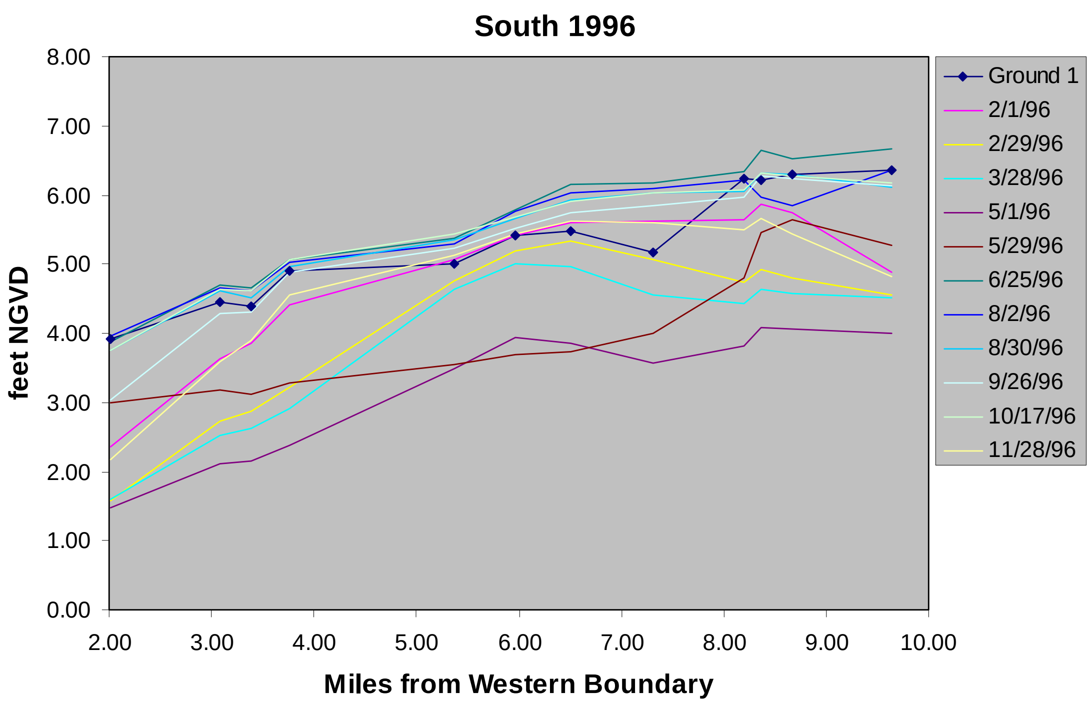

Figure 57. 1996 monthly water profiles for Fakahatchee Strand Preserve State Park South Transect.

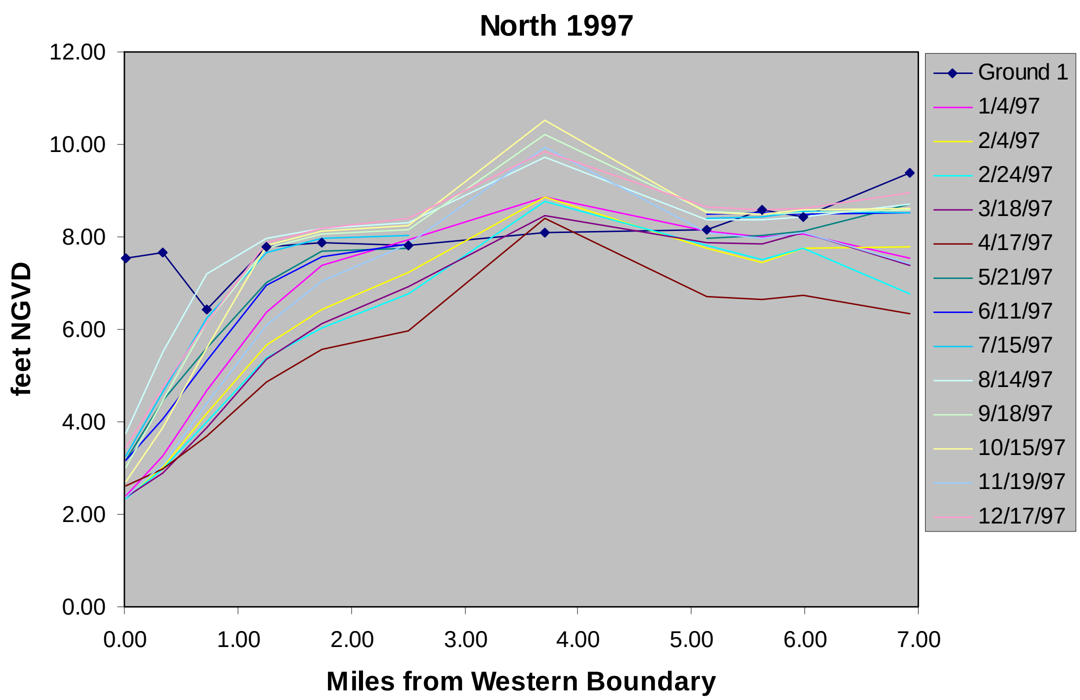

Figure 58. 1997 monthly water profiles for Fakahatchee Strand Preserve State Park North Transect.

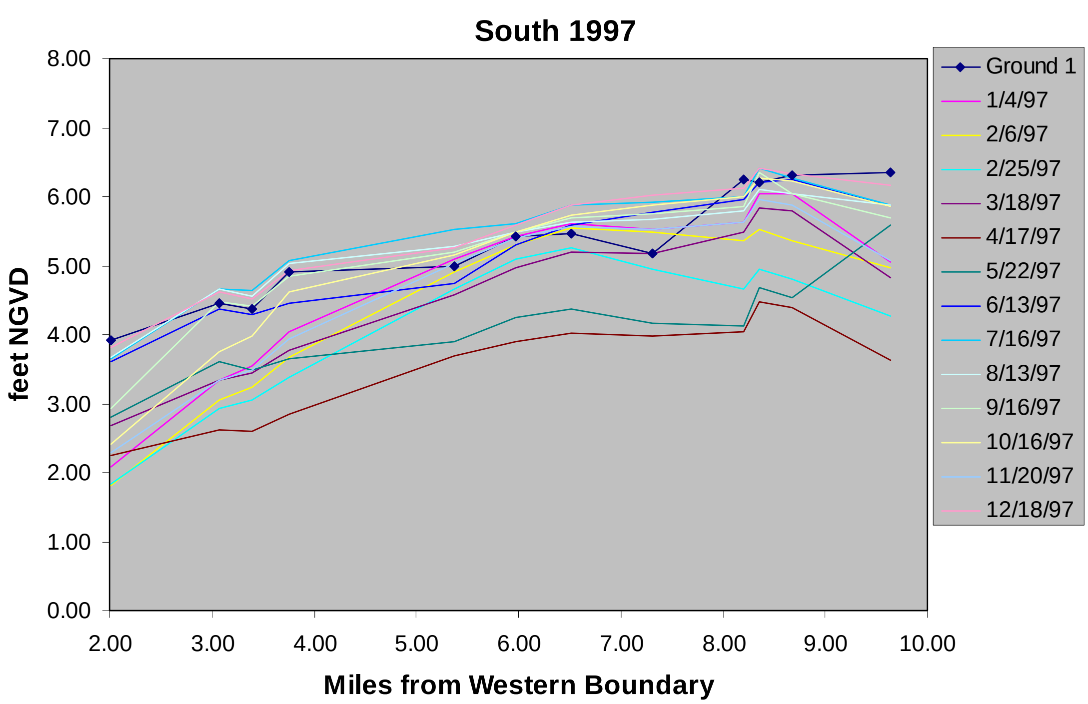

Figure 59. 1997 monthly water profiles for Fakahatchee Strand Preserve State Park South Transect.

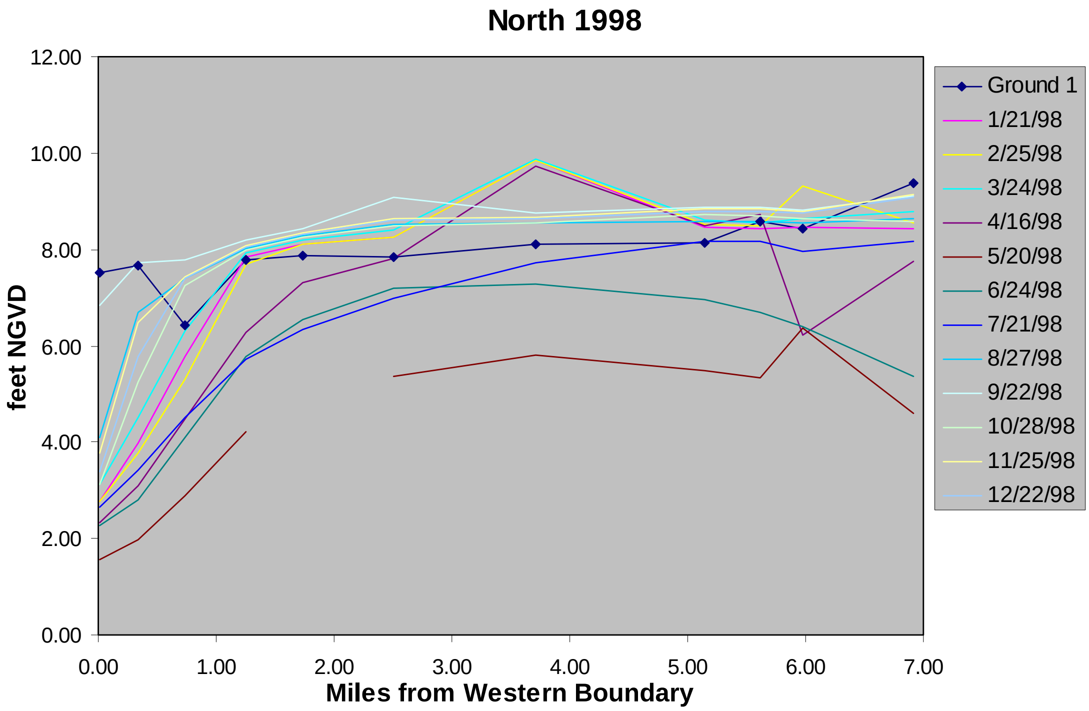

Figure 60. 1998 monthly water profiles for Fakahatchee Strand Preserve State Park North Transect.

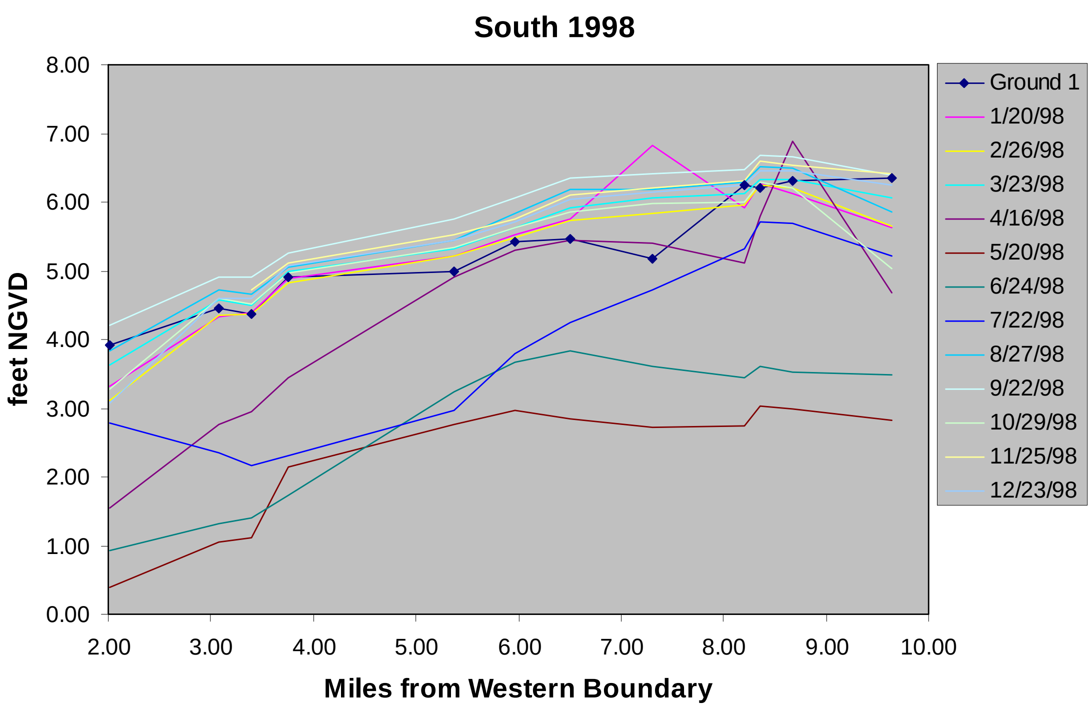

Figure 61. 1998 monthly water profiles for Fakahatchee Strand Preserve State Park South Transect.

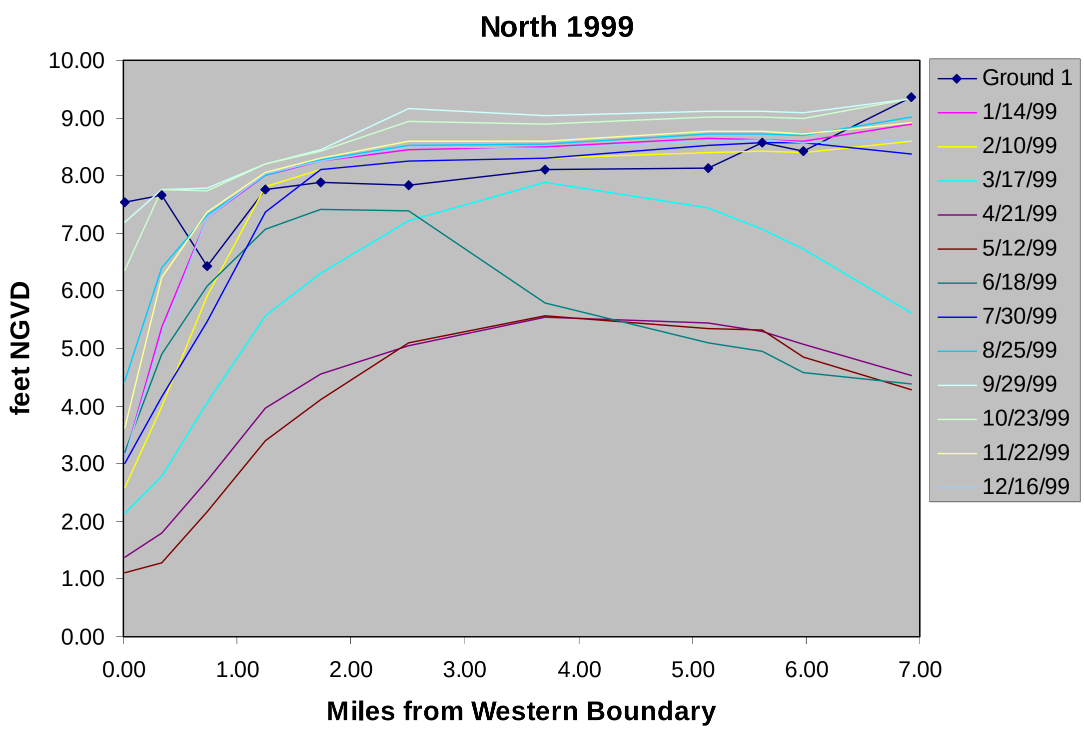

Figure 62. 1999 monthly water profiles for Fakahatchee Strand Preserve State Park North Transect.

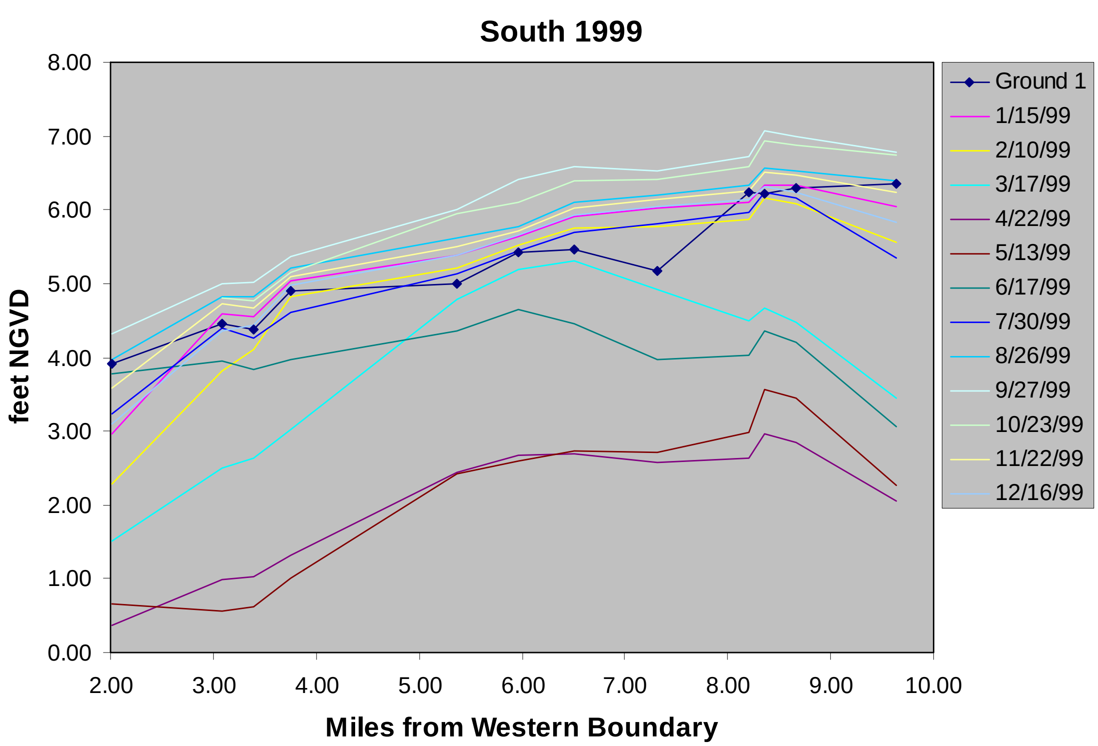

Figure 63. 1999 monthly water profiles for Fakahatchee Strand Preserve State Park South Transect.

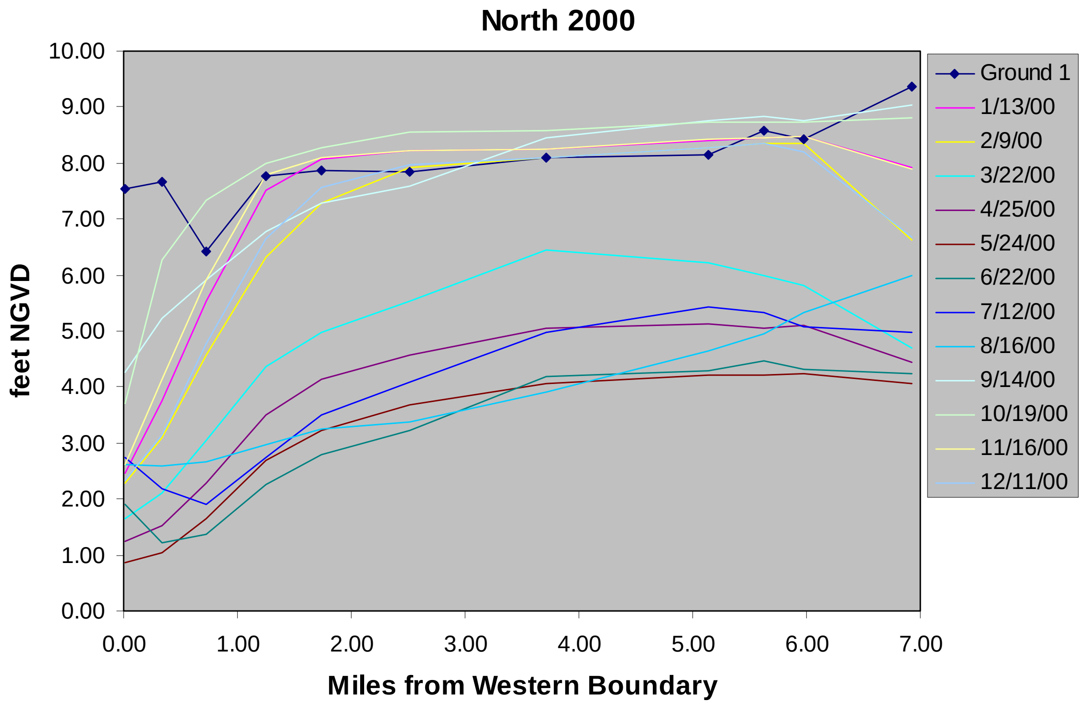

Figure 64. 2000 monthly water profiles for Fakahatchee Strand Preserve State Park North Transect.

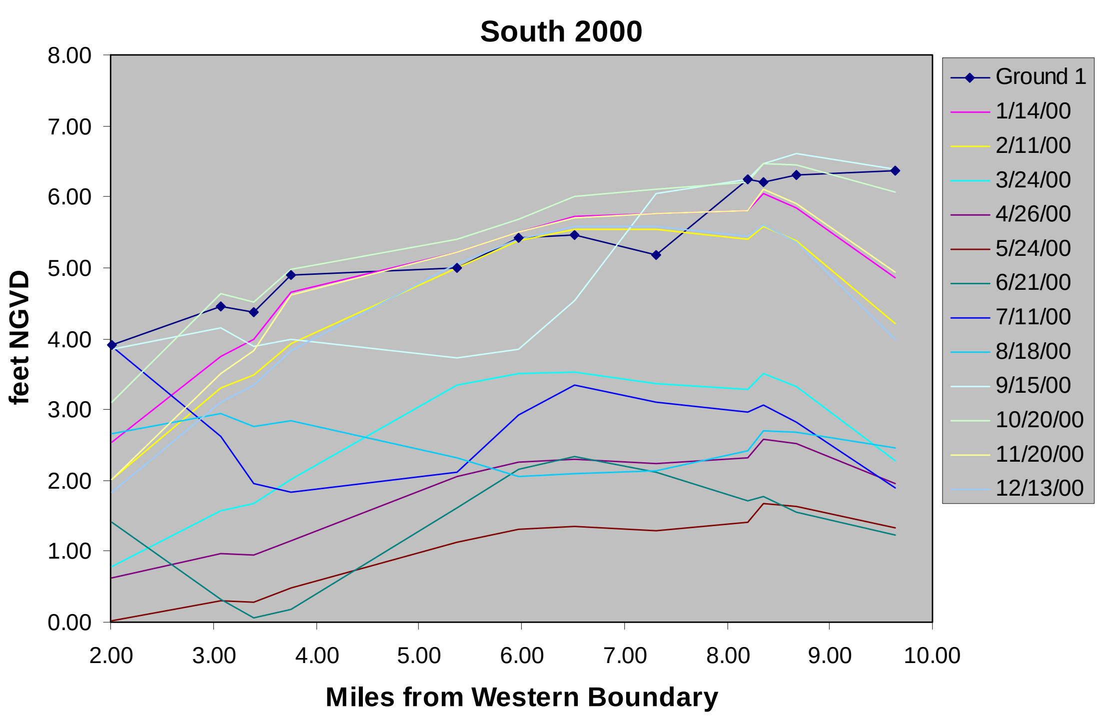

Figure 65. 2000 monthly water profiles for Fakahatchee Strand Preserve State Park South Transect.

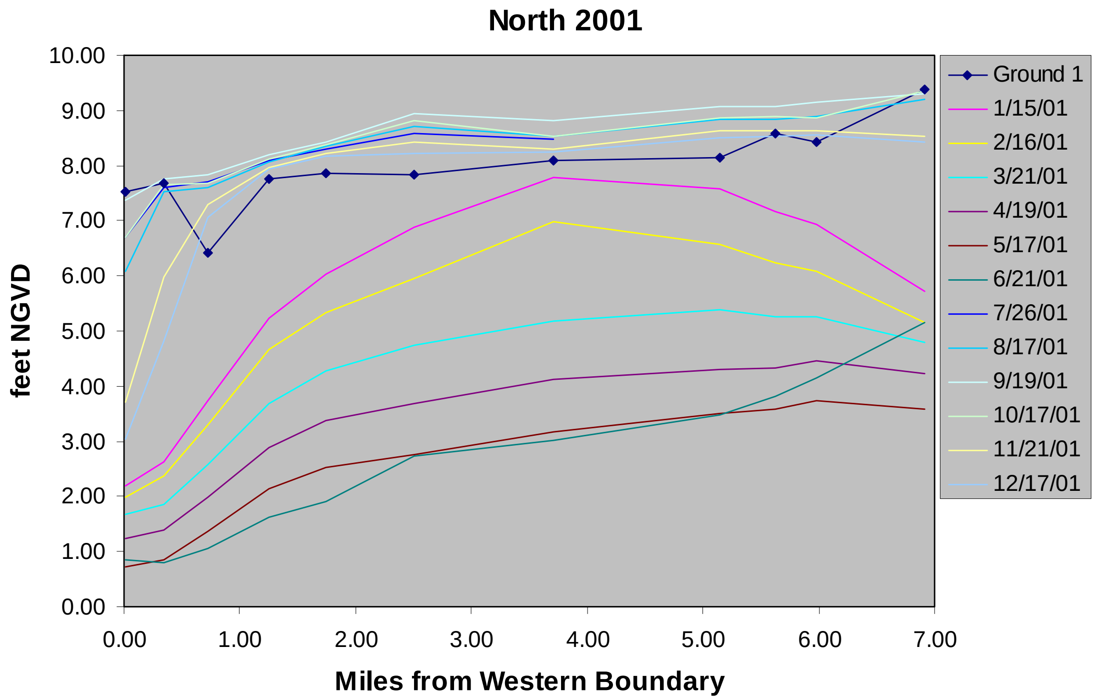

Figure 66. 2001 monthly water profiles for Fakahatchee Strand Preserve State Park North Transect.

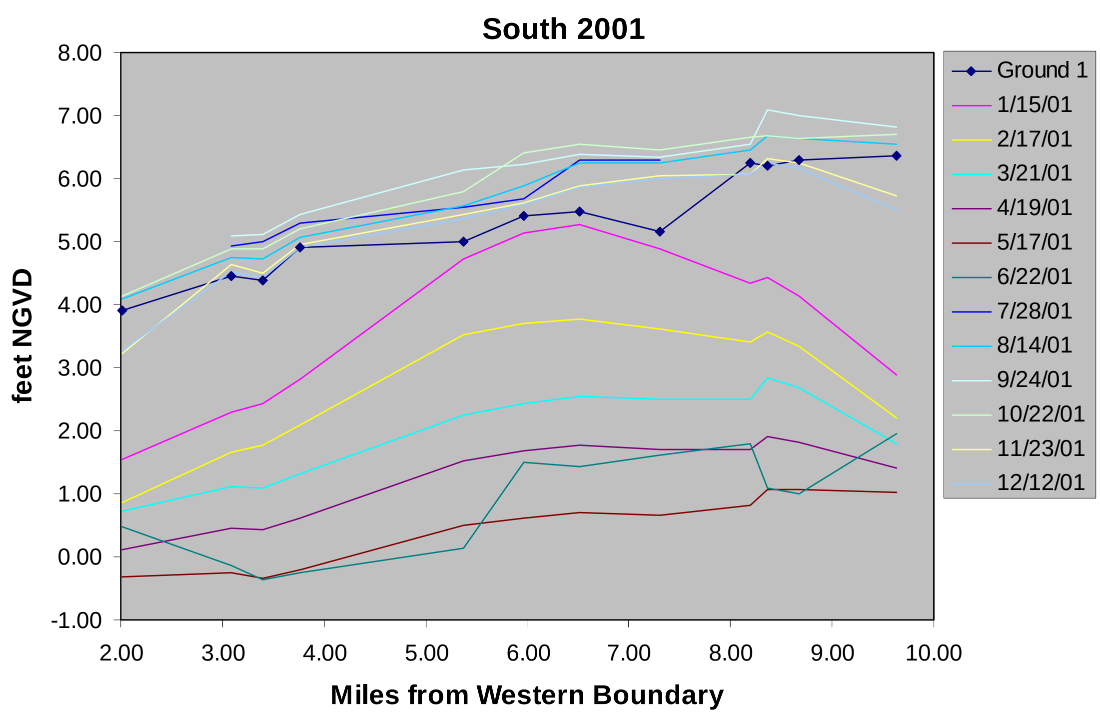

Figure 67. 2001 monthly water profiles for Fakahatchee Strand Preserve State Park South Transect.

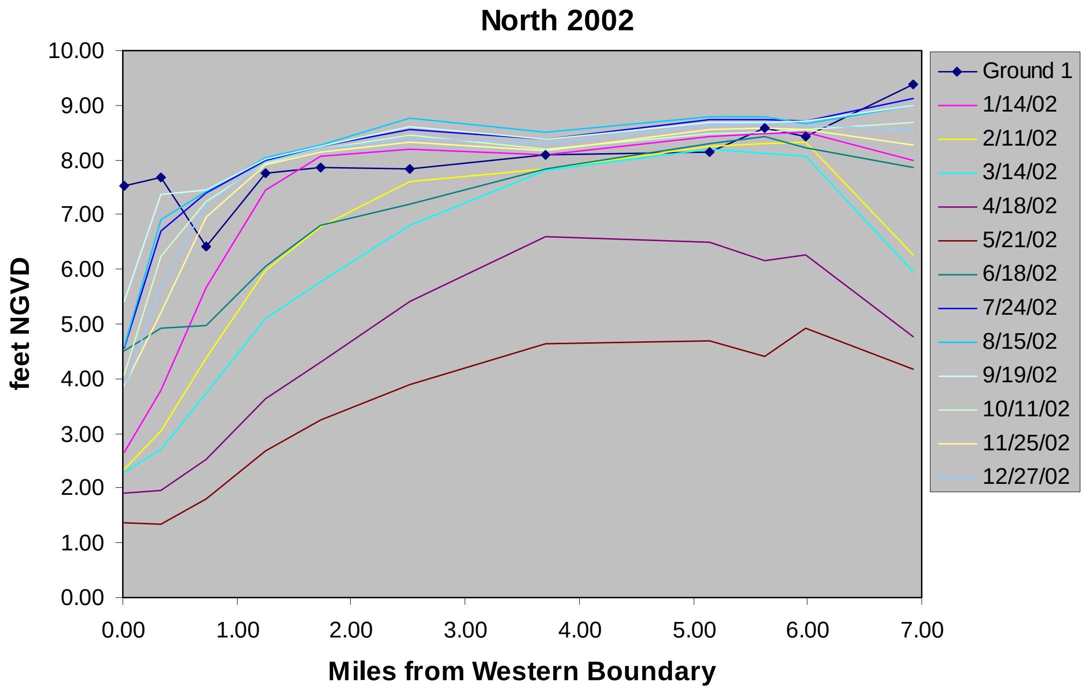

Figure 68. 2002 monthly water profiles for Fakahatchee Strand Preserve State Park North Transect.

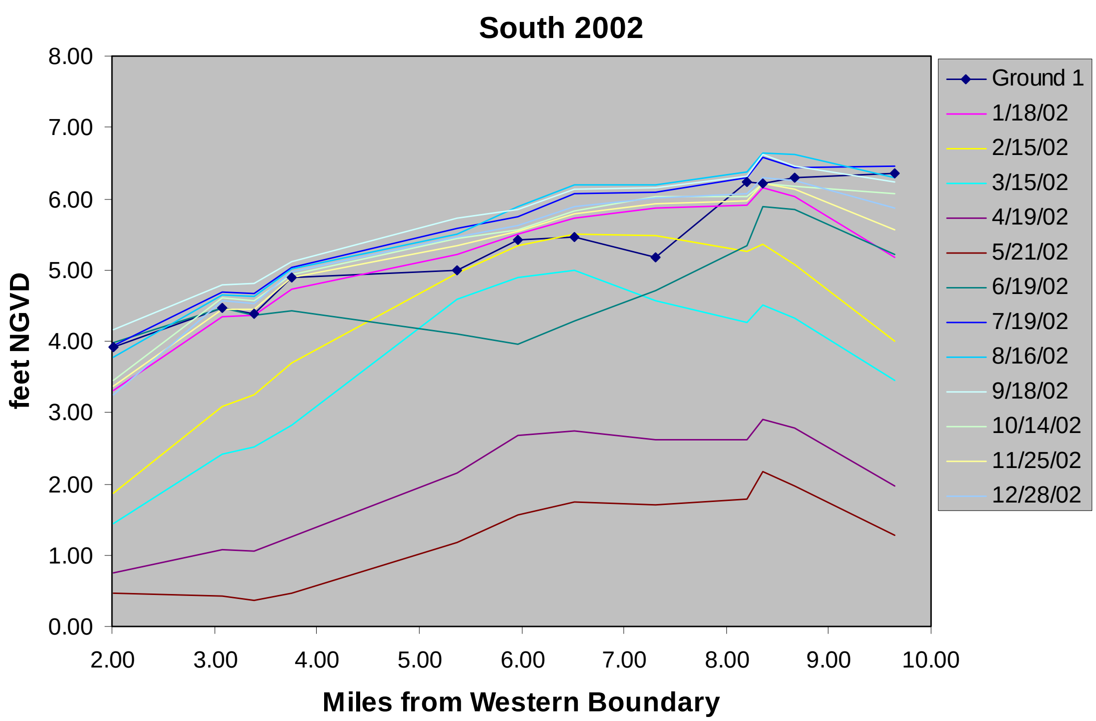

Figure 69. 2002 monthly water profiles for Fakahatchee Strand Preserve State Park South Transect.

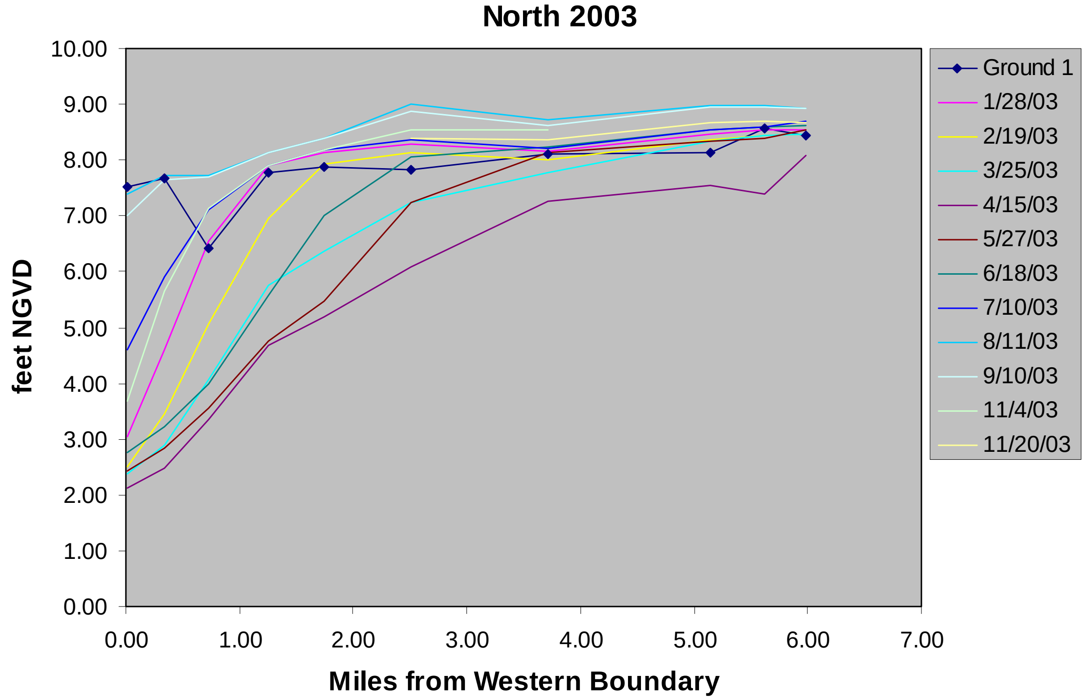

Figure 70. 2003 monthly water profiles for Fakahatchee Strand Preserve State Park North Transect.

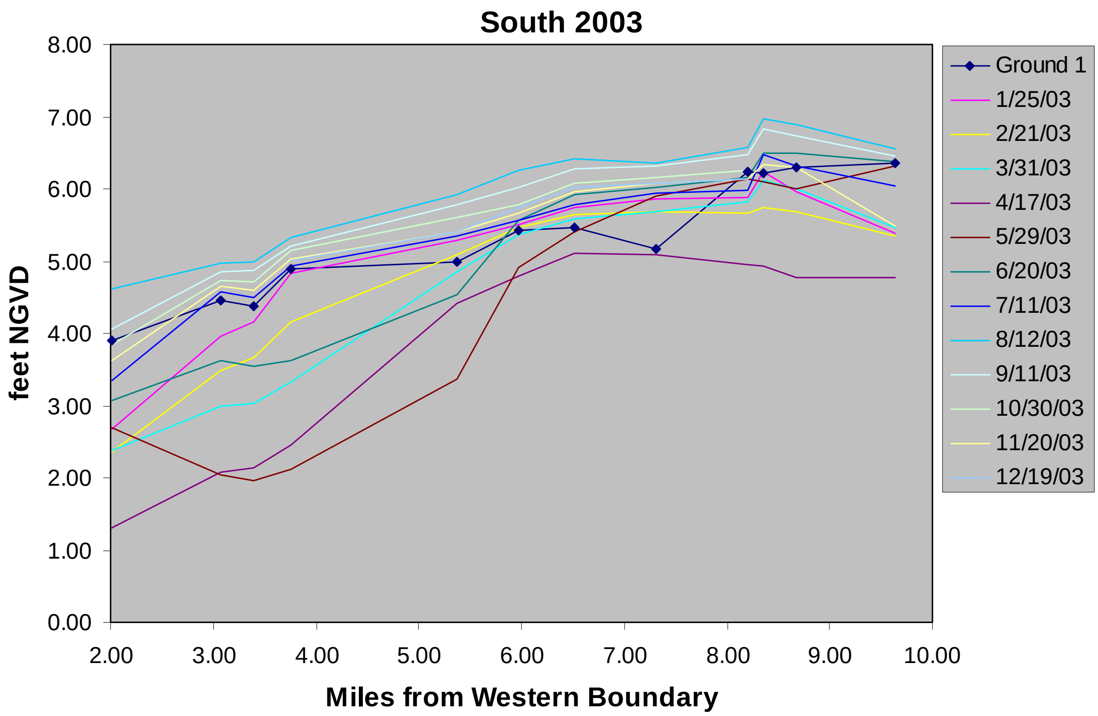

Figure 71. 2003 monthly water profiles for Fakahatchee Strand Preserve State Park South Transect.

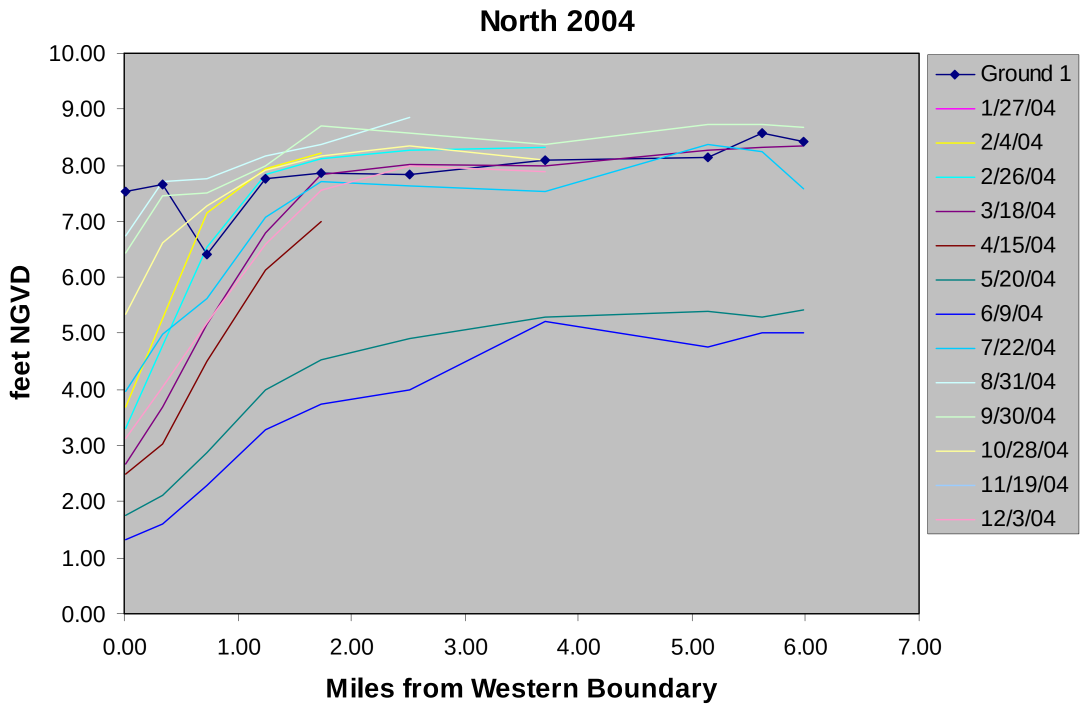

Figure 72. 2004 monthly water profiles for Fakahatchee Strand Preserve State Park North Transect.

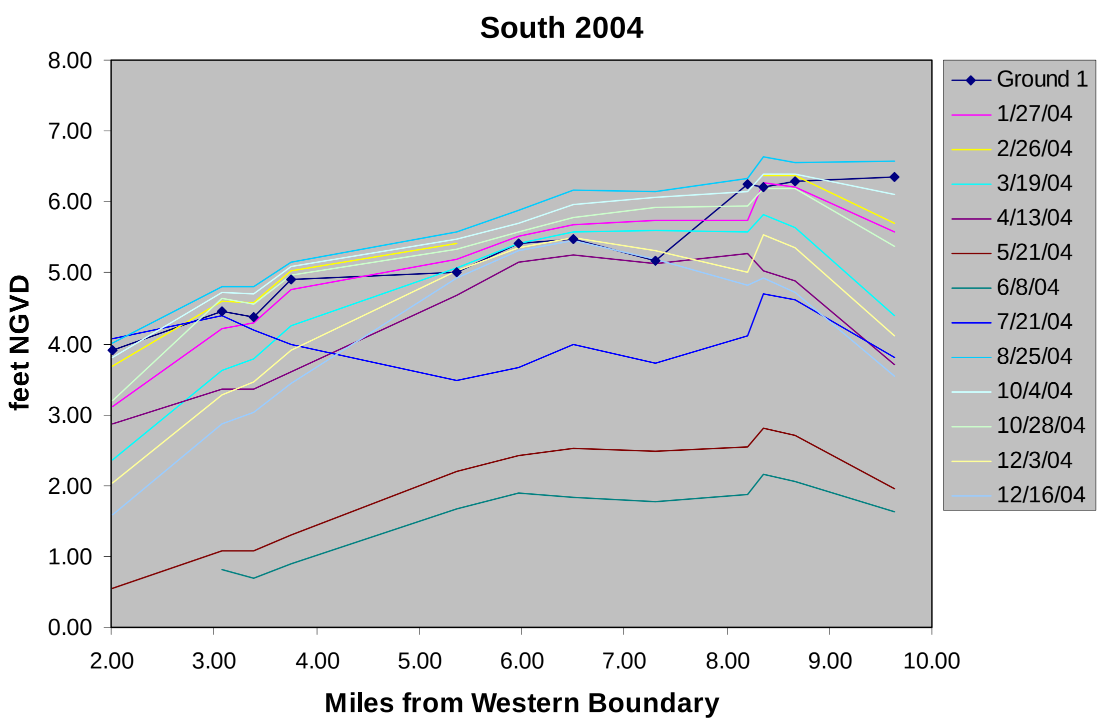

Figure 73. 2004 monthly water profiles for Fakahatchee Strand Preserve State Park South Transect.

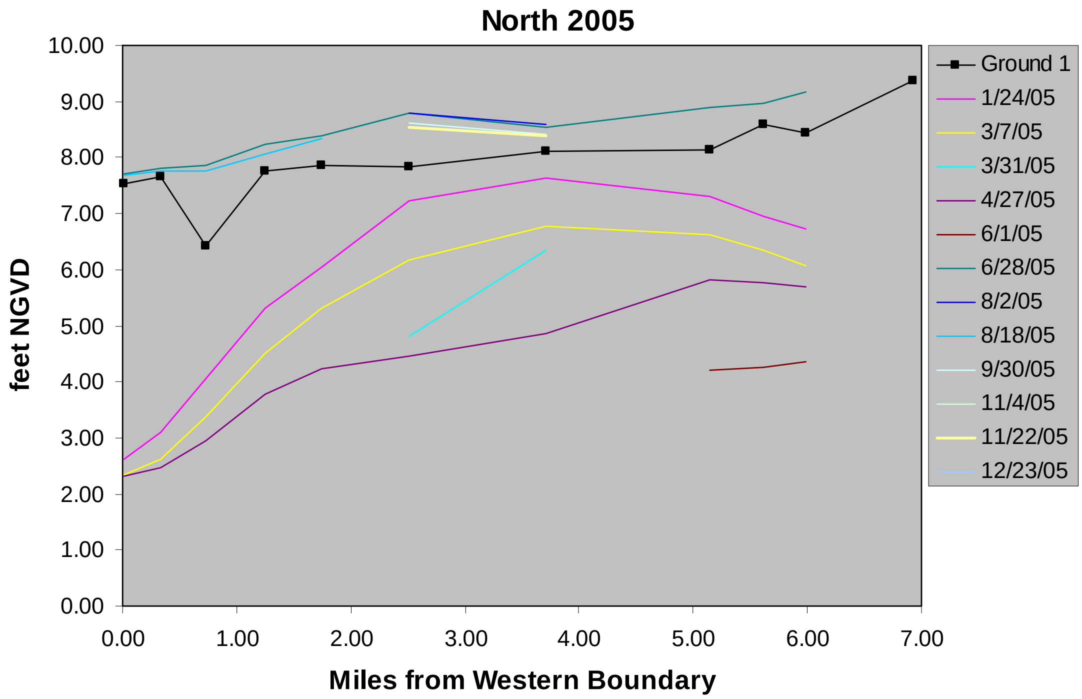

Figure 74. 2005 monthly water profiles for Fakahatchee Strand Preserve State Park North Transect.

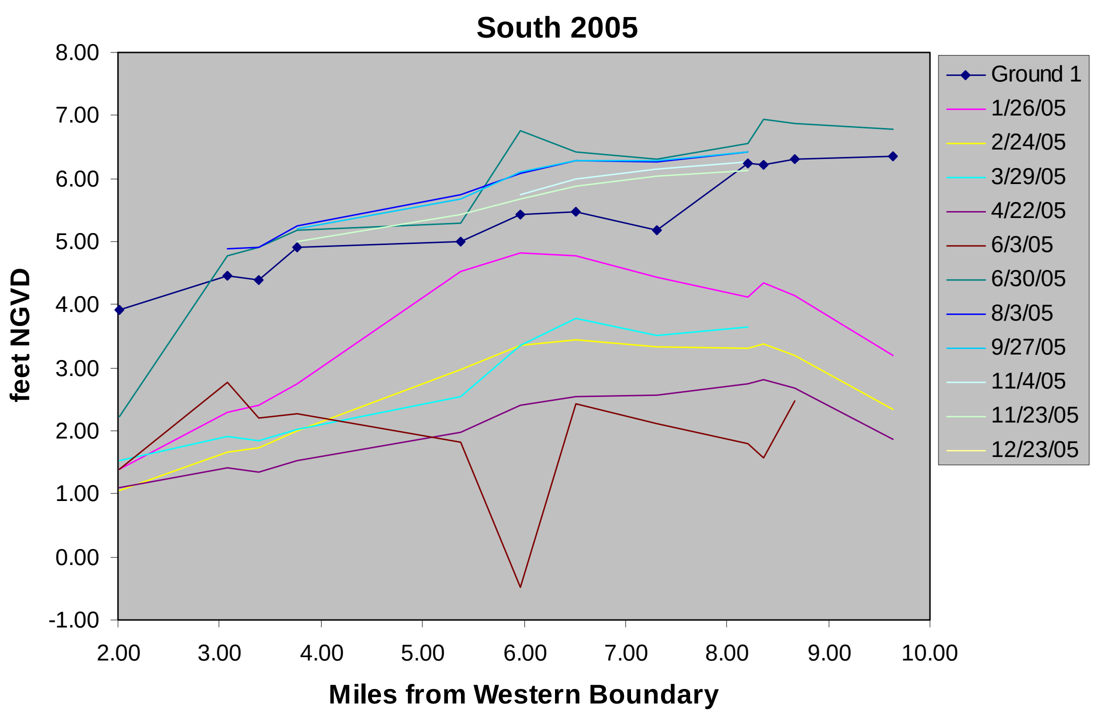

Figure 75. 2005 monthly water profiles for Fakahatchee Strand Preserve State Park South Transect.

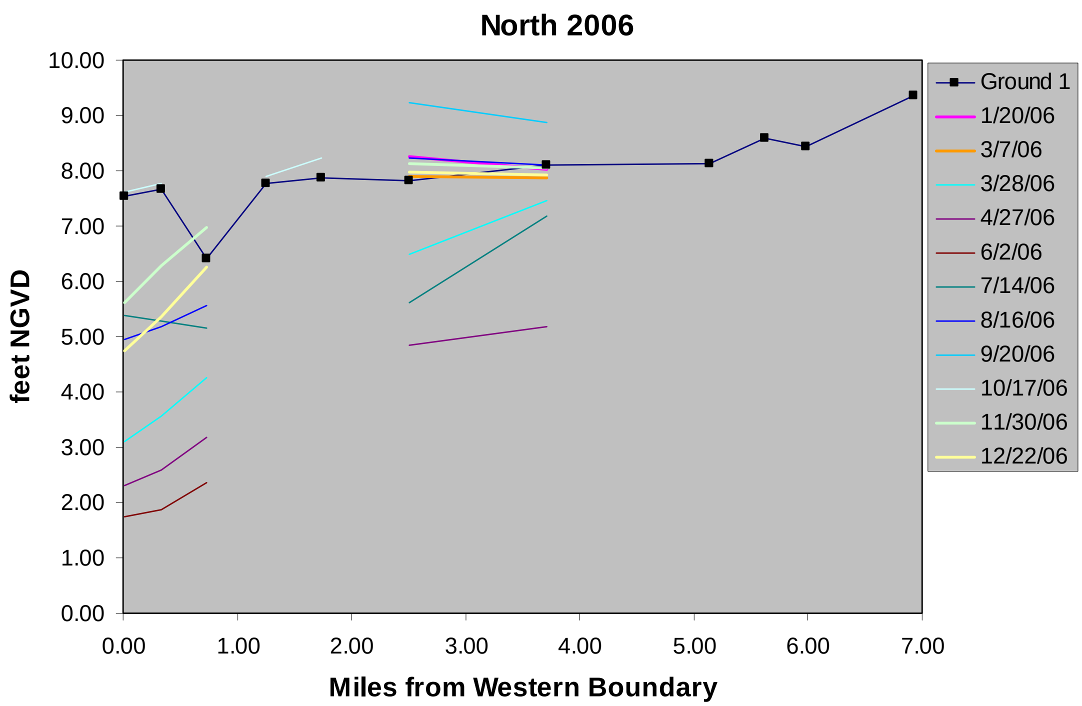

Figure 76. 2006 monthly water profiles for Fakahatchee Strand Preserve State Park North Transect.

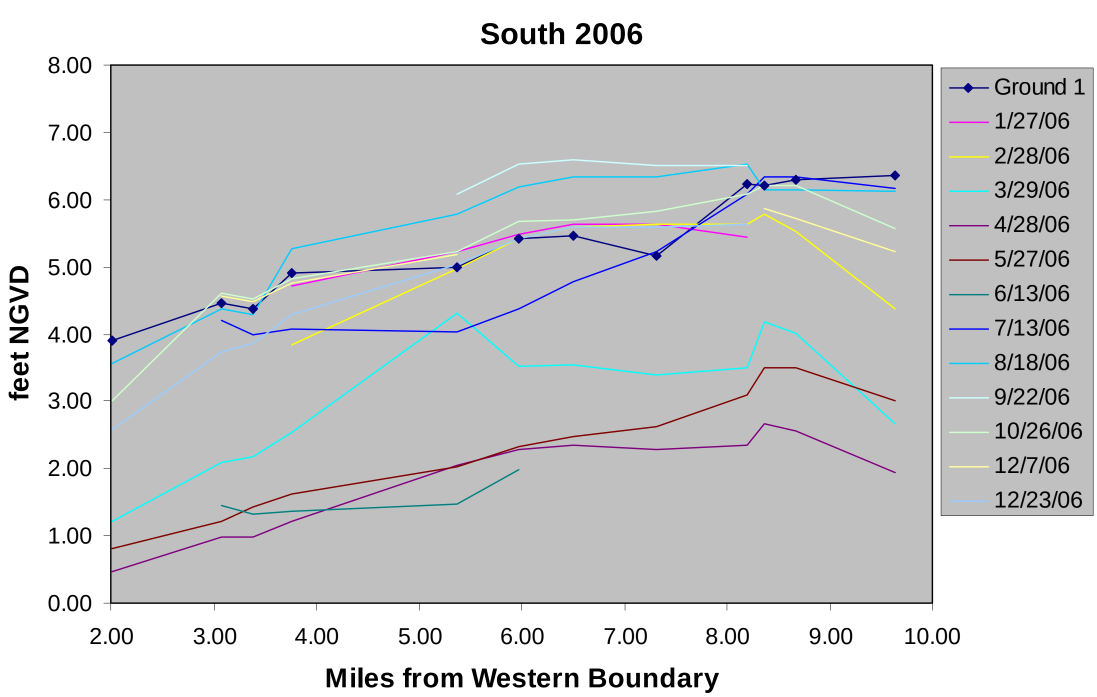

Figure 77. 2006 monthly water profiles for Fakahatchee Strand Preserve State Park South Transect.

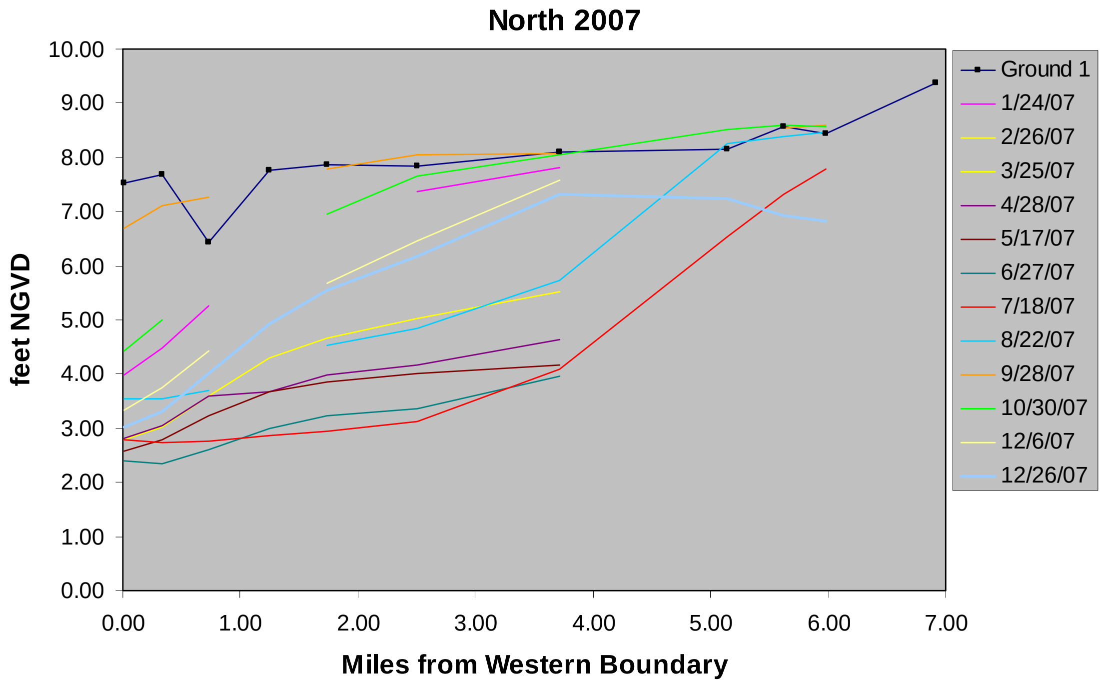

Figure 78. 2007 monthly water profiles for Fakahatchee Strand Preserve State Park North Transect.

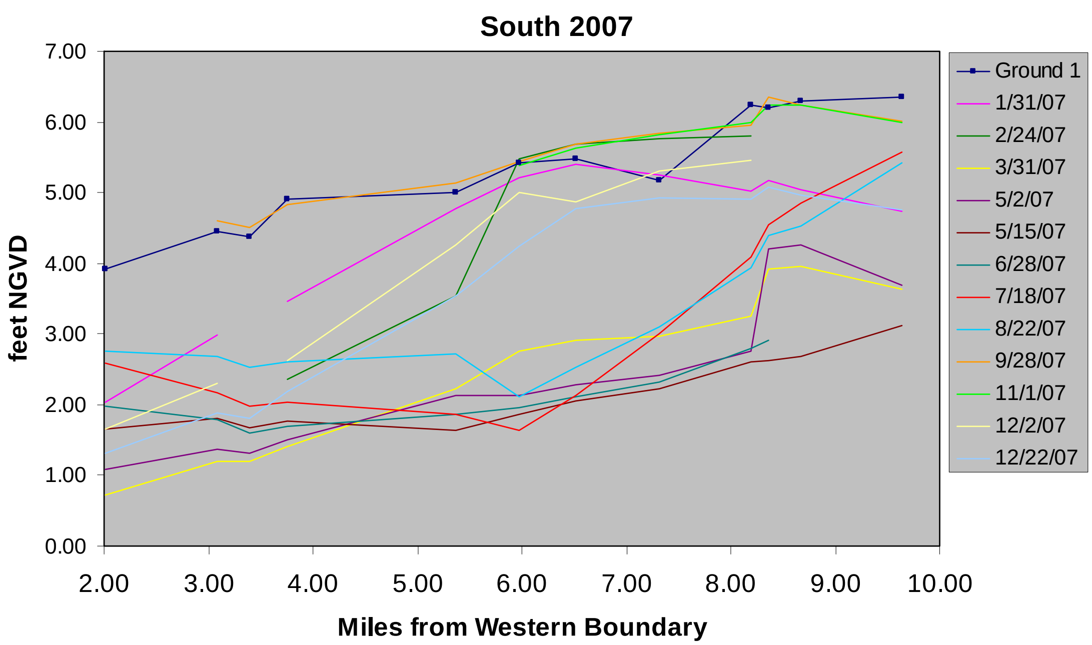

Figure 79. 2007 monthly water profiles for Fakahatchee Strand Preserve State Park South Transect.

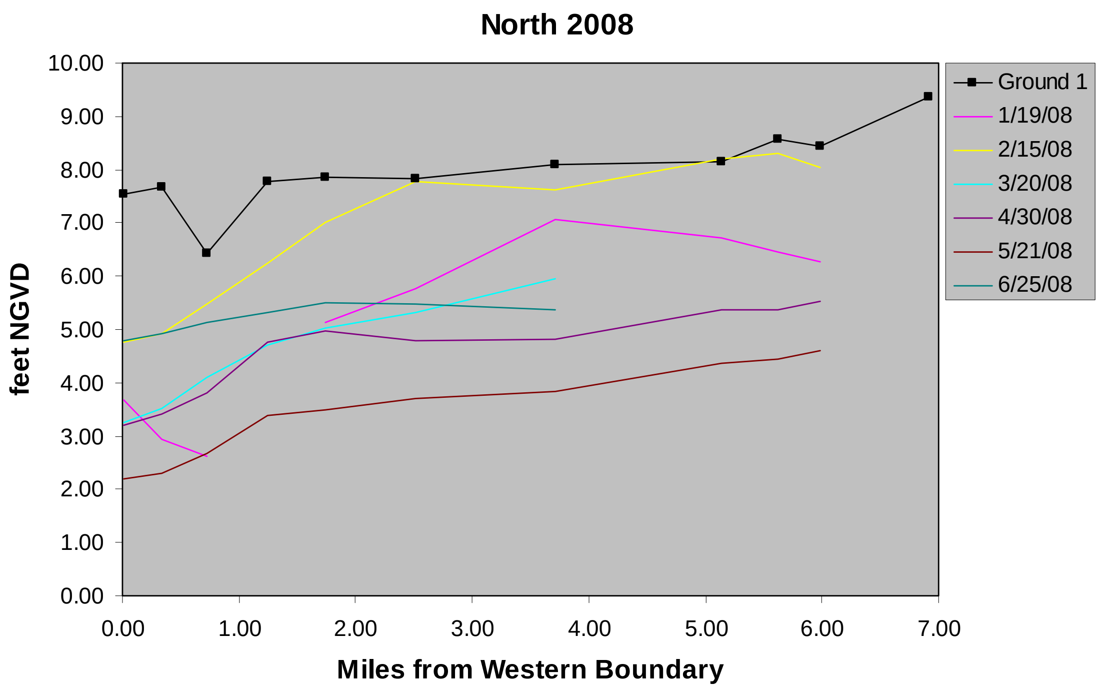

Figure 80. 2008 monthly water profiles (January–June) for Fakahatchee Strand Preserve State Park North Transect.

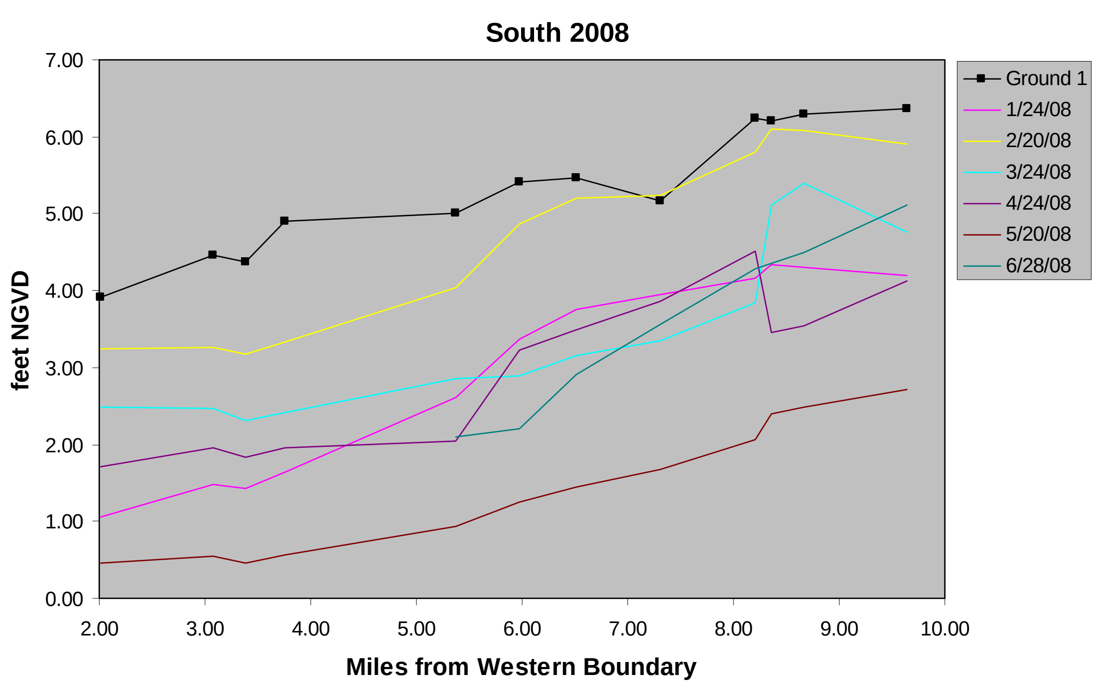

Figure 81. 2008 monthly water profiles (January–June) for Fakahatchee Strand Preserve State Park State Park South Transect.

FLORIDA PANTHER

Picayune Strand provides habitat for the endangered Florida panther (*Puma concolor couguar*) (USACE and SFWMD, 2004) (**Figure 82**). Radio telemetry information for the Florida panther indicates significantly less use of the project area than adjacent public lands to the east and west, possibly due to reduced prey availability and disturbance related to human presence, which is exacerbated by a grid road system (USACE and SFWMD, 2004). Rehydration of project wetlands, restoration of more natural plant cover, and removal of most human disturbance within the large project area will undoubtedly favor the panther's ability to feed, breed, and shelter. Restoration will also improve habitat conditions for the panthers' prey base.

Figure 82. Florida panther (photo by the Conservancy of Southwest Florida by remote camera).

A study was conducted by the Conservancy of Southwest Florida (Shindle and Kelly, 2007) that described the present use by the Florida panther and its primary prey of the Picayune Strand Restoration Project Area. The study was conducted using infrared-triggered remote cameras to obtain three types of indices in panthers and their primary prey: (1) panther and prey presence-absence, including spatial distribution within the project area, (2) relative abundance (traffic) of panther and prey, and (3) minimum numbers of adult panthers known to be alive.

Within the project area, from July 2005 through March 2007, cameras recorded 12,137 photos of 16 mammal and 16 bird species (**Table 2**; **Figure 84**). Cameras were also used in Fakahatchee Strand Preserve State Park and Florida Panther National Wildlife Refuge for reference (**Figure 85**). Fakahatchee Strand Preserve State Park cameras recorded 2,133 photos of 10 mammal, eight bird, and one reptile species (**Table 2**). Florida Panther National Wildlife Refuge cameras recorded 5,050 photos of 10 mammal and 11 bird species (**Table 2**). Human related activities, primarily vehicular and pedestrian, accounted for an additional 5,116, 1,622, and 1,878 photos in Picayune Strand Restoration Project Area, Fakahatchee Strand Preserve State Park, and Florida Panther National Wildlife Refuge, respectively (**Table 2**).

Where possible, individual panthers were identified by age, gender, presence or absence of radio collar, kinked tail, or mid-dorsal cowlick (**Figure 83**), and presence of unique morphological characteristics. The minimum number of individual panthers documented on a monthly basis in Picayune Strand Restoration Project Area was two to seven adults and zero to five kittens (**Figure 86a**) compared to one to five and one to seven adults in Fakahatchee Strand and Florida Panther National Wildlife Refuge, respectively (**Figures 86b** and **86c**). The higher number in the restoration area is due to the larger area sampled.

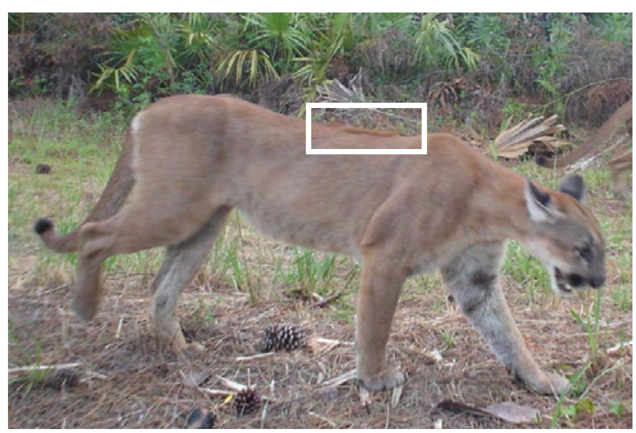

Figure 83. Example of mid-dorsal cowlick (photo by the Conservancy of Southwest Florida by remote camera).

Table 2. Species captured during infrared-triggered remote camera surveys.

Species	No. of Photographs (No. of Camera Stations)		
	Picayune Strand	Fakahatchee Strand Preserve State Park	Florida Panther National Wildlife Refuge
Mammals			
White-tailed deer (*Odocoileus virginianus*)	5,760 (96)	1,411 (10)	2,548 (10)
Black bear (*Ursus americanus floridanus*)	1,606 (95)	273 (10)	338 (10)
Bobcat (*Lynx rufus*)	819 (70)	39 (8)	127 (10)
Raccoon (*Procyon lotor*)	777 (65)	46 (8)	56 (7)
Florida panther (*Puma concolor couguar*)	569 (84)	148 (10)	321 (10)
Feral cattle (*Bos taurus*)	521 (15)		
Virginia opossum (*Didelphis virginana*)	95 (20)	19 (3)	47 (4)
Coyote (*Canis latrans*)	71 (15)		2 (2)
Cottontail rabbit (*Sylvilagus floridanus*)	61 (9)		1 (1)
Domestic dog (*Canis familiaris*)	38 (17)	5 (3)	16 (5)
Nine-banded armadillo (*Dasypus novemcinctus*)	25 (7)	1 (1)	22 (2)
Feral hog (*Sus scrofa*)	19 (6)		2 (2)
Eastern grey squirrel (*Sciurus carolensis*)	13 (2)	5 (3)	4 (2)
River otter (*Lontra canadensis*)	12 (2)	5 (1)	
Spotted skunk (*Spilogale putorius*)	7 (1)		
Domestic cat (*Felis silvestris catus*)	1 (1)		
Unknown mammals	38 (24)	6 (5)	7 (3)
Birds			
Wild turkey (*Meleagris gallopavo*)	1,248 (65)		1,488 (10)
Great blue heron (*Ardea herodias*)	178 (20)	75 (6)	9 (5)
Black vulture (*Coragyps atratus*)	95 (9)		2 (2)
Great egret (*Ardea alba*)	60 (13)	46 (5)	27 (5)
White ibis (*Eudocimus albus*)	38 (10)	9 (3)	6 (4)
Wood stork (*Mycteria americana*)	16 (4)	5 (2)	5 (3)
Turkey vulture (*Cathartes aura*)	14 (4)		11 (3)
Yellow-crowned night heron (*Nyctanassa violacea*)	5 (2)	10 (1)	
American robin (*Turdus migratorius*)	5 (1)		
Bald eagle (*Haliaeetus leucocephalus*)	4 (1)		
American crow (*Corvus brachyrhynchos*)	4 (3)		
Red shouldered hawk (*Buteo lineatus*)	2 (2)	3 (3)	1 (1)
Little blue heron (*Egretta caerulea*)	2 (1)	1 (1)	2 (1)
Glossy ibis (*Plegadis falcinellus*)	1 (1)		
Greater rhea (*Rhea americana*)	1 (1)		
Barred owl (*Strix varia*)	1 (1)		
Miscellaneous birds	23 (1)		1 (1)
Unknown birds	8 (5)	2 (1)	1 (1)
Limpkin (*Aramus guarauna*)		24 (4)	4 (2)
Sandhill crane (*Grus canadensis*)			2 (1)
Reptiles			
American alligator (*Alligator mississippiensis*)		3 (3)	
Human traffic			
Vehicle	4,587 (74)	132 (7)	1,770 (10)
Pedestrian	379 (64)	1,447 (10)	108 (10)
Equestrian	138 (15)		
Bicycle	12 (6)	43 (4)	

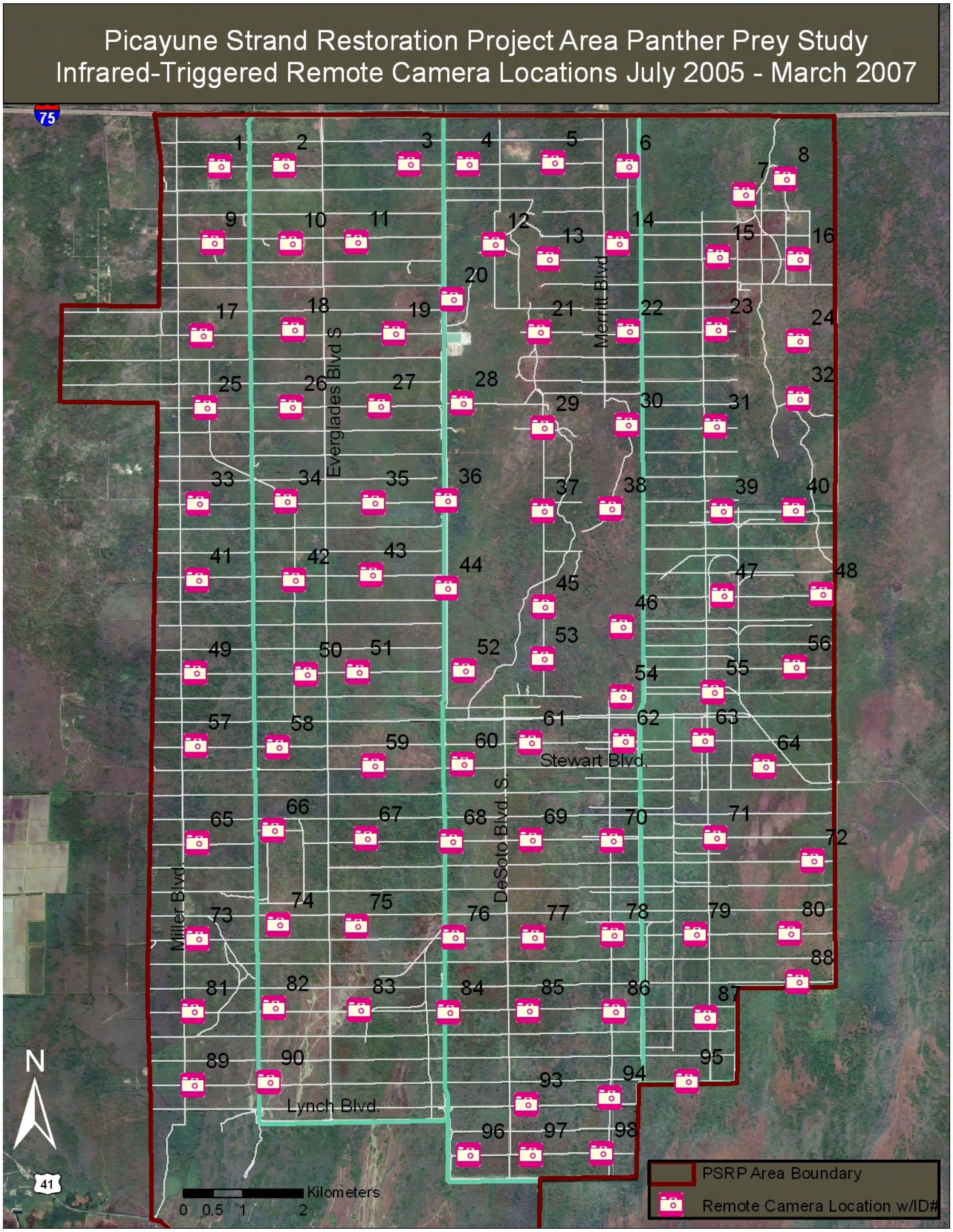

Figure 84. Infrared-triggered remote cameral locations in Picayune Strand Restoration Project Area.

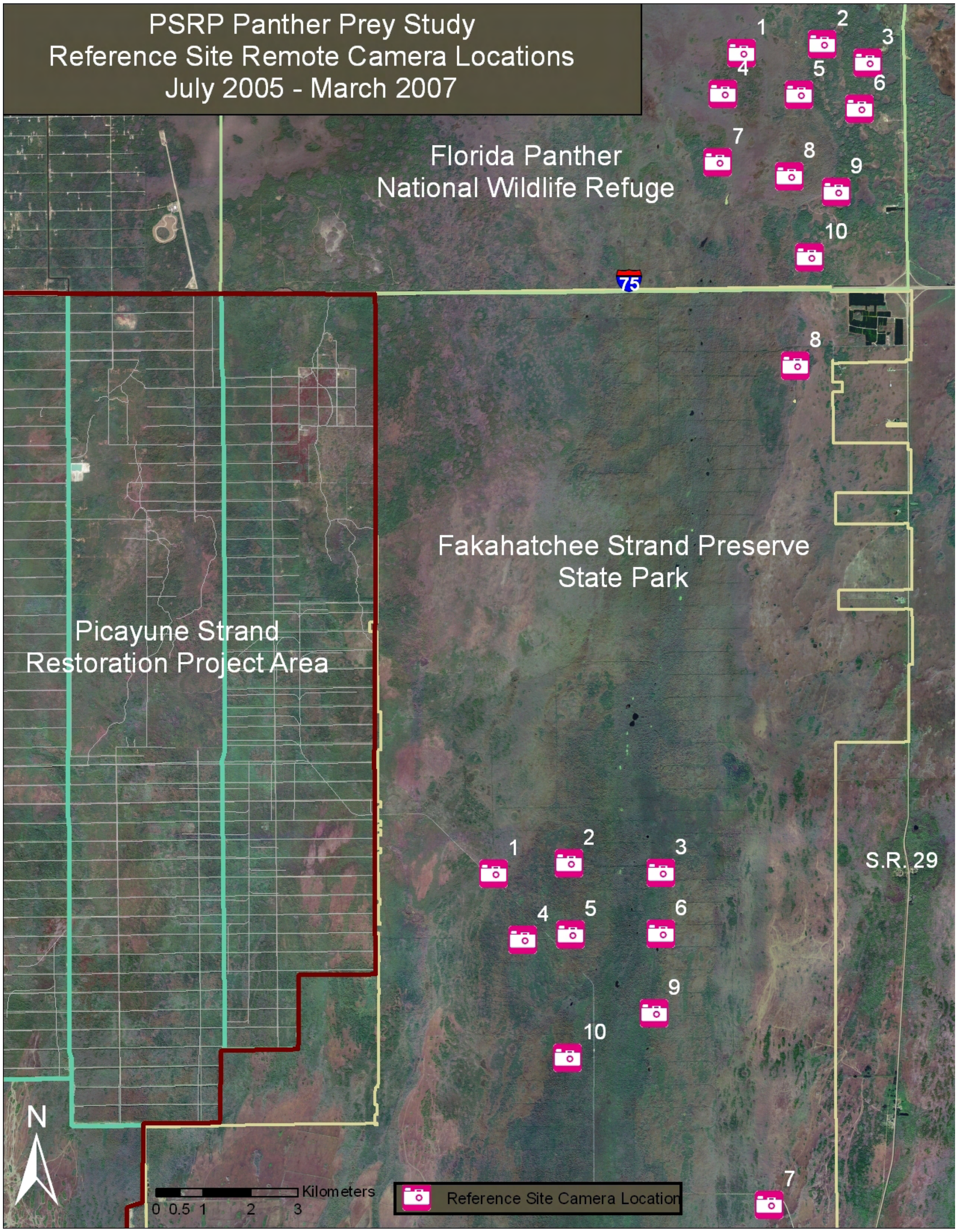

Figure 85. Infrared-triggered remote camera locations in the reference sites: Fakahatchee Strand Preserve State Park and Florida Panther National Wildlife Refuge.

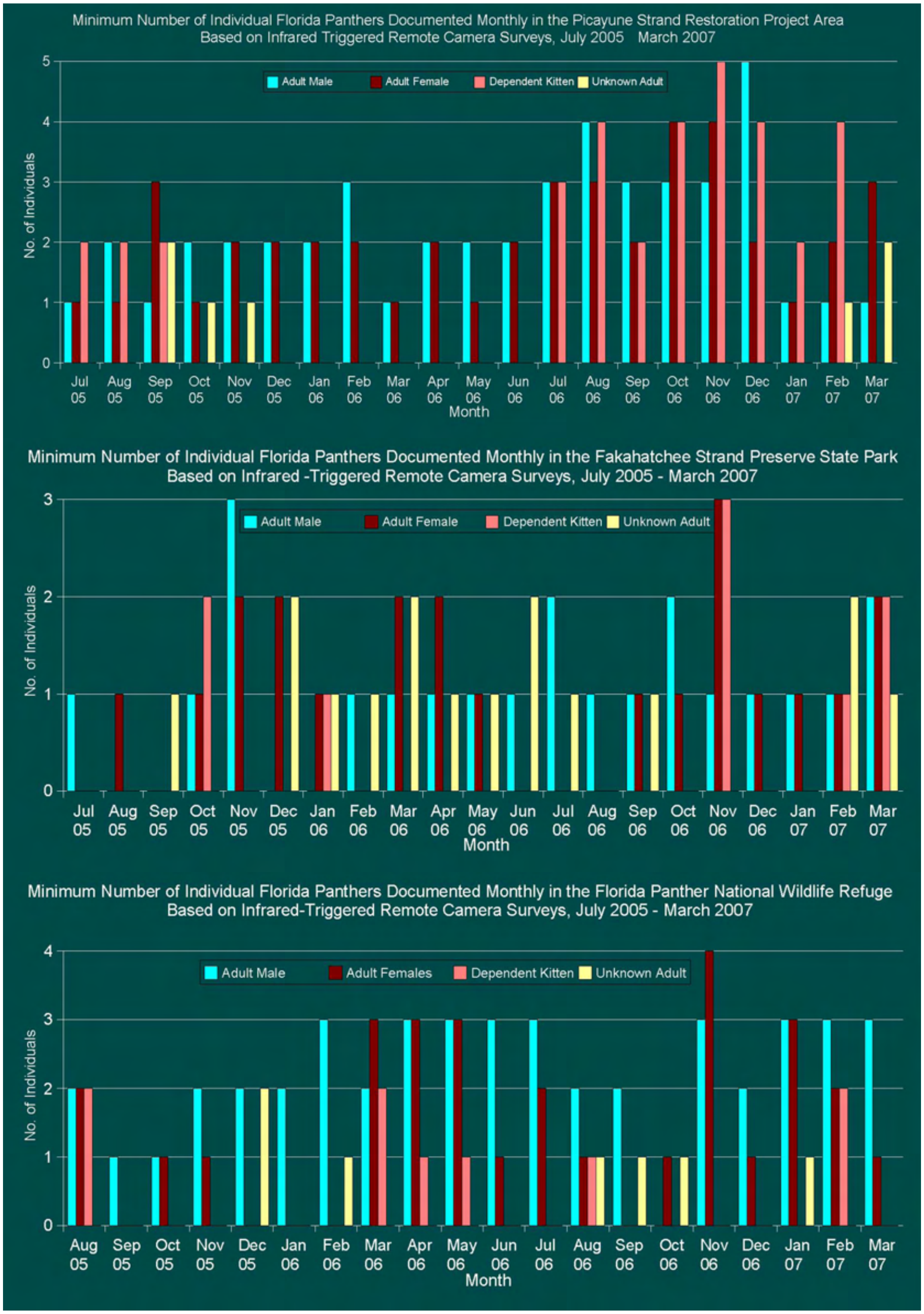

Figure 86. Minimum number of individual Florida panthers documented monthly using infrared-triggered remote cameras in (a) Picayune Strand Restoration Area, (b) Fakahatchee Strand Preserve State Park, and (c) Florida Panther National Wildlife Refuge, from July 2005–March 2007.

At least 12 individual adult panthers (seven male, five female) are using the Picayune Strand Restoration Project Area on at least one occasion during the 16-month survey period and confirmed that preconstruction conditions in the area support a reproductive segment of the panther population. At least three uncollared and two radio collared adult male panthers were resident males that used portions of the Picayune Strand Restoration Area as part of their territory. At least three adult females with dependent-aged kittens used the project area concurrently during late 2006 and one female denned in the project area in April 2007.

A minimum of five different family groups from at least three different non-collared females were photographed in the Picayune Strand Restoration Area during the survey period (**Figures 87** and **88**). At least two family groups, each composed of at least two dependent-aged kittens, were documented in 2005. At least three family groups, together accounting for a minimum of seven dependent-aged kittens, were documented in 2006 and 2007. A collared female denned in early April 2007 within the project area (M. Lotz, FWC, personal communication, May 2007). Adult females with dependent-aged kittens were captured at 19 percent of the camera stations in the restoration area. At least four adult male panthers were seen paired with adult females and assumed to be paired mates (**Figure 89**).

Figure 87. Adult female with dependent-aged kitten.

Figure 88. Adult female with three dependent-aged kittens.

Figure 89. Adult female and adult male paired mates (all photos by the Conservancy of Southwest Florida via remote camera).

Cameras recorded panthers at 87 percent of the camera sites in Picayune Strand Restoration Project Area during the survey period. However, relative abundance indices suggested that panther use of the project area was not equally distributed and that the overall relative abundance of panthers across the entire project area was less than selected reference sites in Fakahatchee Strand Preserve State Park to the east and Florida Panther National Wildlife Refuge to the northeast (**Table 3**; **Figure 90**). The mean relative abundance index ranged from 0.9 to 1.3 independent captures for Picayune Strand, 1.5 to 3.5 for Fakahatchee Strand Preserve State Park, and 3.5 to 6.9 for Florida Panther National Wildlife Refuge.

Table 3. Mean and range of relative abundance index values (independent photo captures per 100 camera trap days) for Florida panther, target prey species, non-target prey species, and other common species.

Species	Mean Capture Rate and Range (Total No. of Independent Captures)		
	Picayune Strand Restoration Project (*n* = 96)	Fakahatchee Strand Preserve State Park (*n* = 10)	Florida Panther National Wildlife Refuge (*n* = 10)
Target species			
Florida panther	1.1 ± 0.2 (569)	2.5 ± 1.0 (141)	5.2 ± 1.7 (302)
White-tailed deer	8.6 ± 1.5 (4,539)	10.7 ± 4.0 (591)	36.1 ± 18.9 (2,147)
Feral hog	0.06 ± 0.04 (30)	0.02 ± 0.04 (1)	0.03 ± 0.05 (2)
Non-target panther prey species			
Raccoon	1.7 ± 1.0 (861)	1.0 ± 0.6 (54)	1.5 ± 2.0 (83)
Virginia opossum	0.2 ± 0.1 (92)	0.3 ± 0.4 (18)	0.8 ± 1.3 (43)
Feral cattle	0.9 ± 0.6 (454)		
Non-target species			
Black bear	2.3 ± 0.4 (1,220)	3.8 ± 1.4 (209)	4.6 ± 2.8 (269)
Bobcat	1.6 ± 0.5 (789)	0.8 ± 0.6 (41)	2.2 ± 1.9 (125)
Coyote	0.1 ± 0.1 (68)		0.04 ± 0.05 (2)
Wild turkey	2.8 ± 1.0 (1,405)		23.4 ± 14.8 (1,382)

Diurnal radio telemetry data collected by the Florida Fish and Wildlife Conservation Commission from 1981–2005 on Florida panthers in the immediate project area suggest significantly reduced occurrence relative to Fakahatchee Strand Preserve State Park and Florida Panther National Wildlife Refuge (**Figure 91**). The project area was primarily used by dispersing sub-adult male panthers and resident male panthers of the reference areas. However, radio collared female denning activity has been documented within the project boundary in three locations from 1981 through 2005. Anecdotal information suggested that the reduced panther occurrence in the project area was likely attributed to a reduction in prey abundance stemming from the degraded habitat quality associated with water management practices and the high levels of human disturbance aggravated by the primary and secondary road grid.

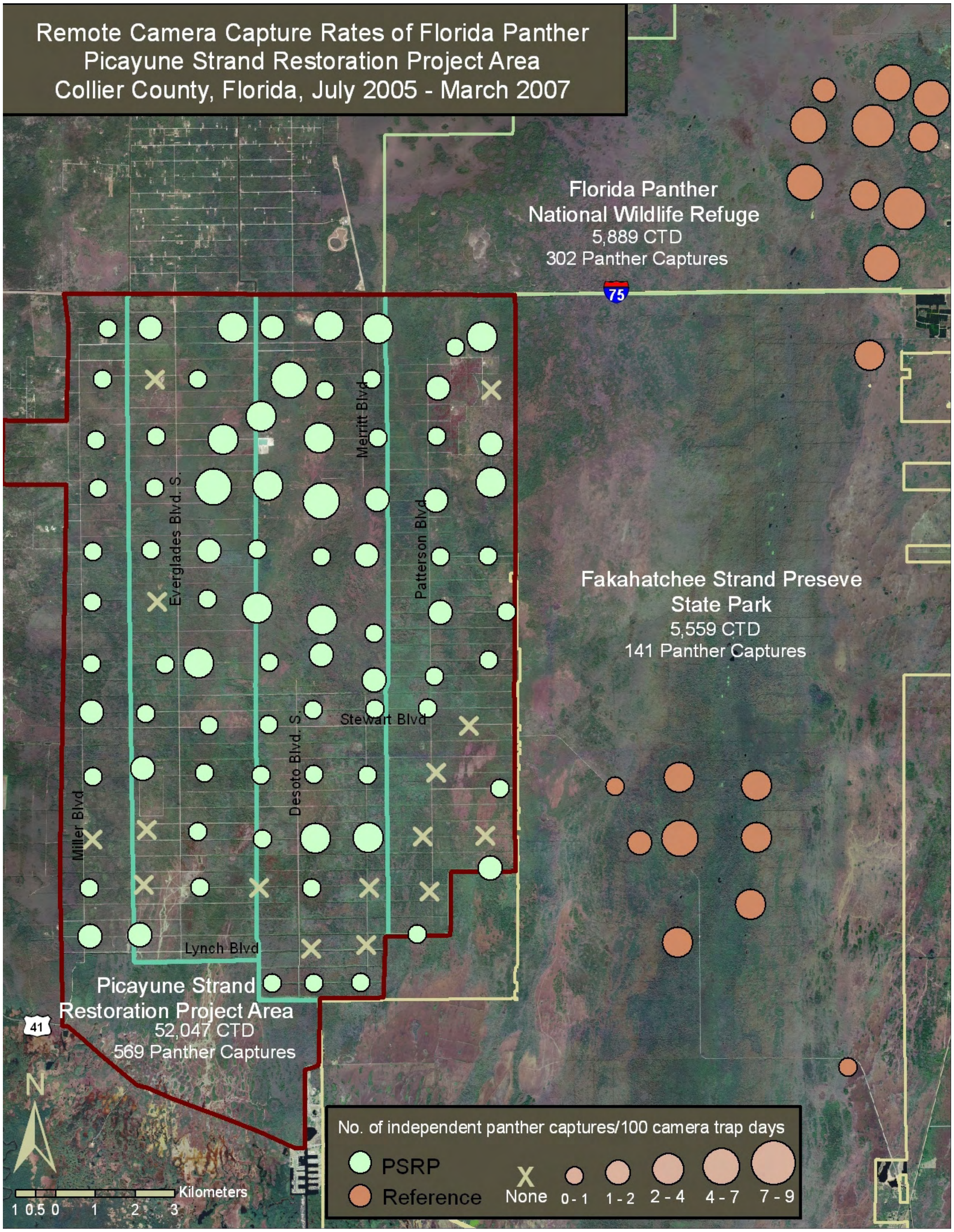

Figure 90. Infrared-triggered remote camera capture rates (number of independent captures/100 camera trap days) of Florida panther in Picayune Strand Restoration Project Area, Florida Panther National Wildlife Refuge, and Fakahatchee Strand Preserve State Park, July 2005–March 2007.

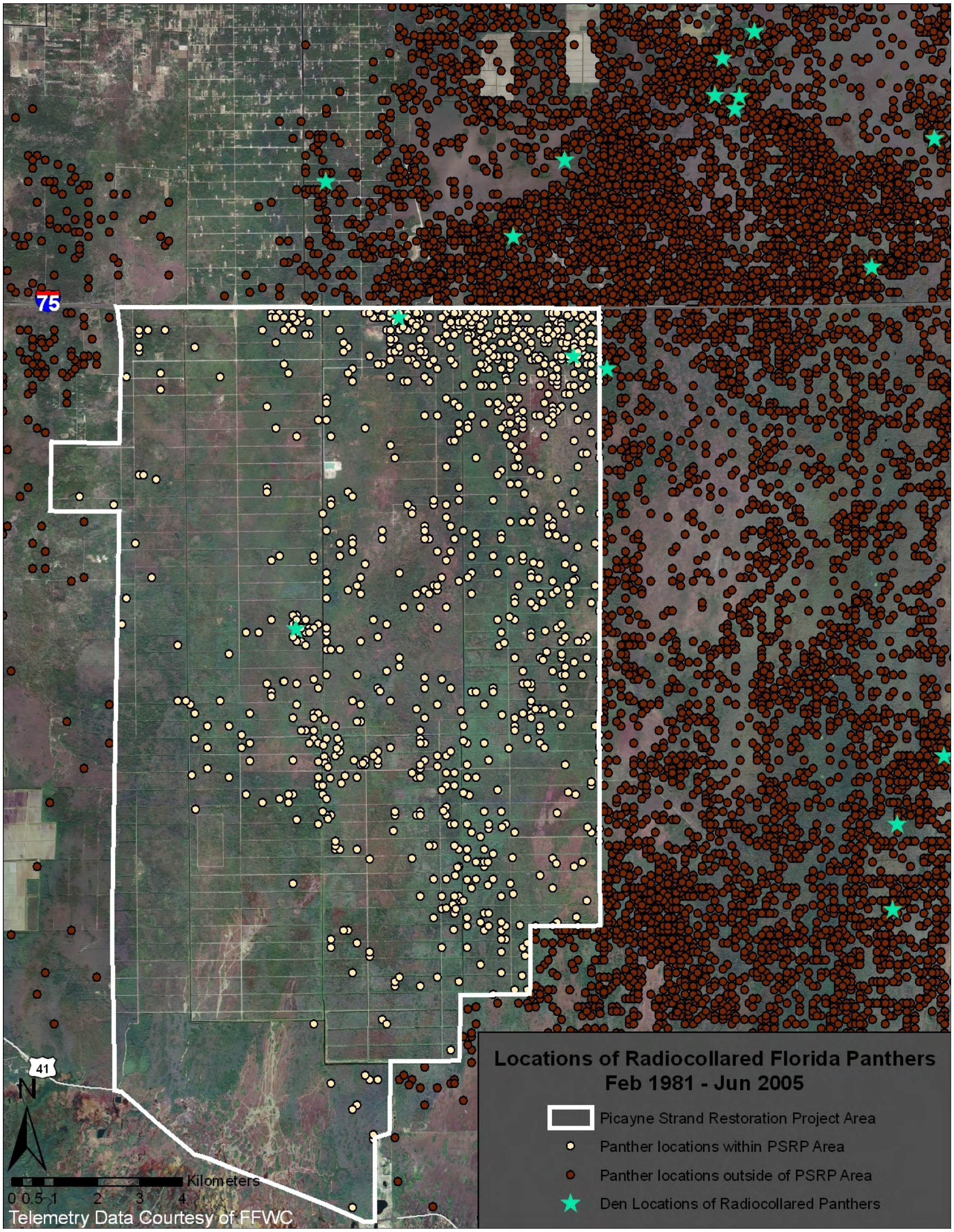

Figure 91. Aerial telemetry and den locations of radio collared Florida panthers in Picayune Strand Restoration Project Area, Fakahatchee Strand Preserve State Park, Florida Panther National Wildlife Refuge, and surrounding areas, from February 1981–June 2005.

Panther Prey

White-tailed deer (*Odocoileas virginicus*) and feral hog (*Sus scrofa*) are preferred prey for panthers, while smaller animals such as marsh rabbit (*Sylvilagus palustris*), raccoon (*Procyon lotor*), and nine-banded armadillo (*Dasypus novemcinctus*) are of secondary importance. An adult panther needs to consume at least the equivalent of one deer or hog per week (McBride, 1985). A pregnant female panther or a female panther with dependent kittens needs to consume at least the equivalent of two deer or hogs per week (McBride, 1985). Therefore, panther prey abundance is an important indicator of the suitability of panther habitat.

White-tailed deer abundance was captured by remote cameras across the entire Picayune Strand Restoration Area as well as the reference sites (**Figures 92** and **94**). Adult does with either fawns or yearlings used at least 65 percent of the area (**Figure 95**). The overall relative abundance of white-tailed deer in the project area (7.1 to 10.1) was similar to that of Fakahatchee Strand Preserve State Park (6.7 to 14.7), but significantly less than Florida Panther National Wildlife Refuge (17.2 to 55.0) (**Table 3**; **Figure 94**). Adult does with fawns or yearlings were captured at eight of 10 camera stations in Fakahatchee Strand Preserve State Park and at all 10 camera stations in Florida Panther National Wildlife Refuge.

Figure 92. White-tailed deer.

Feral hogs (**Figure 93**) were rare in the Picayune Strand Restoration Project Area and both reference sites. They likely are not a significant portion of the available prey base. Only 30 independent captures were recorded in the project area, one in Fakahatchee Strand Preserve State Park and two in Florida Panther National Wildlife Refuge. Feral hog capture rates were low (0.02 to 0.1) and occupied a small portion (6 percent) of the project area (**Table 2**; **Figure 96**). Similar, low numbers of hogs were detected in Fakahatchee Strand Preserve State Park and Florida Panther National Wildlife Refuge (**Table 3**; **Figure 96**). However, as long as there are sufficient numbers of deer available to sustain a panther population, the relatively low abundance of feral hogs documented in the project area should not be a concern (Maehr et al., 1989; Maehr et al., 1990).

Figure 93. Feral hogs (both photos by Conservancy of Southwest Florida via remote camera).

Smaller prey species, such as raccoon and opossum, and other medium-large carnivores, such as bobcat, coyote, and black bear, may be of value to project managers in assessing future panther prey levels, the impact of potential competitors for those prey resources, or the changes in the overall distribution, abundance, and diversity of the mammalian assemblage. Therefore, these species were also noted, though the location and height of the cameras was maximized to capture panther, deer, and hog so their effectiveness in assessing these smaller mammals may be limited.

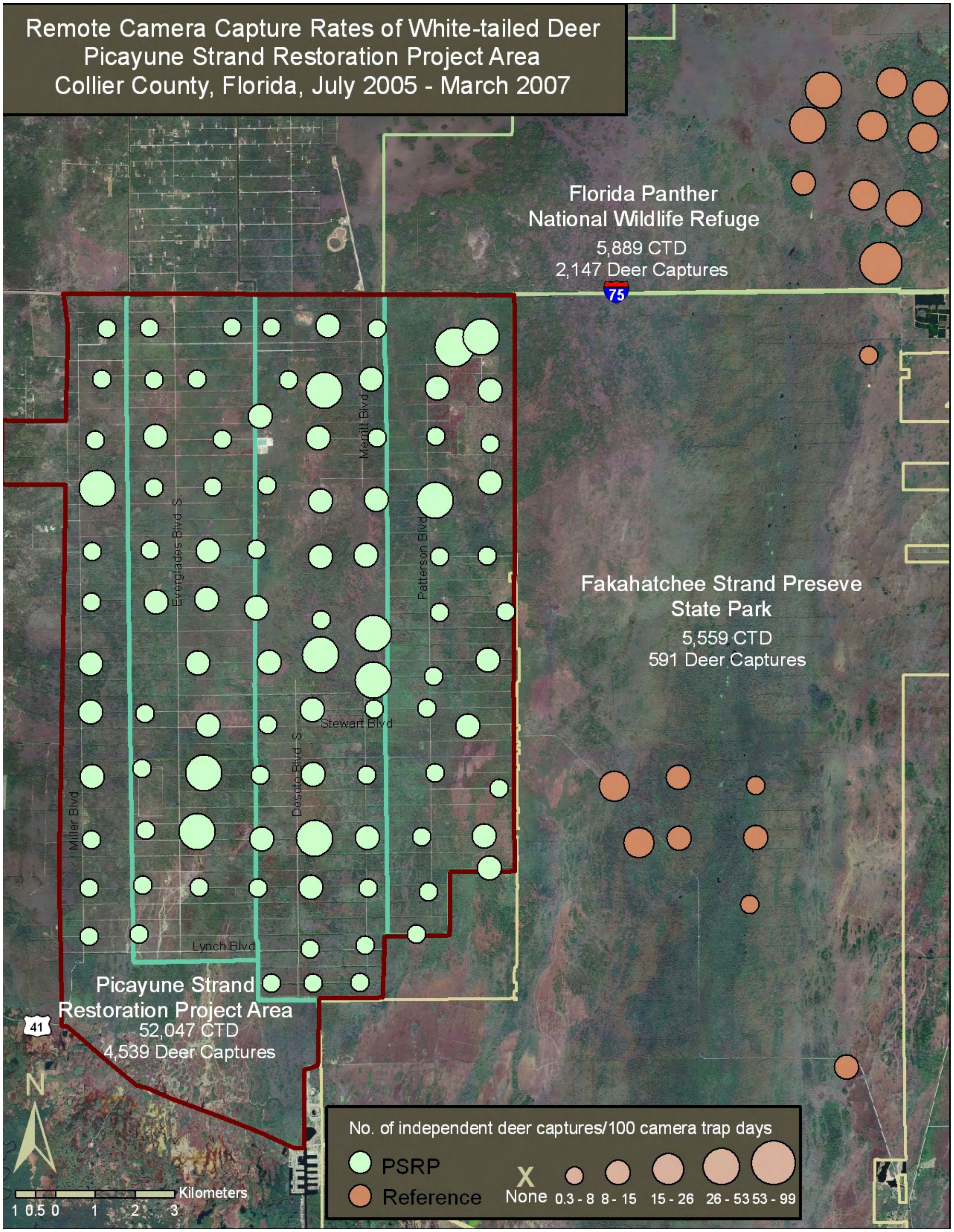

Figure 94. Infrared-triggered remote camera capture rates (number of independent captures/100 camera trap days) of white-tailed deer in Picayune Strand Restoration Area, Florida Panther National Wildlife Refuge, and Fakahatchee Strand Preserve State Park, July 2005–March 2007.

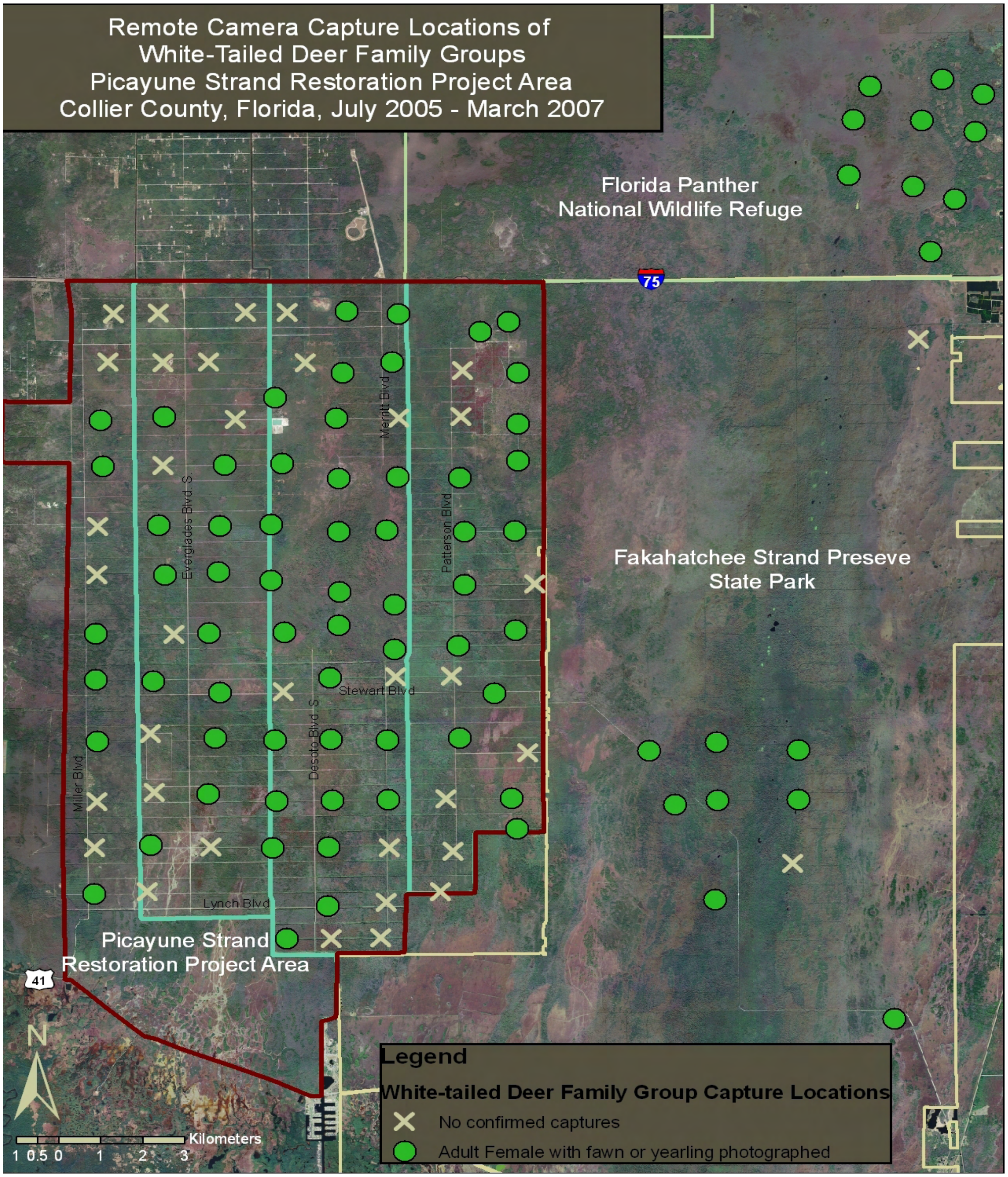

Figure 95. Infrared-triggered remote camera capture rates (number of independent captures/100 camera trap days) of white-tailed deer with dependent-aged fawns or yearlings in Picayune Strand Restoration Area, Florida Panther National Wildlife Refuge, and Fakahatchee Strand Preserve State Park, July 2005–March 2007.

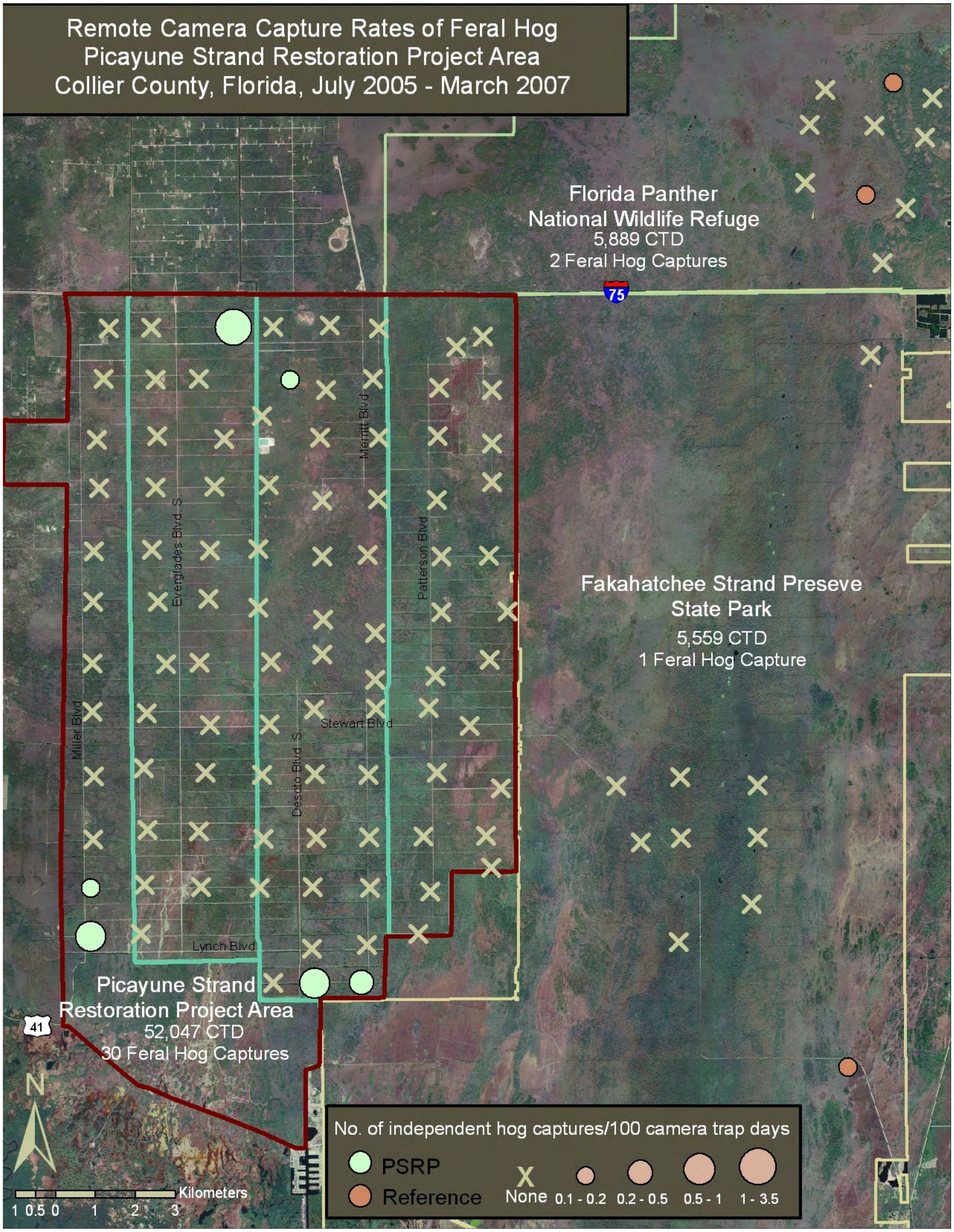

Figure 96. Infrared-triggered remote camera capture rates (number of independent captures/100 camera trap days) of feral hogs in Picayune Strand Restoration Project Area, Florida Panther National Wildlife Refuge, and Fakahatchee Strand Preserve State Park, July 2005–March 2007.

INLAND AQUATIC FAUNA

Aquatic macroinvertebrates and fish were chosen to represent inland aquatic fauna because they are likely to be significantly affected by hydrologic restoration and associated changes in plant communities. They also represent a range of trophic groups inhabiting a range of Picayune Strand habitats, and can be expected to serve as practical indicators for evaluating success of the restoration. Sampling took place from August 2005 through February 2007. All information provided in this section is from a baseline assessment conducted by Ceilley (2008).

Monitoring sites for aquatic fauna (**Figure 97**) were established at representative major habitat types found in the immediate vicinity of the 24 groundwater monitoring wells within and near Picayune Strand (**Figures 4** and **39**). Three monitoring sites were established in the brackish marshes south of the Tamiami Trail (**Figure 4**). Undisturbed reference sites in four major types of plant communities (cypress, wet prairie, hydric pine, and brackish marsh) were established on relatively undisturbed sites in Florida Panther National Wildlife Refuge and Fakahatchee Strand Preserve State Park to provide aquatic fauna and terrestrial invertebrate restoration targets for the Picayune Strand sites. A total of 19 of 30 impacted sites and 11 reference sites were sampled and analyzed for macroinvertebrates and fish. Eleven of the impacted sites had no standing water during the study period. **Table 4** includes a list of sites sampled, the habitat types at the sampling site and the hydrologic monitoring transect associated with the site. Photos of macroinvertebrate sampling are presented in **Figure 98**.

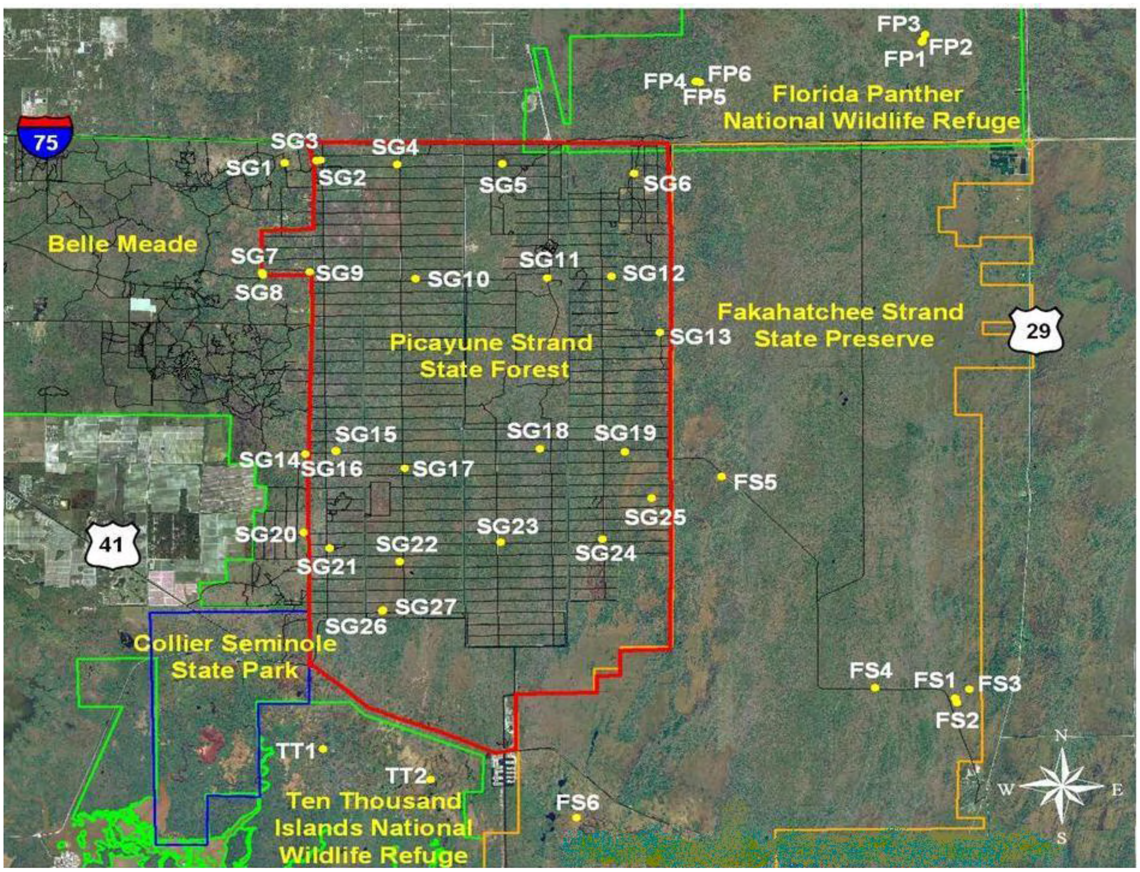

Figure 97. Aquatic fauna sampling sites.

Aquatic Macroinvertebrates

A total of 7,123 individual macroinvertebrates were identified including at least 182 distinct species or taxa representing no less than six classes, 20 orders, and 57 families (**Table 5**). The total number of macroinvertebrates found at each site is provided in **Table 4**. Because of identification limitations, the 182 taxa were reduced to 125 operational taxonomic units (OTUs) considered appropriate for statistical analyses. **Table 6** provides the total abundance of each OTU for all sites combined. Percent composition of OTUs for individual Picayune Strand and estuarine sites are provided in **Table 7** and reference sites in **Table 8**. The greatest species richness and diversity values were reported in the reference wetlands, but species richness, total abundance, and diversity was relatively high in the freshwater marsh site in Picayune Strand (SG5).

Aquatic macroinvertebrate community structure was significantly different between impacted and reference wetlands sampled in this study (Ceilley, 2008). Many impacted sites within cypress, cypress graminoid, wet prairie, marsh, and pine habitat were significantly different from others in that group, especially cypress. With the exception of one hydric-mesic pine site in Fakahatchee Strand, FS3, all reference wetlands of all habitat types shared greater than 45 percent similarity in community structure. Six of the 10 reference sites, FS1, FS2, FP2, FP5, FP3, and FP6, shared greater than 60 percent similarity and, as a group, were not significantly different from each other but were significantly different from all other groups. The macroinvertebrate taxa that were major contributors to the dissimilarity between reference and impacted wetlands included mayflies *Callibaetis* and *Caenis*, the damselfly *Ischnura*, amphipod *Hyalella*, and snails *Hatia* and *Planorbella*. Several taxa were also identified that may serve as indicators of hydrologic recovery over time, including dragonflies, crayfish, freshwater shrimp, and apple snails because of their habitat requirements and relative abundance in reference wetlands.

Table 4. Aquatic sampling site names, location, associated habitat type, well transect, and number of macroinvertebrates found at each site.

Picayune Strand and Coastal Marsh Sites				Reference Sites			
Site Name	Habitat Type	Well Transect*	No. Macro-invert	Site Name	Habitat Type	Well Transect*	No. Macro-invert
SG1	Cypress Graminoid	1	27	FP1	Cypress Graminoid	NA	409
SG5	Freshwater Marsh	1	342	FP2	Wet Prairie	NA	218
SG6	Mesic Pine	1	30	FP3	Hydric Pine	NA	303
SG7	Wet Prairie	2	33	FP4	Cypress	NA	553
SG8	Mesic Pine	2	54	FP5	Wet Prairie	NA	311
SG10	Willow	2	127	FP6	Hydric Pine	NA	205
SG12	Cypress	2	127	FS1	Cypress Graminoid	South	266
SG14	Cypress Graminoid	3	145	FS2	Wet Prairie	South	252
SG15	Cypress	3	77	FS3	Hydric Pine	South	88
SG19	Cypress	3	80	FS4	Cypress	South	828
SG20	Cypress Graminoid	4	416	FS5	Wet Prairie	3	139
SG21	Hydric Pine	4	255	FS6	Salt Marsh	5	367
SG22	Wet Prairie	4	129				
SG24	Cypress	4	46				
SG25	Wet Prairie	3	133				
SG26	Cypress	4	94				
SG27	Wet Prairie	4	39				
TT1	Salt Marsh	5	450				
TT2	Salt Marsh	5	580				

* Well transects 1 through 5 refer to the groundwater well sites and associated transects shown in **Figure 4**. The South transect sites are presented in **Figure 39**.

Table 5. Taxa of aquatic macroinvertebrates collected.

Class	Order/Suborder	Family/Subfamily	Genus/OTU	Species
Annelida	*Hirudinea*	*Hirudinea*	*Hirudinea*	immature
		Erpodellidae	*Placobdella*	sp.
	Oligochaeta	*Oligochaeta*	*Oligochaeta*	unidentified
		Lumbriculidae	*Lumbriculidae*	unidentified
		Naididae	*Naididae*	unidentified
		Tubificida	*Tubificida*	unidentified
	Polychaeta	*Polychaeta*	*Polychaeta*	unidentified
		Polychaeta	*marine vermiform*	unidentified
Hydracnida	*Acariformes*	*Acariformes*	*Acariformes*	unidentified
			Green mite	unidentified
Crustacea	*Isopoda*	*Sphaeromidae*	*Sphaeroma*	*terebrans*
		Epicaridea	*Probopyrus*	*bithynis*
	Copepoda	*Argulidae*	*Argulus*	sp.
	Amphipoda	*Hyallelidae*	*Hyalella*	*azteca*
		Gammaridae	*Gammarus*	sp.
	Cladocera	*Daphnidae*	*Daphnidae*	sp.
	Decapoda	*Cambaridae*	*Procambarus*	*alleni*
			Procambarus	immature
		Palaemonidae	*Palaemonetes*	*paludosus*
			Palaemonetes	sp.
			unident. shrimp	larvae
	Ostracoda	*Cyprididae*	*Cyprididae*	sp.
Insecta	*Ephemeroptera*	*Baetidae*	*Callibaetis*	*floridanus*
			Callibaetis	*pretiosus*
			Callibaetis	spp.
		Caenidae	*Caenis*	spp.
		Leptophlebiidae	*Choroterpes*	*basalis*
	Odonata/Anisoptera	*Aeshnidae*	*Anax*	*junius*
			Anax	sp./imm.
			Gynacantha	*nervosa*
			Coryphaeschna	*ingens*
			Coryphaeschna	sp./imm.
			Nasiaeschna	*pentacantha*
		Libellulidae	*Libellulidae*	immature
			Brachymesia	*gravida*
			Celithemis	spp.
			Crocothemis	*servilia*
			Erythemis	*plebeja*
			Erythemis	*simplicicollis*
			Erythemis	sp./imm.
			Libellula	sp./imm.
			Libellula	*incesta*
			Pachydiplax	longipennis
	Odonata/Zygoptera	*Coenagrionidae*	*Coenagrionidae*	immature
			Enallagma	*pollutum*
			Enallagma	sp.
			Ischnura	*hastata*
			Ischnura	*posita*

Table 5. Continued.

Class	Order/Suborder	Family/Subfamily	Genus/TU	Species
Insecta	*Odonata/Zygoptera*	*Coenagrionidae*	*Ischnura*	*ramburii*
			Ischnura	spp.
			Nehalennia	sp.
			Nehalennia	*integricollis*
	Hemiptera	*Belostomatidae*	*Abedus*	*immaculatus*
			Belostoma	*lutarium*
			Belostoma	*testaceum*
			Abedus/Belostoma	immature
			Lethocerus	*uhleri*
			Lethocerus	*griseus*
			Synaptonecta	*issa*
			Trichocorixa	sp.
			Corixidae	sp./imm.
			Limnogonus	*franciscanus*
			Limnoporus	*canaliculatus*
			Neogerris	*hesione*
			Rheumatobates	sp.
			Trepobates	sp.
			Gerridae	sp./imm.
		Hebridae	*Lipogomphus*	*brevis*
		Hydrometridae	*Hydrometra*	*australis*
			Hydrometra	*barei/martini*
			Hydrometra	*consimilis*
			Hydrometra	sp. imm.
		Mesoveliidae	*Mesovelia*	*amoena*
			Mesovelia	*mulsanti*
			Mesovelia	sp.
		Naucoridae	*Pelocoris*	*balius*
			Pelocoris	*femoratus*
			Pelocoris	sp./imm.
		Nepidae	*Ranatra*	*buenoi*
			Ranatra	sp./imm.
			Ranatra	*drakei**
			Ranatra	*australis*
		Notonectidae	*Notonectidae*	*immature*
			Buenoa	*confusa*
			Notonecta	*irrorata**
		Ochteridae	*Ochterus*	sp.
		Pleidae	*Neoplea*	*striola*
			Paraplea	sp.
		Saldidae	*Micranthia*	sp./*husseyi*
		Veliidae	*Microvelia*	*hinei*
			Steinovelia	*stagnalis*
	Trichoptera	*Hydroptilidae*	*Oxyethira*	sp.
			Oecetis	sp.
	Coleoptera	*Dytiscidae*	*Dytiscidae*	imm. larvae
			Agabus	sp.

Table 5. Continued.

Class	Order/Suborder	Family/Subfamily	Genus/TU	Species
Insecta	*Coleoptera*	*Dytiscidae*	*Bidessonotus*	sp./*longovalis*
			Celina	sp.
			Copelatus	sp.
			Copelatus	*caelatipennis princeps*
			Copelatus	*chevrolati chevrolati*
			Coptotomus	*interogatus obscurus*
			Cybister	*fimbriolatus crotchi*
			Cybister	larvae
			Derovatellus	*lentus floridanus*
			Desmopachria	*grana*
			Hydaticus	*bimarginatus*
			Hydaticus	*cinctipennis*
			Hydaticus	larvae
			Hydrovatus	*pustulatus compressus*
			Laccodytes	sp.
			Laccodytes	*pumilio*
			Laccophilus	*proximus*
			Laccophilus	*gentilis*
			Laccophilus	sp.
			Liodessus	*cantralli*
			Neoporus	*lynceus complex*
			Neoporus	sp.
			Pachydrus	*princeps*
			Thermonectus	*basillaris*
		Dryopidae	*Pelonomus*	*obscurus*
		Gyrinidae	*Dineutus*	*carolinus*
			Dineutus	sp.
			Gyrinus	*elevatus*
			Gyrinus	sp.
		Haliplidae	*Peltodytes*	*dietrichi*
		Hydrophilidae	*Hydrophilidae*	larvae
			Berosus	*exiguus*
			Berosus	*youngi*
			Berosus	sp.
			Derallus	*altus*
			Dibolocelus	larvae
			Enochrus	*hamiltoni*
			Enochrus	*ochraceus*
			Enochrus	sp.
			Helobata	*larvalis*
			Hydrobiomorpha	*casta*
			Hydrochus	sp.
			Phaenonotum	*minor/exstriatum*
			Phaenonotum	sp.
			Tropisternus	*blatchleyi*
			Tropisternus	*collaris*
			Tropisternus	*lateralis nimbatus*
			Tropisternus	*quadristriatus*

Table 5. Continued.

Class	Order/Suborder	Family/Subfamily	Genus/TU	Species
Insecta	*Coleoptera*	*Hydrophilidae*	*Tropisternus*	larvae
		Noteridae	*Hydrocanthus*	*oblongus*
			Hydrocanthus	larvae
			Suphis	*inflatus*
			Suphisellus	*gibbulus*
			Suphisellus	*puncticollis*
			Suphisellus	sp.
		Scirtidae	*Scirtes*	larvae
			Cyphon	larvae
	Collembola	*Isotomidae*	*Isotomidae*	sp.
	Diptera	*Ceratopogonidae*	*Ceratopogonidae*	spp.
			Bezzia/Palpomyia	sp.
			Forcipomyia	sp.
		Chaoboridae	*Chaoborus*	larvae
		Chironomidae	*Chironomidae*	spp.
		Culicidae	*Culicidae imm.*	imm
			Anopheles	spp.
			Culex	spp.
			Psorophora	*ciliata/columbiae*
		Ephydridae	*Ephydridae*	*Ephydridae*
		Stratiomyidae	*Odontomyia/Heterodiscus*	sp.
		Tabanidae	*Tabanidae*	sp.
Mollusca	*Gastropoda*	*Ancylidae*	*Ancylidae*	spp.
			Ferrissia	sp.
			Laevapex	*peninsulae*
		Ampullariidae	*Pomacea*	*paludosa*
		Physidae	*Hatia*	sp.
		Hydrobiidae	*Hydrobiidae*	sp.
			Littoridinops	sp.
		Planorbidae	*Planorbella*	sp.
			Planorbella	*trivolvis intertexta*
			Planorbella	*scalaris*
			Gyraulus	*parvus*
			Micromenetus	sp.
		Limnaeidae	*Fossoria*	*cubensis*
			Psuedosuccinea	*colemella*
	Bivalvia	*Sphaeriidae*	*Sphaerium*	*occidentalis*
			Musculium	*lacustre*
Porifera	*Porifera*	*Spongillidae*	Fw sponges	colonies

Table 6. Operational taxonomic units (OTUs) for aquatic macroinvertebrates and total abundance for all sites combined.

OTU	Total	OTU	Total	OTU	Total
Hirudinea	35	*Trichocorixa*	59	*Hydrophilidae*	1
Placobdella	2	*Corixidae*	7	*Berosus sp.*	28
Oligochaeta	26	*Limnogonus*	3	*Derallus*	32
Lumbriculidae	2	*Limnoporus*	21	*Dibolocelus*	1
Naididae	1	*Neogerris*	70	*Enochrus*	79
Tubificida	1	*Rheumatobates*	9	*Helobata*	2
Polychaeta	3	*Trepobates*	37	*Hydrobiomorpha*	2
marine vermiform	5	*Gerridae*	13	*Hydrochus*	1
Acariformes	15	*Lipogomphus*	7	*Phaenonotum*	15
Sphaeroma	12	*Hydrometra*	75	*Tropisternus*	93
Probopyrus	6	*Mesovelia*	86	*Hydrocanthus*	240
Argulus	1	*Pelocoris*	85	*Suphis*	12
Hyalella	271	*Ranatra*	11	*Suphisellus*	43
Gammarus	9	*Buenoa*	80	*Scirtes*	68
Daphnidae	1	*Notonecta*	2	*Isotomidae*	6
Procambarus	122	*Ochterus*	1	*Ceratopogonidae*	13
Palaemonetes	101	*Neoplea*	6	*Bezzia*	14
unidentified shrimp	15	Micranthia	1	*Chironomidae*	538
Cyprididae	64	*Microvelia*	3	*Culicidae imm.*	5
Callibaetis	1380	*Steinovelia*	3	*Anopheles*	41
Caenis	338	*Oxyethira*	1	*Culex*	52
Choroterpes	20	*Oecetis*	1	*Psorophora*	147
Anax	3	*Dytiscidae larva*	1	*Ephydridae*	2
Gynacantha	3	*Agabus*	2	*Odontomyia*	57
Coryphaeschna	16	*Bidessonotus*	6	*Tabanidae*	4
Nasiaeschna	26	*Celina*	8	*Ancylidae imm.*	4
Libellulidae imm.	14	*Copelatus*	51	*Ferrissia*	2
Brachymesia	4	*Cybister*	24	*Laevapex*	9
Celithemis	1	*Derovatellus*	5	*Pomacea*	31
Crocothemis	9	*Desmopachria*	3	*Hatia*	281
Erythemis	47	*Hydaticus*	16	*Hydrobiidae*	4
Libellula	28	*Hydrovatus*	4	*Littoridinops*	91
Pachydiplax	197	*Laccodytes*	4	*Planorbella*	167
Coenagrionidae	39	*Laccophilus*	139	*Gyraulus*	2
Enallagma	36	*Liodessus*	3	*Micromenetus*	2
Ischnura	865	*Neoporus*	61	*Fossoria*	2
Nehalennia	6	*Pachydrus*	15	*Pseudosuccinea*	3
Abedus	27	*Thermonectus*	43	*Sphaerium*	1
Belostoma	152	*Pelonomus*	2	*Musculium*	13
Abedus/Belostoma	34	*Dineutus*	36	*Porifera*	38
Lethocerus	11	*Gyrinus*	18		
Synaptonecta	6	*Peltodytes*	1	**Total Taxa Identified**	**7123**

Table 7. Percent composition of OTUs from impacted Picayune Strand and coastal marsh sites.

OTU	SG1	SG5	SG6	SG7	SG8	SG10	SG12	SG14	SG15	SG19	SG20	SG21	SG22	SG24	SG25	SG26	SG27	TT1	TT2
Hirudinea	0.0	2.0	3.3	0.0	0.0	0.0	0.0	1.4	0.0	6.3	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.2	1.0
Placobdella	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Oligochaeta	11.1	0.9	0.0	0.0	1.9	0.8	0.0	0.7	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lumbriculidae	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Naididae	0.0	0.0	0.0	0.0	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tubificida	0.0	0.0	0.0	0.0	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Polychaeta	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.3
marine vermiform	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9
Acariformes	0.0	0.0	0.0	0.0	0.0	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
Sphaeroma	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9
Probopyrus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Argulus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hyalella	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gammarus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Daphnidae	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Procambarus	7.4	0.6	0.0	27.3	1.9	0.8	3.1	11.7	0.0	0.0	2.4	0.4	1.6	0.0	0.0	1.1	0.0	0.0	0.0
Palaemonetes	0.0	0.0	0.0	0.0	0.0	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	4.8
unidentified shrimp	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cyprididae	0.0	0.9	0.0	0.0	0.0	0.0	0.0	3.4	0.0	0.0	8.4	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Callibaetis	3.7	12.3	0.0	12.1	0.0	0.8	0.0	20.7	0.0	0.0	22.1	0.0	25.6	0.0	22.6	22.3	25.6	0.4	1.0
Caenis	0.0	3.8	0.0	3.0	0.0	15.0	0.8	1.4	0.0	0.0	0.5	0.0	0.0	0.0	4.5	2.1	12.8	0.2	0.0
Choroterpes	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Anax	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
Gynacantha	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Coryphaeschna	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	1.1	0.0	0.0	0.0
Nasiaeschna	0.0	0.3	0.0	0.0	0.0	3.9	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Libellulidae immature	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	2.6	0.0	0.0
Brachymesia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7
Celithemis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Crocothemis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0

Table 7. Continued.

OTU	SG1	SG5	SG6	SG7	SG8	SG10	SG12	SG14	SG15	SG19	SG20	SG21	SG22	SG24	SG25	SG26	SG27	TT1	TT2
Erythemis	0.0	4.4	0.0	0.0	0.0	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	1.4
Libellula	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9
Pachydiplax	0.0	8.8	0.0	0.0	0.0	0.0	11.8	0.7	0.0	0.0	6.3	0.0	0.0	6.5	0.0	0.0	0.0	0.0	0.0
Coenagrionidae	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.5	0.0	0.0	0.0	0.0	1.9
Enallagma	0.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.4	0.0	0.0	0.0
Ischnura	0.0	9.9	0.0	6.1	0.0	4.7	0.0	13.8	0.0	0.0	5.3	0.0	1.6	0.0	30.8	26.6	33.3	35.8	26.6
Nehalennia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Abedus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Belostoma	0.0	0.0	0.0	0.0	0.0	0.0	11.0	2.8	0.0	0.0	3.1	0.0	0.0	0.0	3.8	0.0	0.0	7.1	3.4
Abedus/Belostoma	3.7	3.8	0.0	3.0	0.0	0.0	0.0	0.0	0.0	2.5	0.0	0.0	3.1	2.2	0.0	0.0	0.0	0.0	0.2
Lethocerus	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.4	0.0	0.0	0.8	0.0	0.0	0.0	0.0
Synaptonecta	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Trichocorixa	0.0	1.5	0.0	0.0	0.0	0.0	0.0	4.1	0.0	0.0	0.0	5.9	0.0	0.0	0.0	0.0	0.0	1.1	0.5
Corixidae	0.0	0.0	0.0	9.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.6	0.4	0.0
Limnogonus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
Limnoporus	0.0	0.0	0.0	0.0	0.0	3.9	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Neogerris	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.2	7.2
Rheumatobates	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Trepobates	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	1.1	0.0	0.0	0.0
Gerridae	0.0	0.0	0.0	3.0	0.0	0.0	0.0	4.1	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lipogomphus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	2.3	2.2	0.0	0.0	0.0	0.0	0.0
Hydrometra	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	0.0	0.0	0.7	2.0	0.0	0.0	0.0	0.0	7.7	0.2	1.9
Mesovelia	3.7	1.2	0.0	6.1	0.0	1.6	0.0	0.0	0.0	0.0	1.4	0.4	0.0	0.0	0.0	2.1	0.0	6.2	3.1
Pelocoris	0.0	4.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.6	2.0	2.8
Ranatra	0.0	0.0	0.0	0.0	0.0	0.0	1.6	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.8	1.1	0.0	0.0	0.0
Buenoa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.3	0.0	8.8	10.1	1.2	0.0	6.5	0.0	2.1	0.0	0.0	0.0
Notonecta	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ochterus	0.0	0.0	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Neoplea	0.0	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 7. Continued.

OTU	SG1	SG5	SG6	SG7	SG8	SG10	SG12	SG14	SG15	SG19	SG20	SG21	SG22	SG24	SG25	SG26	SG27	TT1	TT2
Micranthia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Microvelia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Steinovelia	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Oxyethira	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Oecetis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dytiscidae immature larvae	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
Agabus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bidessonotus	0.0	0.0	0.0	0.0	7.4	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Celina	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Copelatus	0.0	0.0	6.7	0.0	11.1	0.0	0.0	0.0	2.6	8.8	0.5	7.1	8.5	6.5	0.0	0.0	0.0	0.0	0.0
Cybister	0.0	0.9	0.0	0.0	0.0	0.0	1.6	0.0	0.0	0.0	0.0	0.0	0.0	2.2	0.8	0.0	0.0	0.0	0.0
Derovatellus	0.0	0.0	0.0	0.0	0.0	0.0	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Desmopachria	0.0	0.0	0.0	6.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hydaticus	0.0	0.0	10.0	0.0	0.0	0.0	0.8	0.0	1.3	1.3	0.0	1.2	0.0	10.9	0.0	1.1	0.0	0.0	0.0
Hydrovatus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Laccodytes	14.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Laccophilus	0.0	0.3	6.7	0.0	0.0	0.0	1.6	0.0	0.0	0.0	0.0	22.0	30.2	4.3	0.0	1.1	0.0	0.0	0.0
Liodessus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0
Neoporus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pachydrus	0.0	0.0	0.0	0.0	0.0	0.0	3.1	0.0	0.0	6.3	0.0	0.0	0.0	6.5	0.8	0.0	0.0	0.0	0.0
Thermonectus	3.7	1.5	0.0	0.0	1.9	0.0	10.2	0.0	0.0	2.5	0.0	4.3	2.3	6.5	1.5	0.0	0.0	0.2	0.0
Pelonomus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dineutus	7.4	0.0	0.0	0.0	0.0	2.4	4.7	3.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1	0.0	0.0	0.0
Gyrinus	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Peltodytes	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hydrophilidae	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Berosus sp.	11.1	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	4.7	0.0	0.0	3.0	0.0	0.0	0.0	0.0
Derallus	0.0	1.5	0.0	0.0	0.0	1.6	0.0	0.0	0.0	1.3	0.0	0.4	0.0	0.0	0.0	1.1	0.0	0.0	0.0

Table 7. Continued.

OTU	SG1	SG5	SG6	SG7	SG8	SG10	SG12	SG14	SG15	SG19	SG20	SG21	SG22	SG24	SG25	SG26	SG27	TT1	TT2
Dibolocelus	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Enochrus	0.0	2.6	3.3	0.0	11.1	0.0	0.8	0.0	0.0	3.8	0.2	0.8	3.1	0.0	7.5	0.0	0.0	1.6	0.3
Helobata	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.0	0.0
Hydrobiomorpha	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hydrochus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Phaenonotum	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.5	1.1	0.0	0.0	0.0
Tropisternus	0.0	3.5	0.0	3.0	0.0	0.8	2.4	0.0	0.0	0.0	1.0	0.0	0.0	4.3	6.8	0.0	0.0	4.0	2.6
Hydrocanthus	0.0	5.6	0.0	6.1	0.0	15.7	0.0	6.9	3.9	0.0	9.4	1.6	8.5	0.0	0.0	4.3	0.0	0.0	0.5
Suphis	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Suphisellus	0.0	0.3	0.0	0.0	0.0	3.1	0.0	2.1	0.0	0.0	3.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Scirtes	0.0	0.0	0.0	0.0	0.0	0.0	26.0	0.0	0.0	33.8	1.0	0.0	1.6	0.0	0.0	0.0	0.0	0.0	0.0
Isotomidae	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.7	0.0	1.3	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ceratopogonidae	0.0	0.0	0.0	0.0	0.0	3.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
Bezzia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	1.1	5.1	1.6	0.2
Chironomidae	22.2	10.2	0.0	6.1	0.0	26.8	11.8	0.0	19.5	17.5	2.6	2.0	7.8	19.6	9.0	9.6	7.7	19.3	21.4
Culicidae immature	0.0	0.0	16.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Anopheles	0.0	0.3	0.0	0.0	0.0	1.6	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.8	0.0
Culex	11.1	0.6	0.0	0.0	61.1	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	2.3	0.0	0.0	0.0	0.0
Psorophora	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	61.0	0.0	0.0	39.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ephydridae	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Odontomyia	0.0	2.6	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	7.1	0.7
Tabanidae	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ancylidae immature	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	2.1	0.0	0.0	0.0
Ferrissia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Laevapex	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pomacea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hatia	0.0	2.0	50.0	0.0	0.0	3.9	1.6	0.0	0.0	3.8	10.1	0.0	0.0	10.9	0.0	7.4	0.0	0.0	0.0
Hydrobiidae	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3

Table 7. Continued.

OTU	SG1	SG5	SG6	SG7	SG8	SG10	SG12	SG14	SG15	SG19	SG20	SG21	SG22	SG24	SG25	SG26	SG27	TT1	TT2
Littoridinops	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.6	9.1
Planorbella	0.0	1.5	0.0	0.0	0.0	0.0	0.0	9.7	0.0	0.0	6.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gyraulus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.3	0.0	0.0	0.0	0.0	0.0
Micromenetus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1	0.0	0.0	0.0
Fossoria	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pseudosuccinea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sphaerium	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0
Musculium	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.4
Porifera	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Figure 98. Macroinvertebrate sampling (photos by Florida Gulf Coast University).

Table 8. Percent composition of OTUs collected from reference sites.

OTU	FP1	FP2	FP3	FP4	FP5	FP6	FS1	FS2	FS3	FS4	FS5	FS6
Hirudinea	0.2	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
Placobdella	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Oligochaeta	0.0	0.0	0.3	0.7	0.6	0.0	0.4	0.4	0.0	0.7	0.0	0.0
Lumbriculidae	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0
Naididae	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tubificida	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Polychaeta	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
marine vermiform	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Acariformes	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9
Sphaeroma	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
Probopyrus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6
Argulus	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hyalella	30.3	5.5	2.3	6.7	2.3	0.0	8.6	4.0	0.0	1.6	0.0	8.4
Gammarus	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
Daphnidae	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0
Procambarus	1.7	3.2	3.3	1.6	1.3	2.4	1.1	4.4	0.0	1.2	0.7	1.4
Palaemonetes	3.2	1.4	0.3	6.5	0.0	0.5	0.8	0.0	0.0	0.0	3.6	2.2
unidentified shrimp	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.1
Cyprididae	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.0	1.0	0.0	0.8
Callibaetis	7.3	17.9	24.1	13.7	25.4	30.7	13.5	31.3	54.5	62.3	28.8	7.9
Caenis	4.2	9.2	11.6	2.0	8.7	12.7	11.7	14.3	9.1	2.3	18.0	8.4
Choroterpes	3.2	0.5	0.3	0.0	0.0	0.0	1.9	0.0	0.0	0.0	0.0	0.0
Anax	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gynacantha	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Coryphaeschna	0.7	0.0	0.0	0.9	0.0	0.5	0.0	0.0	0.0	0.1	0.0	0.0
Nasiaeschna	0.0	0.0	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0
Libellulidae immature	0.2	3.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	0.3
Brachymesia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Celithemis	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Crocothemis	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Erythemis	0.0	1.4	0.7	0.0	2.3	1.0	0.0	0.0	0.0	0.0	0.0	0.3
Libellula	0.7	0.0	2.6	0.5	0.6	1.0	0.0	0.0	1.1	0.0	0.0	1.1
Pachydiplax	0.7	0.0	4.3	9.9	1.9	1.0	0.0	1.2	3.4	4.5	0.0	0.0
Coenagrionidae	0.0	0.0	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.1	5.0	3.0
Enallagma	0.0	0.0	0.0	2.5	0.0	0.0	1.5	0.4	0.0	0.7	0.7	0.0
Ischnura	2.9	10.6	6.9	7.8	17.0	17.1	19.5	19.0	4.5	2.5	12.2	15.3
Nehalennia	0.2	0.0	0.7	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.5
Abedus	1.0	0.0	2.3	0.0	1.9	2.9	0.8	0.0	2.3	0.0	0.0	0.0
Belostoma	0.0	1.8	2.0	2.9	1.9	0.5	2.3	0.8	0.0	0.1	0.0	6.0
Abedus/Belostoma	0.0	0.0	0.0	0.5	0.0	0.5	0.0	0.4	0.0	0.0	1.4	1.1
Lethocerus	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.4	0.0	0.0	1.4	0.0
Synaptonecta	0.5	0.0	0.0	0.0	0.6	0.0	0.0	0.8	0.0	0.0	0.0	0.0
Trichocorixa	0.7	4.6	0.3	0.0	0.0	2.0	0.0	0.4	0.0	0.0	3.6	0.3
Corixidae	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.0	0.0
Limnogonus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Limnoporus	0.0	0.0	0.0	1.4	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0

Table 8. Continued.

OTU	FP1	FP2	FP3	FP4	FP5	FP6	FS1	FS2	FS3	FS4	FS5	FS6
Neogerris	2.7	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4
Rheumatobates	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0
Trepobates	3.4	1.8	2.0	0.5	1.3	0.5	0.0	0.0	0.0	0.0	0.7	0.0
Gerridae	0.5	0.0	0.3	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0
Lipogomphus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
Hydrometra	0.5	3.2	1.0	1.4	3.9	1.0	2.3	0.4	1.1	0.4	0.0	1.4
Mesovelia	0.0	3.7	0.0	0.0	1.0	0.0	2.3	0.4	0.0	0.2	0.0	0.5
Pelocoris	1.2	2.8	0.0	0.0	0.6	0.0	1.9	0.0	0.0	0.0	0.0	7.1
Ranatra	0.2	0.5	0.3	0.4	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0
Buenoa	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0
Notonecta	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ochterus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Neoplea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Micranthia	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Microvelia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Steinovelia	0.2	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Oxyethira	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Oecetis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dytiscidae immature larvae	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Agabus	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Bidessonotus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.0	0.0
Celina	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	1.1	0.2	0.0	0.0
Copelatus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cybister	0.0	0.5	0.7	0.4	0.3	1.0	0.0	0.0	1.1	0.7	0.0	0.5
Derovatellus	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Desmopachria	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0
Hydaticus	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hydrovatus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Laccodytes	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Laccophilus	0.2	0.0	2.3	2.0	1.6	0.0	1.1	0.8	6.8	0.1	0.0	0.0
Liodessus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Neoporus	0.0	0.0	0.0	5.4	0.0	0.0	0.0	0.0	0.0	3.7	0.0	0.0
Pachydrus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0
Thermonectus	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pelonomus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dineutus	0.2	0.0	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0
Gyrinus	1.7	0.5	0.0	0.2	1.3	0.0	0.0	1.2	0.0	0.0	0.0	0.3
Peltodytes	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hydrophilidae	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
Berosus sp.	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
Derallus	2.2	0.5	1.7	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.3
Dibolocelus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Enochrus	1.0	0.9	0.3	0.7	2.6	1.5	0.0	0.0	4.5	0.2	0.0	1.4
Helobata	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Hydrobiomorpha	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 8. Continued.

OTU	FP1	FP2	FP3	FP4	FP5	FP6	FS1	FS2	FS3	FS4	FS5	FS6
Hydrochus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Phaenonotum	0.2	0.0	0.3	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tropisternus	0.7	2.3	0.3	0.5	3.5	1.5	0.0	0.4	0.0	0.0	0.0	0.3
Hydrocanthus	4.2	2.3	4.0	3.6	3.5	3.9	6.4	6.0	8.0	0.5	2.2	1.6
Suphis	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0
Suphisellus	0.0	3.2	0.0	0.4	0.0	6.3	0.0	0.0	0.0	0.0	0.0	0.0
Scirtes	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Isotomidae	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.1	0.0	0.0
Ceratopogonidae	0.2	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.1	0.7	0.0
Bezzia	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Chironomidae	2.7	1.8	2.3	5.8	1.6	1.0	4.1	4.0	0.0	2.4	6.5	9.8
Culicidae immature	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Anopheles	1.7	1.8	0.0	0.5	0.0	0.0	0.4	0.0	0.0	0.4	0.7	0.3
Culex	0.5	0.5	0.0	0.2	0.3	0.5	0.0	0.0	0.0	0.1	0.0	0.0
Psorophora	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ephydridae	0.0	0.0	0.0	0.0	0.3	0.0	0.4	0.0	0.0	0.0	0.0	0.0
Odontomyia	0.2	0.9	0.0	0.2	0.0	0.0	1.1	0.0	0.0	0.0	0.0	0.8
Tabanidae	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8
Ancylidae immature	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ferrissia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Laevapex	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
Pomacea	0.0	0.0	1.3	0.9	1.6	2.0	3.0	1.6	0.0	0.1	0.0	0.0
Hatia	9.8	7.3	12.2	2.0	5.5	4.9	9.4	5.6	0.0	2.1	4.3	0.5
Hydrobiidae	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0
Littoridinops	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0
Planorbella	5.1	4.6	5.6	4.3	3.2	1.5	0.8	2.0	0.0	2.5	4.3	0.5
Gyraulus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Micromenetus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fossoria	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pseudosuccinea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.2	0.0
Sphaerium	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Musculium	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.3
Porifera	1.0	0.0	0.0	4.5	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.3

Fishes

A total of 6,381 individual fish were collected by Beder trap (**Figure 99**) during the baseline assessment, including at least 25 species representing nine families with two nonnative families and five nonnative species (**Table 9**). Only 17 (52 percent) of 31 impacted wetlands and 10 (91 percent) of 11 reference wetlands produced fishes during the sampling period. The reference site that did not contain any fish was a mesic-hydric pine habitat in Fakahatchee Strand (FS3) that was not directly connected to other surface waters during the sampling events. The most abundant species by far was the eastern mosquitofish (*Gambusia holbrooki*), which was found at all locations where fish were collected. Also abundant at some locations were sailfin molly (*Poecilia latipinna*), sheepshead minnows (*Cyprinodon variegatus*), Florida flagfish (*Jordanella floridae*), and least killifish (*Heterandria formosa*) (**Table 9**).

Table 9. Fish family, genus, species, and total abundance for all sites combined.

Family	Genus	Species	Total
Atherinidae	*Labidesthes*	*sicculus*	17
	Menidia	*beryllina*	10
Calicthyidae	*Hoplosternum*	*littorale*	2
Pociliidae	*Belonesox*	*belizanus*	8
	Gambusia	*holbrooki*	4,024
	Heterandria	*formosa*	201
	Poecilia	*latipinna*	916
Cyprinodontidae	*Adinia*	*xenica*	3
	Cyprinodon	*variegatus*	483
	Jordanella	*floridae*	335
Fundulidae	*Fundulus*	*chrysotus*	47
	Fundulus	*confluentus*	80
	Fundulus	*grandis*	3
	Lucania	*goodei*	105
	Lucania	*parva*	53
Elassomatidae	*Elassoma*	*evergladei*	4
Centrarchidae	*Lepomis*	*gulosus*	11
	Lepomis	*marginatus*	9
	Lepomis	*microlophus*	2
	Lepomis	*punctatus*	9
	Lepomis	*sp. Juv.*	5
Cichlidae	*Astronotus*	*ocellatus*	3
	Cichlasoma	*bimaculatum*	16
	Cichlasoma	*urophthalmus*	34
Gobiidae	*Microgobius*	*gulosus*	1
		Total individuals	**6,381**

Figure 99. Setting and retrieving Beder traps for fish sampling (photos by Florida Gulf Coast University).

For reference wetlands, fish species ranged from three at the hydric pine site FP6 to 13 species at the brackish marsh site FS6. The mean species richness for reference sites was 8.1 species per site. Total species richness for the 14 impacted freshwater wetlands in Picayune Strand ranged from one to seven species with a mean value of 4.5 fish species per site. The impacted brackish marshes, TT1 and TT2, contained nine and 11 species, respectively, but samples were dominated by mosquitofish and euryhaline species such as sailfin molly and sheepshead minnow, indicating tidal influence and reduced freshwater flow. All three brackish marshes exhibited longer hydroperiods than most of the impacted freshwater sites in Picayune Strand and were therefore more accessible to fish.

Species percent composition for each Picayune Strand and coastal marsh site is presented in **Table 10**. **Table 11** presents species composition for the reference sites in Florida Panther National Wildlife Refuge and Fakahatchee Strand Preserve State Park. Reference wetlands had more diverse fish communities than impacted wetlands, with a more even distribution of species abundances and percent composition within and between sites. Everglades pygmy sunfish (*Elassoma evergladei*) and warmouth sunfish (*Leopmis gulosus*) were only collected from reference wetlands and may be considered as indicators of restoration success.

There are four significantly different groupings with one large group that includes all reference sites and several of the impacted sites. Only five impacted sites group closely with eight of the reference sites including one wet prairie site in Fakahatchee Strand (FS5) and a deep freshwater marsh in Picayune Strand (SG4) with other sites (SG6, SG7, and SG25) that were most likely affected by the 2004 restoration work of filling Prairie Canal that partially restored hydroperiods in that area. Reference sites average 58 percent similarity (42 percent dissimilarity) of fish community structure, with seven species contributing to more than 93 percent of the similarity between reference sites. Of the impacted wetlands that contained fishes, there was an average of 45 percent similarity (55 percent dissimilarity) with five species contributing to more than 93 percent of that 45 percent similarity between sites with the tolerant and ubiquitous eastern mosquitofish contributing the most (> 66 percent).

Table 10. Percent composition of fish species within samples collected from Picayune Strand and coastal marsh sites.

Family	Genus	Species	SG1	SG5	SG6	SG7	SG10	SG12	SG14	SG15	SG19
Atherinidae	*Labidesthes*	*sicculus*	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Menidia	*beryllina*	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Calicthyidae	*Hoplosternum*	*littorale*	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Pociliidae	*Belonesox*	*belizanus*	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Gambusia	*holbrooki*	97.9%	90.5%	48.8%	62.2%	95.4%	98.5%	88.7%	100.0%	94.7%
	Heterandria	*formosa*	1.1%	0.7%	4.8%	4.4%	0.0%	0.0%	0.0%	0.0%	3.2%
	Poecilia	*latipinna*	0.0%	3.8%	1.2%	6.7%	0.0%	0.0%	0.0%	0.0%	0.0%
Cyprinodontidae	*Adinia*	*xenica*	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Cyprinodon	*variegatus*	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Jordanella	*floridae*	1.1%	3.8%	28.6%	13.3%	0.0%	1.5%	6.5%	0.0%	2.1%
Fundulidae	*Fundulus*	*chrysotus*	0.0%	0.2%	1.2%	4.4%	0.0%	0.0%	1.6%	0.0%	0.0%
	Fundulus	*confluentus*	0.0%	0.0%	14.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Fundulus	*grandis*	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Lucania	*goodei*	0.0%	0.2%	0.0%	8.9%	2.6%	0.0%	0.0%	0.0%	0.0%
	Lucania	*parva*	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Elassomatidae	*Elassoma*	*evergladei*	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Centrarchidae	*Lepomis*	*gulosus*	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Lepomis	*marginatus*	0.0%	0.0%	0.0%	0.0%	2.0%	0.0%	0.0%	0.0%	0.0%
	Lepomis	*microlophus*	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Lepomis	*punctatus*	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Lepomis	sp.Juv.	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Cichlidae	*Astronotus*	*ocellatus*	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.6%	0.0%	0.0%
	Cichlasoma	*bimaculatum*	0.0%	0.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Cichlasoma	*urophthalmus*	0.0%	0.0%	1.2%	0.0%	0.0%	0.0%	1.6%	0.0%	0.0%
Gobiidae	*Microgobius*	*gulosus*	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Table 10. Continued.

Family	Genus	Species	SG20	SG24	SG25	SG26	SG27	TT1	TT2
Atherinidae	*Labidesthes*	*sicculus*	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.2%
	Menidia	*beryllina*	0.0%	0.0%	0.0%	0.0%	0.0%	1.8%	0.0%
Calicthyidae	*Hoplosternum*	*littorale*	1.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Pociliidae	*Belonesox*	*belizanus*	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
	Gambusia	*holbrooki*	74.6%	98.6%	40.8%	72.2%	47.5%	16.5%	25.4%
	Heterandria	*formosa*	0.0%	1.4%	24.5%	0.0%	0.0%	0.0%	0.0%
	Poecilia	*latipinna*	2.8%	0.0%	0.0%	0.0%	0.0%	39.3%	30.6%
Cyprinodontidae	*Adinia*	*xenica*	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.4%
	Cyprinodon	*variegatus*	0.0%	0.0%	0.0%	0.0%	0.0%	28.4%	34.8%
	Jordanella	*floridae*	19.7%	0.0%	18.6%	0.0%	0.0%	2.6%	0.0%
Fundulidae	*Fundulus*	*chrysotus*	0.0%	0.0%	0.2%	8.3%	26.2%	0.0%	0.0%
	Fundulus	*confluentus*	0.0%	0.0%	0.0%	0.0%	0.0%	1.0%	2.9%
	Fundulus	*grandis*	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.1%
	Lucania	*goodei*	0.0%	0.0%	15.8%	2.8%	14.8%	0.0%	0.0%
	Lucania	*parva*	0.0%	0.0%	0.0%	0.0%	0.0%	8.1%	1.6%
Elassomatidae	*Elassoma*	*evergladei*	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Centrarchidae	*Lepomis*	*gulosus*	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Lepomis	*marginatus*	0.0%	0.0%	0.0%	2.8%	3.3%	0.0%	0.0%
	Lepomis	*microlophus*	0.0%	0.0%	0.0%	2.8%	1.6%	0.0%	0.0%
	Lepomis	*punctatus*	0.0%	0.0%	0.0%	2.8%	4.9%	0.0%	0.0%
	Lepomis	sp.Juv.	0.0%	0.0%	0.0%	8.3%	0.0%	0.0%	0.0%
Cichlidae	*Astronotus*	*ocellatus*	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Cichlasoma	*bimaculatum*	1.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Cichlasoma	*urophthalmus*	0.0%	0.0%	0.0%	0.0%	1.6%	2.0%	1.7%
Gobiidae	*Microgobius*	*gulosus*	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%

Table 11. Percent composition of fish species within samples collected from reference sites.

Family	Genus	Species	FP1	FP2	FP3	FP4	FP5	FP6	FS1	FS2	FS4	FS5	FS6
Atherinidae	*Labidesthes*	*sicculus*	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Menidia	*beryllina*	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
Calicthyidae	*Hoplosternum*	*littorale*	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Pociliidae	*Belonesox*	*belizanus*	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.4%	1.4%	0.5%
	Gambusia	*holbrooki*	86.8%	48.4%	50.0%	90.7%	81.6%	79.7%	93.4%	88.4%	94.5%	73.8%	31.2%
	Heterandria	*formosa*	0.6%	0.0%	10.0%	6.2%	0.6%	0.0%	1.0%	3.3%	1.3%	1.4%	0.2%
	Poecilia	*latipinna*	0.6%	1.9%	3.3%	0.0%	0.6%	0.0%	0.0%	0.6%	0.4%	9.2%	53.4%
Cyprinodontidae	*Adinia*	*xenica*	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Cyprinodon	*variegatus*	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	9.4%
	Jordanella	*floridae*	7.1%	38.1%	33.3%	0.4%	11.5%	11.9%	0.5%	5.3%	0.0%	9.9%	2.2%
Fundulidae	*Fundulus*	*chrysotus*	1.0%	4.5%	0.0%	0.0%	1.7%	8.5%	0.5%	0.3%	0.4%	0.0%	0.1%
	Fundulus	*confluentus*	1.9%	4.5%	0.0%	0.1%	1.1%	0.0%	0.5%	1.2%	0.4%	4.3%	1.6%
	Fundulus	*grandis*	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
	Lucania	*goodei*	0.0%	0.6%	3.3%	0.6%	0.0%	0.0%	3.6%	0.6%	0.4%	0.0%	0.0%
	Lucania	*parva*	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
Elassomatidae	*Elassoma*	*evergladei*	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.5%	0.0%	0.0%	0.0%	0.1%
Centrarchidae	*Lepomis*	*gulosus*	0.3%	1.3%	0.0%	0.6%	0.6%	0.0%	0.0%	0.0%	0.8%	0.0%	0.0%
	Lepomis	*marginatus*	0.6%	0.0%	0.0%	0.0%	0.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Lepomis	*microlophus*	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Lepomis	*punctatus*	0.0%	0.0%	0.0%	0.4%	0.0%	0.0%	0.0%	0.3%	0.4%	0.0%	0.0%
	Lepomis	sp. Juv.	0.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Cichlidae	*Astronotus*	*ocellatus*	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Cichlasoma	*bimaculatum*	0.0%	0.6%	0.0%	0.6%	1.7%	0.0%	0.0%	0.0%	0.8%	0.0%	0.0%
	Cichlasoma	*urophthalmus*	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.0%
Gobiidae	*Microgobius*	*gulosus*	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

ESTUARINE BENTHIC HABITAT MAPPING

In the 2008 SFER – Volume I, Appendix 7A-2 reported on benthic habitat mapping conducted in Pumpkin Bay. This 2009 SFER appendix completes the baseline of benthic habitat mapping by reporting on Faka Union and Fakahatchee Bays (**Figure 100**). Mapping of these two bays took place from June 2 to August 29, 2004 (Locker, 2005). Benthic habitats and bottom type is presented in **Figure 101**, substrate (or QTC) classification is presented in **Figure 102**, and a bathymetric map is presented in **Figure 103**. The mapping study provides a baseline dataset for comparison with future change that may result from watershed restoration efforts or other future factors such as sea-level rise and climate change. The knowledge of benthic habitat distribution patterns will also assist ongoing investigations of species diversity and fish habitat suitability.

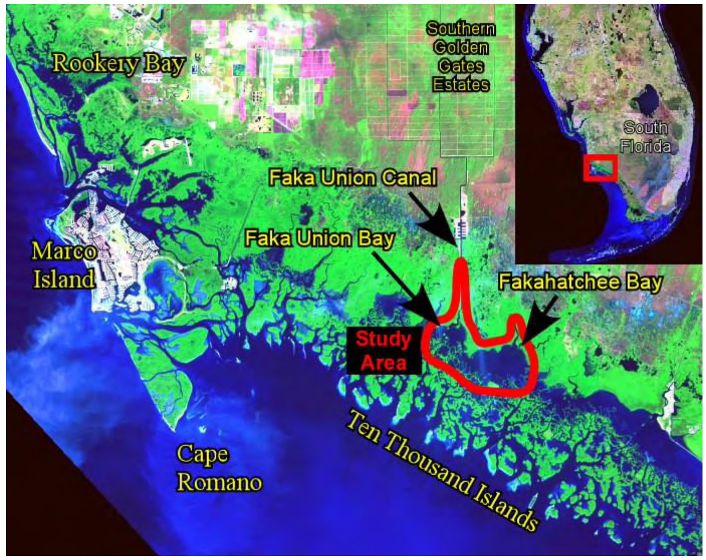

Figure 100. Benthic mapping study area.

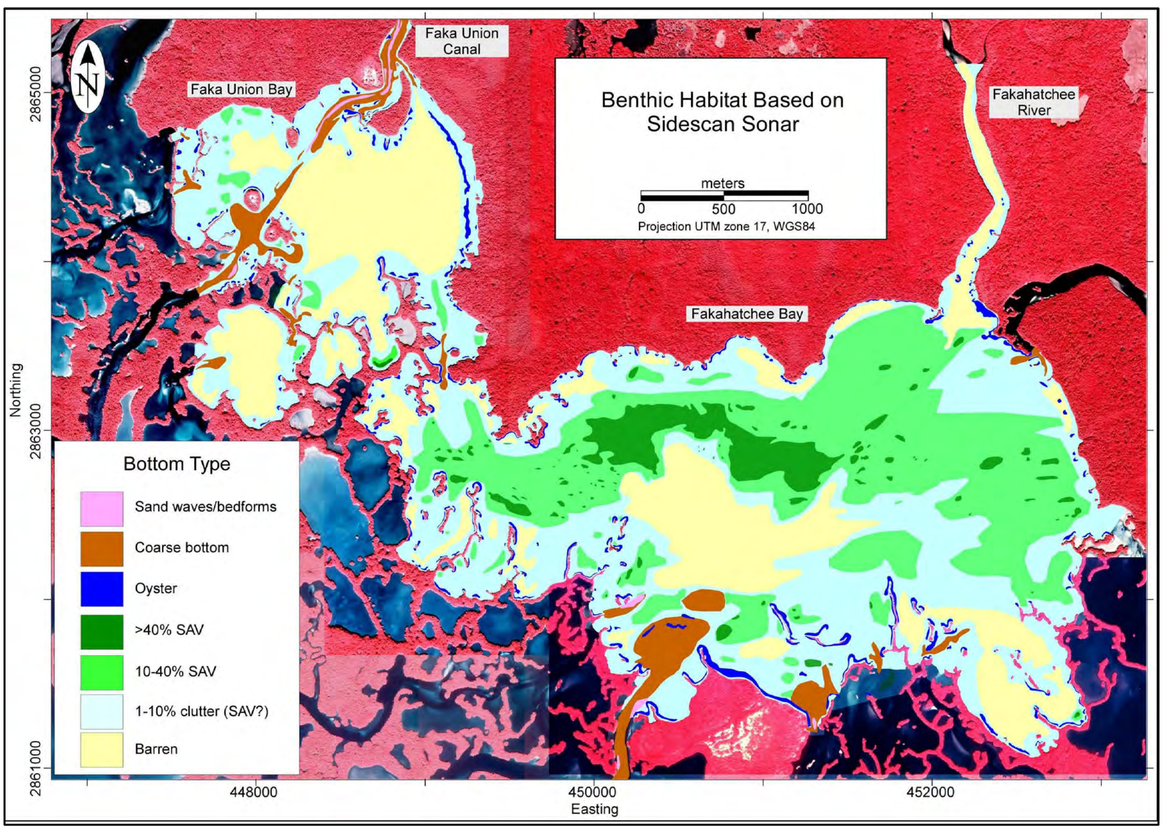

Figure 101. Benthic habitat in Faka Union and Fakahatchee bays in 2004.

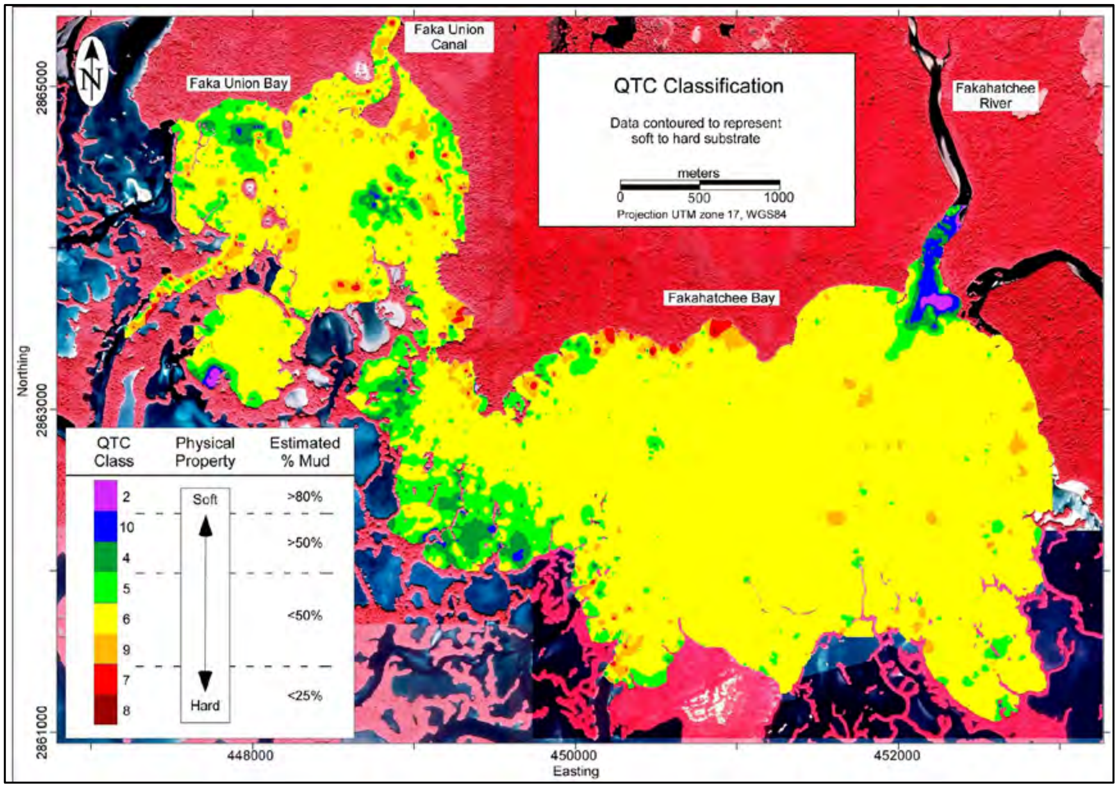

Figure 102. Substrate classification for Faka Union and Fakahatchee bays.

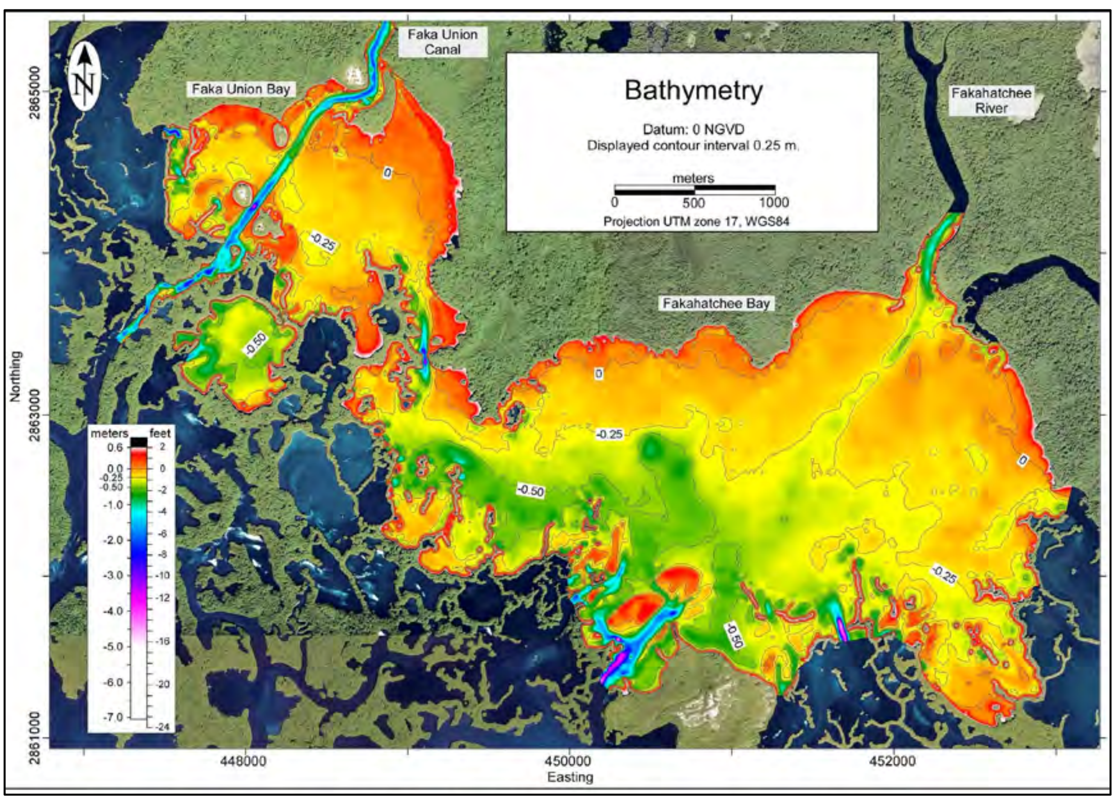

Figure 103. Bathymetric map for Faka Union and Fakahatchee bays.

Benthic habitat and sediment type mapping in Faka Union and Fakahatchee Bays have revealed major differences in benthic environments related to impacts of high-volume freshwater flows exiting the Faka Union Canal into Faka Union Bay. Key observations include a general absence of submerged aquatic vegetation (SAV) in Faka Union Bay, while it is widespread in Fakahatchee Bay (**Figure 101**). Surface sediment in Faka Union Bay is very muddy in comparison to Fakahatchee Bay (**Figure 102**), with evidence indicating an anthropogenic mud layer blankets much of the bay due to flushing of organic-rich fines from the Faka Union Canal.

In Faka Union Bay, little SAV is observed. However, in Fakahatchee Bay, SAV is widespread and mostly located in the northern portion of the bay. A comparison between water depth and SAV distribution suggest depth might be an important control on SAV. **Figure 104** suggests a marked reduction of SAV occurs in water deeper than about –30 cm relative to the low water level of 0 ft NGVD. This potential depth control assists in predicting SAV recovery in Faka Union Bay following restoration. Areas in the "distal" southern and western portion of Faka Union Bay would be best suited for SAV recovery.

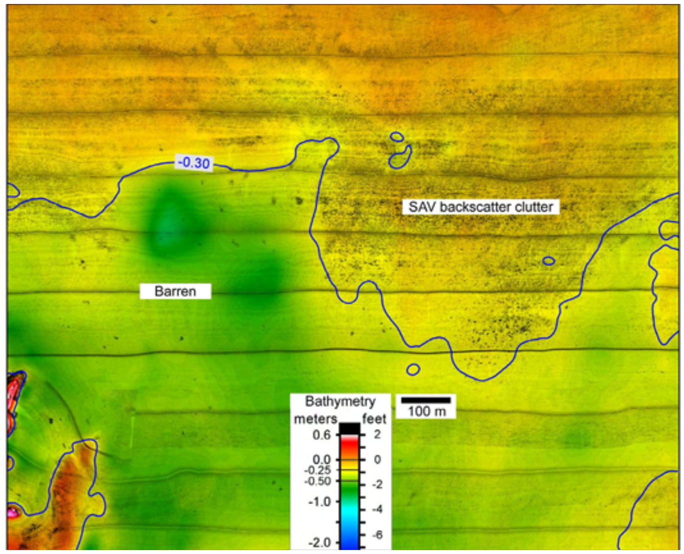

Figure 104. Map of SAV distribution in central Fakahatchee Bay with -30 cm depth contour.

Other major differences between the two bays are seen at the mouths of the two main river inputs and in the bay-wide sediment patterns, where Faka Union Bay is muddy and Fakahatchee Bay is sandy (**Figure 102**). The mud in Faka Union Bay is believed to be an anthropogenic mud layer deposited from the flushing of fine grained organic-rich material from the Faka Union Canal during high volume freshwater inflows. The lower reaches of the Faka Union Canal and Fakahatchee River, where freshwater flows enter the bays, provides a clear view of the differences between the more natural setting at Fakahatchee River in comparison to the altered setting at Faka Union Canal (**Figures 105** through **108**). Muddy organic-rich sediment is accumulating on the bottom of the Fakahatchee River mouth as well as up river (**Figure 105,** panel b; and **Figure 108,** panel b). This indicates a lack of strong freshwater inflows impacting the environment. Oyster reefs appear well developed and extend up river beyond the figure. At Faka Union Canal, the channel is erosional, with sediment wave bedforms indication high velocity flow and sediment transport into Faka Union Bay (**Figure 105,** panel a; **Figure 107,** panel a; and **Figure 108,** panel a). It is not possible to differentiate how much erosion in the channel is due to currents or due to the initial dredging of the channel. There is little evidence of the typical oyster reef development and oyster reefs are not apparent up river. Very little SAV habitat is found in this portion of the Faka Union Bay (**Figure 106,** panel a), while the mouth of the Fakahatchee River (**Figure 106,** panel b) has a large amount of SAV and more prevalent oyster reefs.

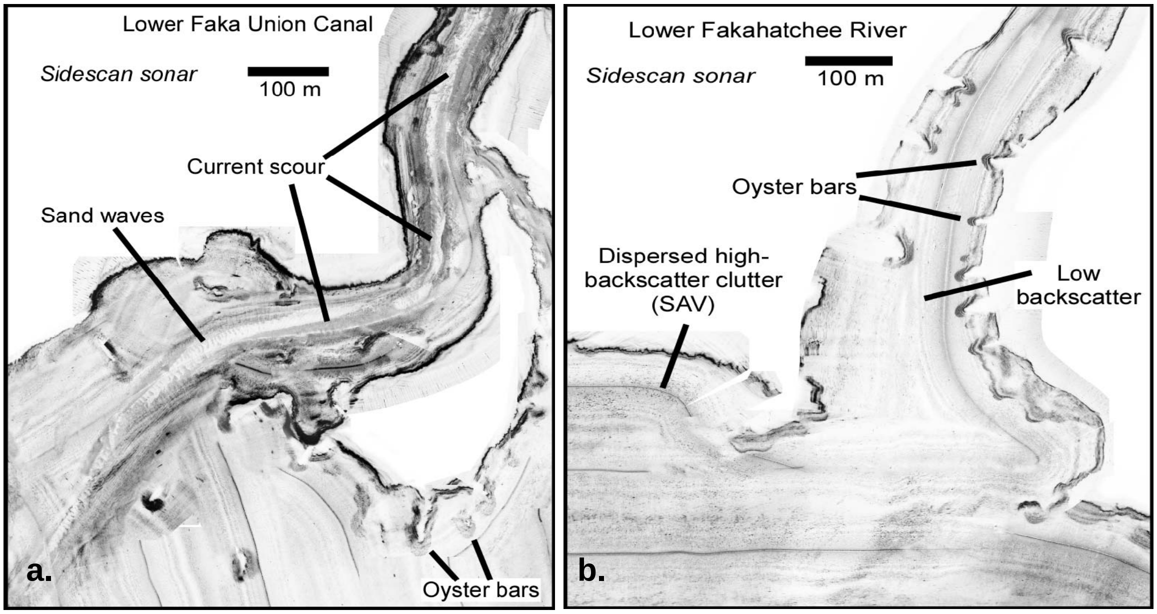

Figure 105. Side-scan sonar imagery at the mouth of (a) Fakahatchee River and (b) Faka Union Canal.

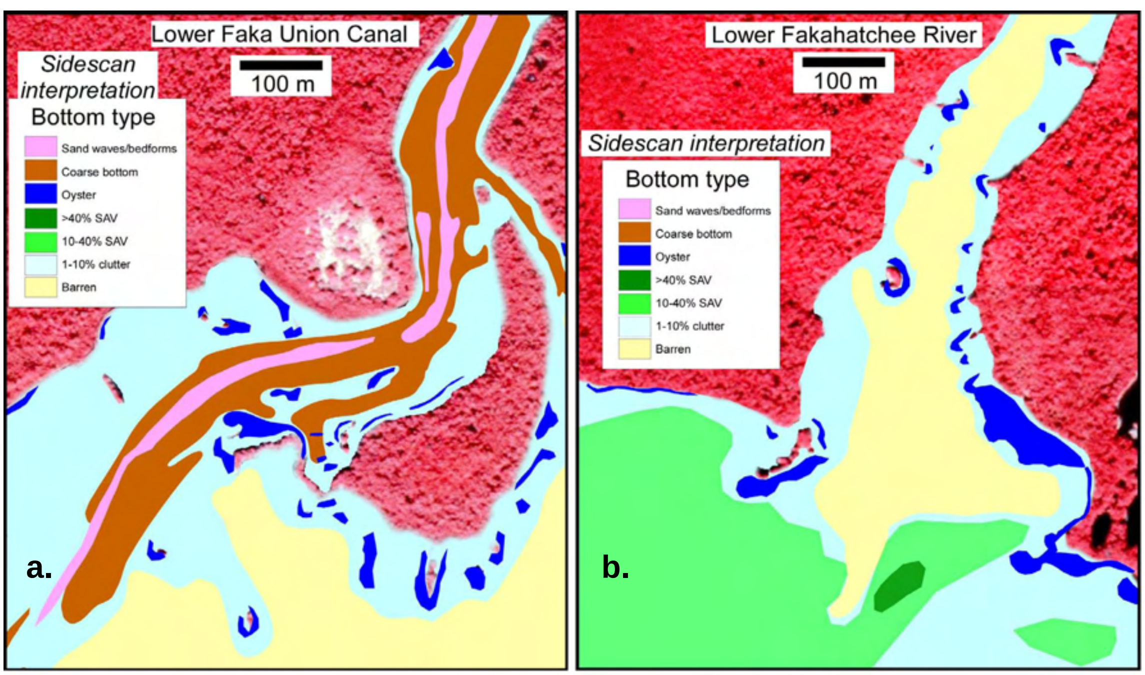

Figure 106. Benthic habitat at the mouth of (a) Faka Union Canal and (b) Fakahatchee River.

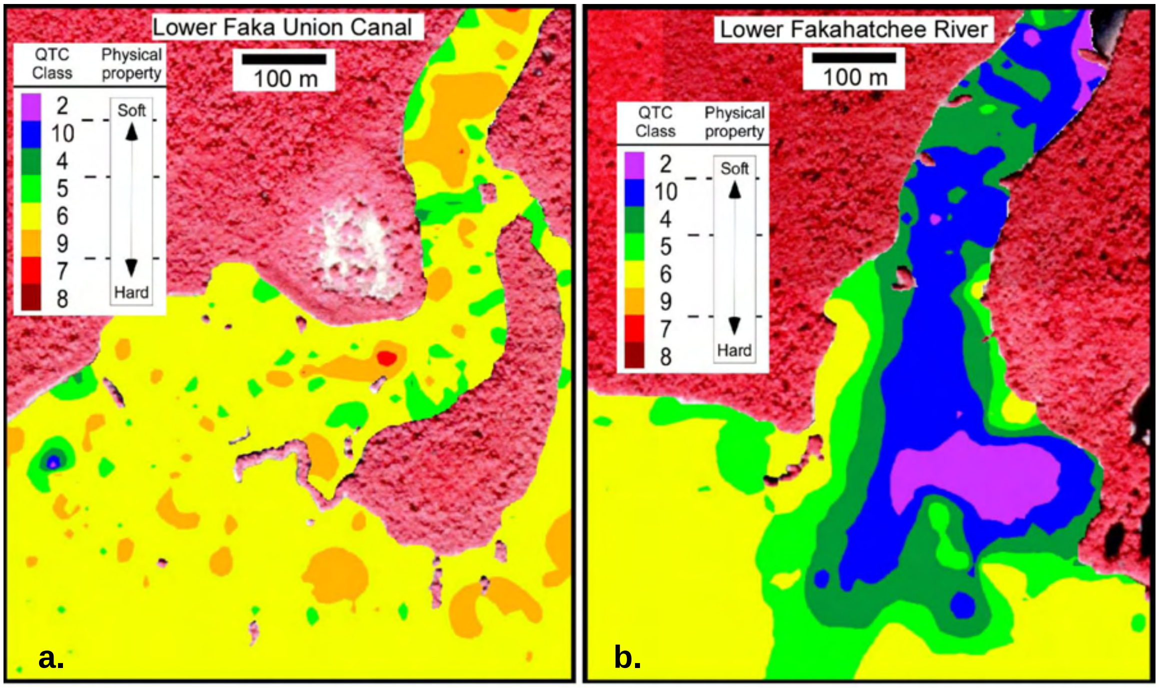

Figure 107. Substrate at the mouth of (a) Faka Union Canal and (b) Fakahatchee River.

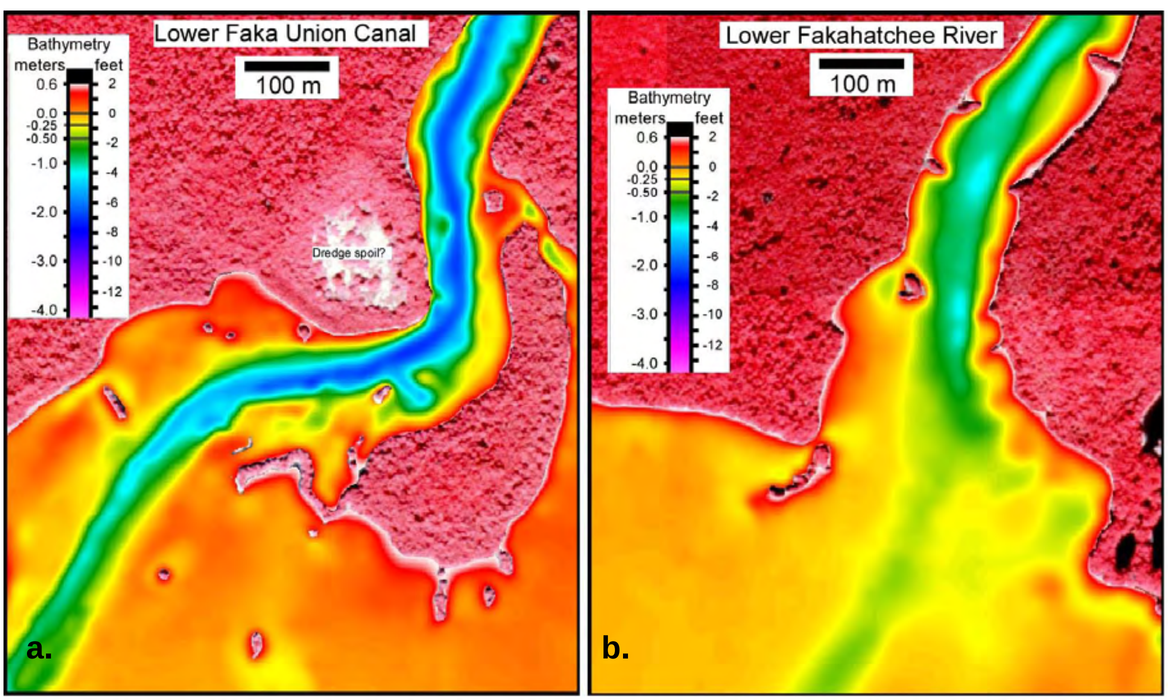

Figure 108. Water depth at the mouth of (a) Faka Union Canal and (b) Fakahatchee River.

Distribution of propeller scar tracks within the bays is presented in **Figure 109**. Propeller scarring is having two noticeable impacts in the study area. One is at the entrance to the Faka Union Canal where boats consistently gouge the channel margin on the south side. This resuspension of sediment from boat props has caused a displacement of sediment into the channel causing shoaling that is further reducing the channel depths (**Figure 110**). Given the logical assumption that this is primarily occurring on falling tides as boats head upriver, the disturbed sediment would drift seaward with the ebbing tide. This process will continue to happen, leading to more restricted passage. Boats are already beginning to touch bottom in the redeposited area. Another significant long-term effect of boat traffic is its destructive impact on SAV. This appears to be causing a reduction in SAV coverage in western Fakahatchee Bay (**Figure 111**). The detectable prop scar tracks show that SAV has been severely damaged in this area, imparting a northwest-southeast lineation pattern to the SAV patches that remain. At this location, the SAV occurrence extends into slightly deeper water, however the apparent optimal water depth for SAV of shallower than -30 cm also exposes SAV to more likely boat groundings (see yellow shades in **Figure 111**).

Recovery of SAV in Faka Union Bay following restoration of freshwater inflow will meet with several complications due to past and present anthropogenic impacts. The sediment type in much of the bay has changed to an organic-rich mud that might be subject to sediment anoxia or contain other contaminants unfavorable to seagrass development. Prop scarring from boat traffic is considerably impacting both bays, reducing or preventing SAV development. In Fakahatchee Bay, SAV coverage could potentially experience a decline as recreational boating and prop scaring increases in the future. The future recovery or maintenance of benthic habitats in these estuarine systems will need to contend not only with an anthropogenic legacy, but also with the continuing impact of recreational boating that would most likely increase with continuing development in Southwest Florida.

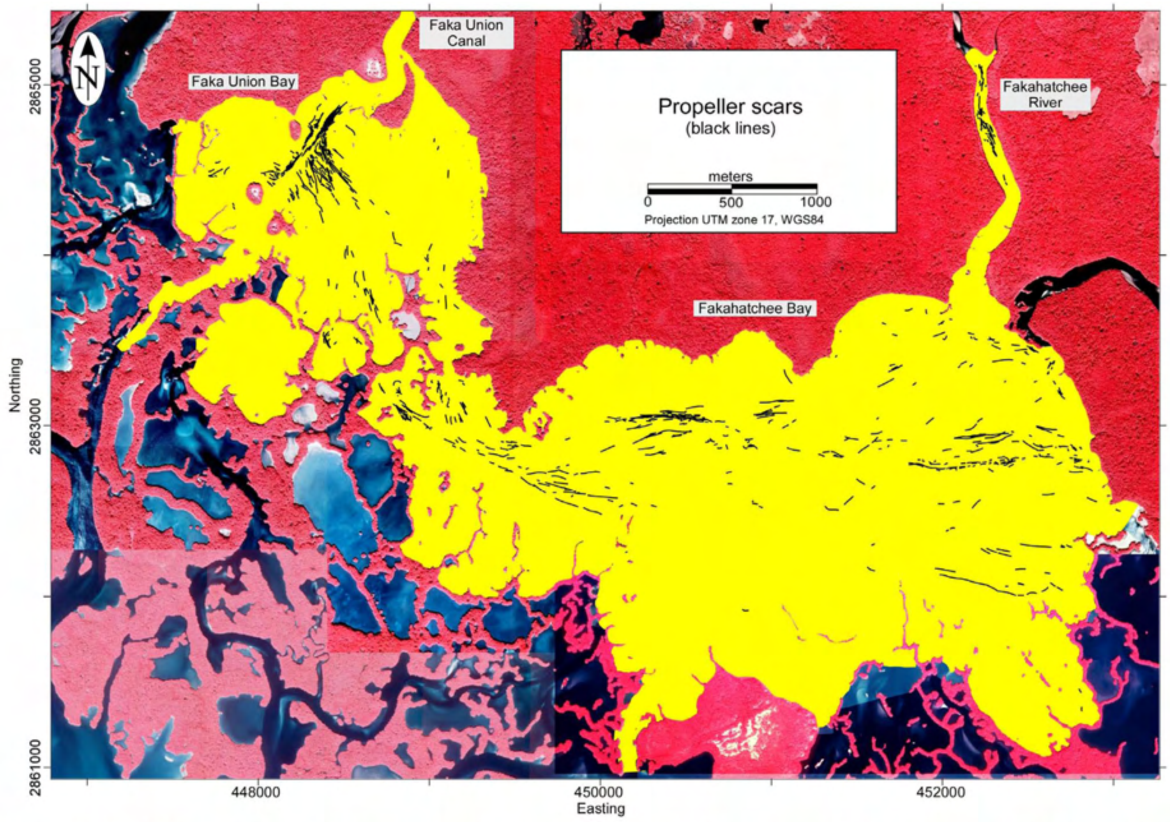

Figure 109. Distribution of most noticeable propeller scar tracks in the Faka Union and Fakahatchee bays.

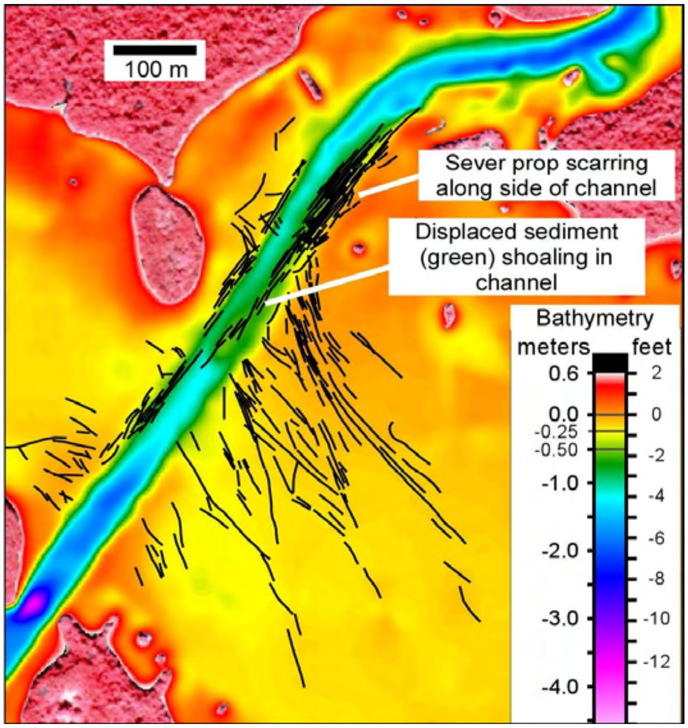

Figure 110. Location of prop scar tracks (black lines) at the entrance to Faka Union Canal.

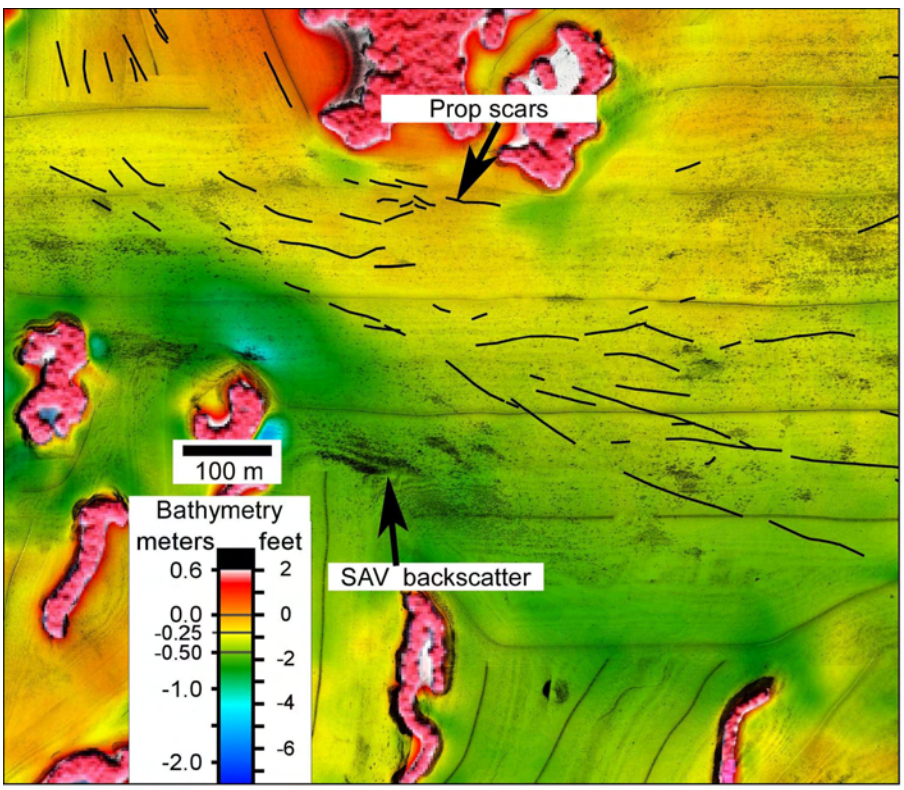

Figure 111. Propeller scar tracks (black lines) appear to have caused destruction in western Fakahatchee Bay.

ESTUARINE SPECIES

Freshwater inflow directly and indirectly influences factors that control estuarine species composition, including larval recruitment, reproduction, food availability, and predation (Gilmore et al., 1983; Stanley and Nixon, 1992; Cartaxana, 1994; Van Den Avyle and Maynard, 1994; Whit eld, 1999; Riera et al., 2000). Anthropogenic alterations in the quantity, quality, and timing of freshwater inflow can have wide-ranging consequences, thereby altering species composition (Montague and Ley, 1993; Sklar and Browder, 1998; Grange et al., 2000; Meng and Matern, 2001).

The natural freshwater inflow to most estuaries within the Ten Thousand Islands region, including Faka Union Bay, has been altered by channelization of wetland sheet ow. As a result, the salinity of these estuaries is influenced more by canal management than by tides and rainfall. Fakahatchee Bay currently receives approximately 98 percent of its annual, natural predrainage freshwater inflow so it serves as a reference site for conditions in the other estuaries within the Ten Thousand Islands region.

In the *Nekton* and *Oyster Reef Crab* sections of this appendix, seasonal rainfall patterns are discussed. Natural seasonal rainfall patterns with corresponding estuarine salinity conditions can be categorized as early dry season (December through February), late dry season (March through May), early wet season (June through August), and late wet season (September through November) (Shirley and Brandt-Williams, 2003).

Nekton

Nekton species are those organisms living suspended in the water. Nekton species are composed principally of fish and crustaceans (**Figure 112**). For two years, 2001–2002, nekton was sampled in Faka Union and Fakahatchee bays (see **Figure 100**) (Shirley et al., 2004a).

A striking difference between Faka Union Bay and the reference estuary, Fakahatchee Bay, was the extreme salinity fluctuation observed during May through February in Faka Union Bay. The management strategy of quickly draining the watershed to prevent upstream flooding of residential areas delivers unnaturally large volumes of fresh water into this estuary and extends the influence of the wet season into the early dry season. In 2001 and 2002, these estuaries had significantly different species compositions, and the species contributing most to this difference were in greater abundance in Fakahatchee Bay. Despite these differences, the overall catch per unit effort (CPUE) in these estuaries for the same season during each year was not statistically different. Wet season CPUEs were greater than dry season CPUEs in both estuaries.

Three taxa accounted for over 75 percent of the total fish catch. Spotfin mojarra (*Eucinostomus argenteus*), silver jenny (*Eucinostomus gula*), and pink shrimp (*Farfantepenaeus duorarum*) dominated the catch of all estuaries during both years. The next most abundant species were fringed ounder (*Etropus crossotus*), pig sh (*Orthopristis chrysoptera*), anchovies [*Anchoa* spp., primarily bay anchovy (*A. mitchilli*)], blackcheek tongue sh (*Symphurus plagiusa*), and pin sh (*Lagodon rhomboides*).

Species composition showed a distinct seasonal pattern. The late wet season and the late dry season are extremes separated by the transitional early dry and early wet seasons, though Faka Union Bay showed less distinction between the transitional seasons than Fakahatchee Bay. The ve species contributing most to the dry season versus wet season differences in species composition for the reference estuary, Fakahatchee Bay, varied from year to year, with the exception of pig sh (**Table 12**).

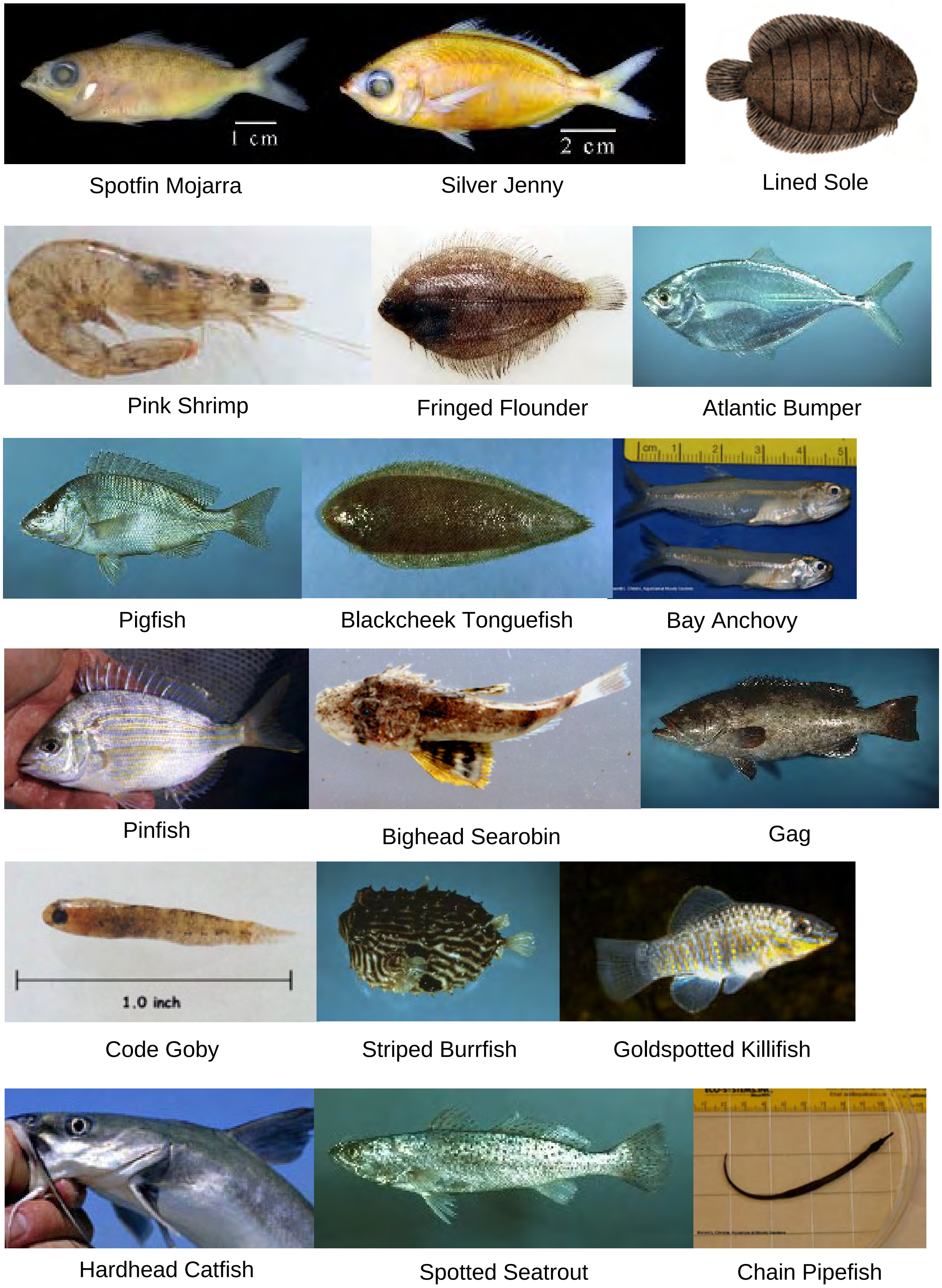

Figure 112. Some of the nekton species collected in Fakahatchee and Faka Union bays (pink shrimp photo is from Smithsonian Marine Station at Fort Pierce; bighead searobin photo is from Samford University in Alabama; and remaining photos are from www.fishbase.org).

Table 12. Species contributing most to the difference in nekton species composition in Fakahatchee Bay estuary in 2001 and 2002 for the late wet versus late dry season.

2001		2002	
Species	**Common Name**	**Species**	**Common Name**
Symphurus plagiusa	Blackcheek tonguefish	*Orthopristis chrysoptera*	Pigfish
Achirus lineatus	Lined sole	*Anchoa spp.*	Anchovy
Orthopristis chrysoptera	Pigfish	*Chloroscombrus chrysurus*	Atlantic bumper
Farfantepenaeus duorarum	Pink shrimp	*Prionotus tribulus*	Bighead searobin
Eucinostomus spp.	Mojarra	*Prionotus scitulus*	Leopard searobin

In 2001, pink shrimp were one of the five species contributing most to the species composition difference between late dry season and late wet season. This species was collected in greater abundance during the late dry season. Pig sh, lined sole (*Achirus lineatus*), blackcheek tongue sh, and mojarra were also among the species contributing most to this seasonal species composition difference, but these species were collected in greater abundance during the late wet season.

In 2002, pig sh and leopard searobin (*Prionotus scitulus*) were two of the ve most important contributors to the observed seasonal species composition difference in Fakahatchee Bay. These two species were collected in greater abundance during the late dry season. The other three species in this ranking were anchovies, Atlantic bumper (*Chloroscombrus chrysurus*), and the bighead searobin (*Prionotus tribulus*); all three were collected in greater abundance during the late wet season.

For each season, the five species contributing most to the species composition differences between Fakahatchee and Faka Union bays, with the exception of pig sh, varied during both years (**Table 13**). In both 2001 and 2002, the code goby (*Gobiosoma robustum*), blackcheek tongue sh and leopard searobin were among the five species contributing most to the difference in species composition between these two bays during the early dry season, late dry season and the late wet season, respectively. Overall, 34 unique species ranked within the five species contributing most to the species composition differences between the reference estuary and the estuary with altered freshwater inflow. More than 75 percent of these species were in greater abundance in the reference estuary, Fakahatchee Bay (**Table 13**).

Table 13. Species contributing most to the difference in nekton species composition when comparing Fakahatchee Bay and Faka Union Bay estuaries for the seasons found to have significantly different species composition.

2001			
Early Dry		**Late Dry**	
		Common Name	**Scientific Name**
Not significantly different		lined sole	*Achirus lineatus*
		gag	*Mycteroperca microlepis*
		leopard searobin	*Prionotus scitulus*
		striped burrfish	*Orthopristis chrysoptera*
		pigfish	*Lutjanus griseus*
Early Wet		**Late Wet**	
Common Name	**Scientific Name**	**Common Name**	**Scientific Name**
goldspotted killifish	*Floridichthys carpio*	Irish pompano	*Diapterus auratus*
fringed flounder	*Etropus crossotus*	rainwater killifish	*Lucania parva*
hardhead catfish	*Ariopsis felis*	bighead searobin	*Prionotus tribulus*
striped burrfish	*Chilomycterus schoepfii*	gafftopsoil catfish	*Bagre marinus*
pigfish	*Orthopristis chrysoptera*	code goby	*Gobiosoma robustum*
2002			
Early Dry		**Late Dry**	
Common Name	**Scientific Name**	**Common Name**	**Scientific Name**
lane snapper	*Lutjanus synagris*	pigfish	*Orthopristis chrysoptera*
anchovies	*Anchoa spp.*	fringed flounder	*Etropus crossotus*
pigfish	*Orthopristis chrysoptera*	spotted seatrout	*Cynoscion nebulosus*
chain pipefish	*Syngnathus louisianae*	pinfish	*Lagodon rhomboides*
hardhead catfish	*Ariopsis felis*	gulf toadfish	*Opsanus beta*
Early Wet		**Late Wet**	
Common Name	**Scientific Name**		
pinfish	*Lagodon rhomboids*	Not significantly different	
anchovies	*Anchoa spp.*		
pigfish	*Orthopristis chrysoptera*		
Atlantic bumper	*Chloroscombrus chrysurus*		
emerald goby	*Ctenogobius smaragdus*		

Oyster Reef Crab

Relative abundance of stenohaline and euryhaline crab populations can be used as a measure of estuarine health (Shirley et al., 2004b). Stenohaline organisms are those that are unable to withstand wide variation in salinity of surrounding water. Euryhaline organisms are able to live in waters of a wide range of salinity.

During 2001–2003, two species of crab, green porcelain crab (stenohaline) (*Petrolisthes armatus*) (**Figure 113**, panel a) and flatback mud crab (euryhaline) (*Eurypanopeus depressus*) (**Figure 113,** panel b) were sampled monthly in the estuaries of Faka Union Bay and Blackwater River, which feeds into Buttonwood Bay (see **Figure 100**) (Shirley et al., 9004b). They were also sampled in Fakahatchee Bay (see **Figure 100**), which is used as a reference site, during the same time frame.

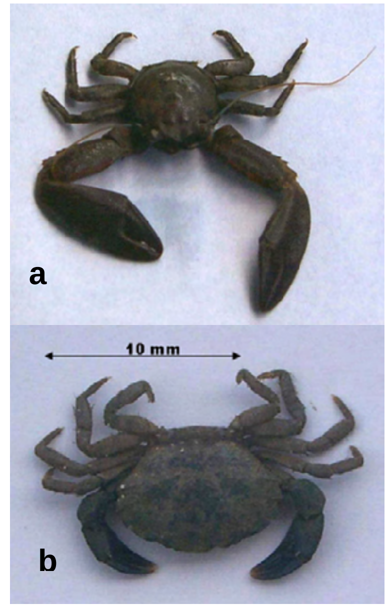

Figure 113. Green porcelain crab (a) and flatback mud crab (b) (photos by Rookery Bay National Estuarine Research Reserve).

Highest salinities for all three estuaries were recorded during the late dry season and lowest salinities were recorded during the late wet season (**Figure 114**). The early wet season and early dry season exhibited intermediate salinities. For most of the three-year period, Fakahatchee Bay salinities were greater than Faka Union Bay salinities. Mean seasonal salinity within Blackwater River was similar to that of the Fakahatchee Bay, with the exception of the late wet season in 2002 and early wet season of 2003, when Blackwater River salinity was greater than that of Fakahatchee Bay. Mean change in salinity was calculated for each estuary by season (**Figure 115**). An extreme difference in salinity fluctuation was seen at the Faka Union Bay site compared with the other two study sites.

Over the three-year study period, a total of 8,334 green porcelain and flatback mud crabs were collected. Of these, 2,113 green porcelain crabs and 2,378 flatback mud crabs were 5 millimeters wide or larger. Peak recruitment of these species to the samplers occurred in the late dry through late wet seasons.

Within Fakahatchee Bay, mean stenohaline to euryhaline crab ratio varied from season to season and from year to year (**Figures 116**, **117**, and **118**). During 2001, this ratio increased from the early dry to the early wet season, and the mean ratio decreased from the early wet to the late wet season. No difference was found between the early dry season and the late wet season or between the late dry season and the early wet season values of the mean ratio (**Figure 116**). The mean ratio of stenohaline to euryhaline was consistently high, indicating that the crab populations of this site were more stenohaline, especially during the late dry and early wet seasons. Stenohaline crabs within Fakahatchee Bay were still consistently more abundant than more euryhaline crab species in 2002, with maximum abundances observed during the late dry and early wet seasons (**Figure 117**). As with the previous year, this ratio significantly increased from the early dry to the early wet seasons and decreased from the early wet to the late wet seasons. Furthermore, no significant difference was found between the early dry and the late wet seasons. In 2003, the mean ratio of stenohaline to euryhaline crabs for Fakahatchee Bay was maintained close to 1.0 during all seasons (**Figure 118**). In contrast to the preceding two years, no significant differences were found between seasons.

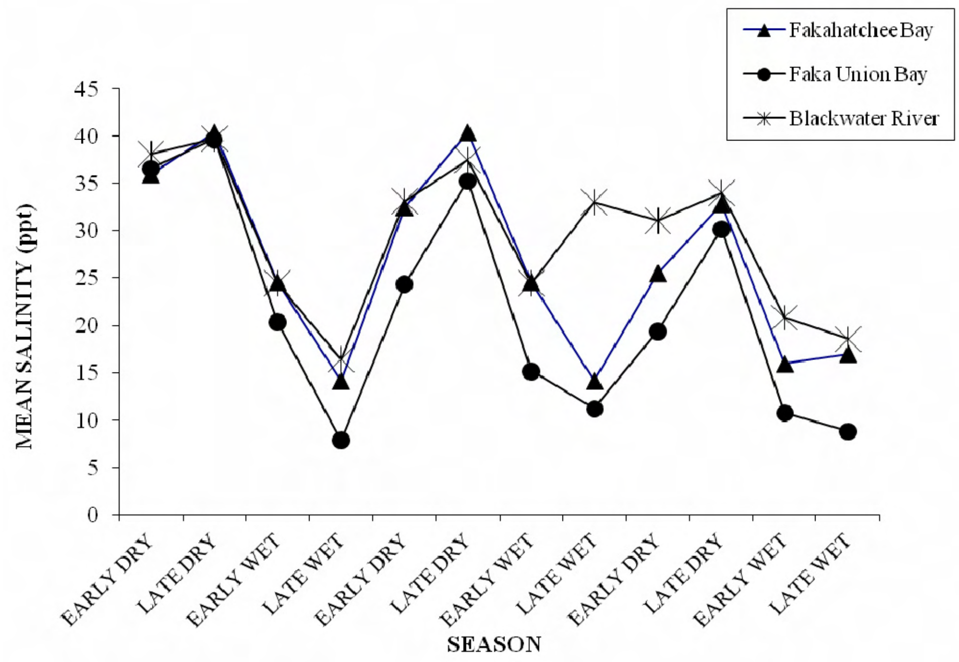

Figure 114. Mean seasonal salinity (percentage) for each estuary.

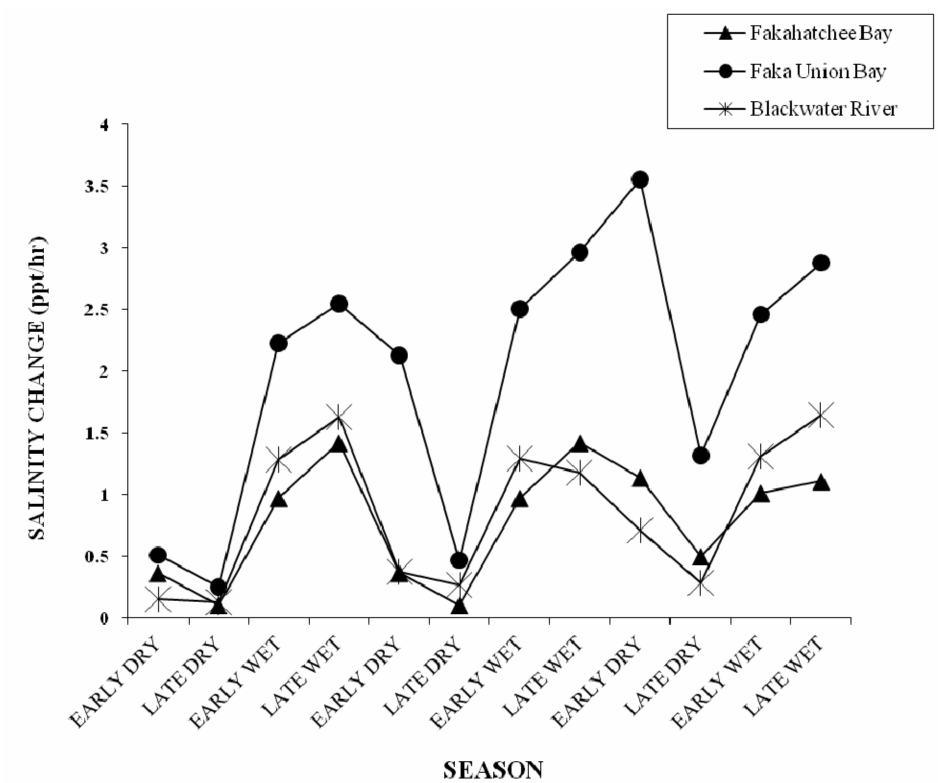

Figure 115. Mean change in salinity for each estuary by season over a three-year period.

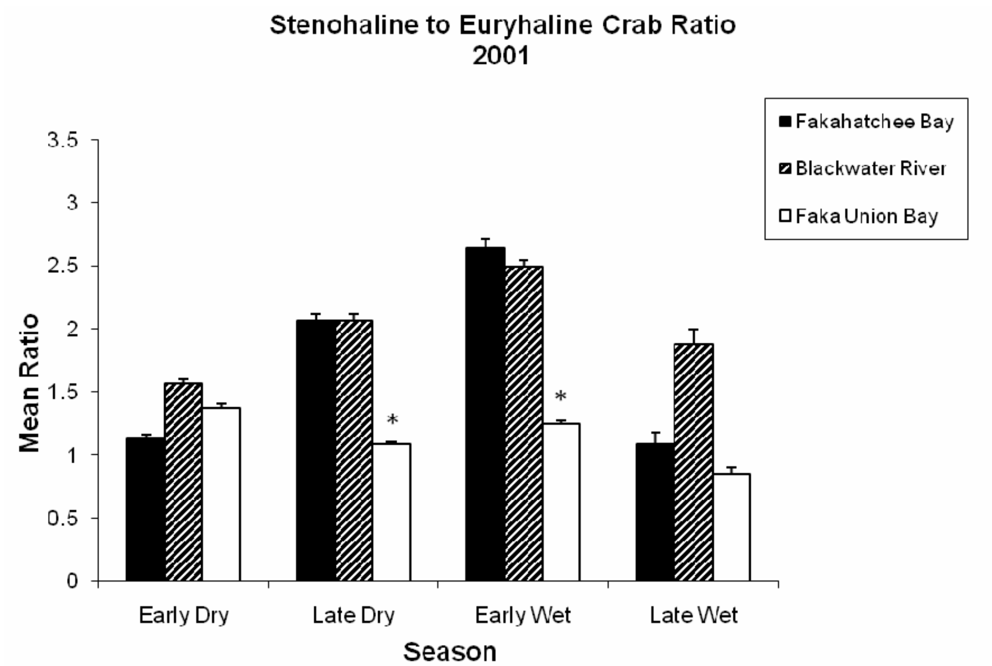

Figure 116. Mean stenohaline to euryhaline crab abundance for Fakahatchee and Faka Union bays and Blackwater River in 2001. Asterisks indicate a significant difference in this value compared with Fakahatchee Bay.

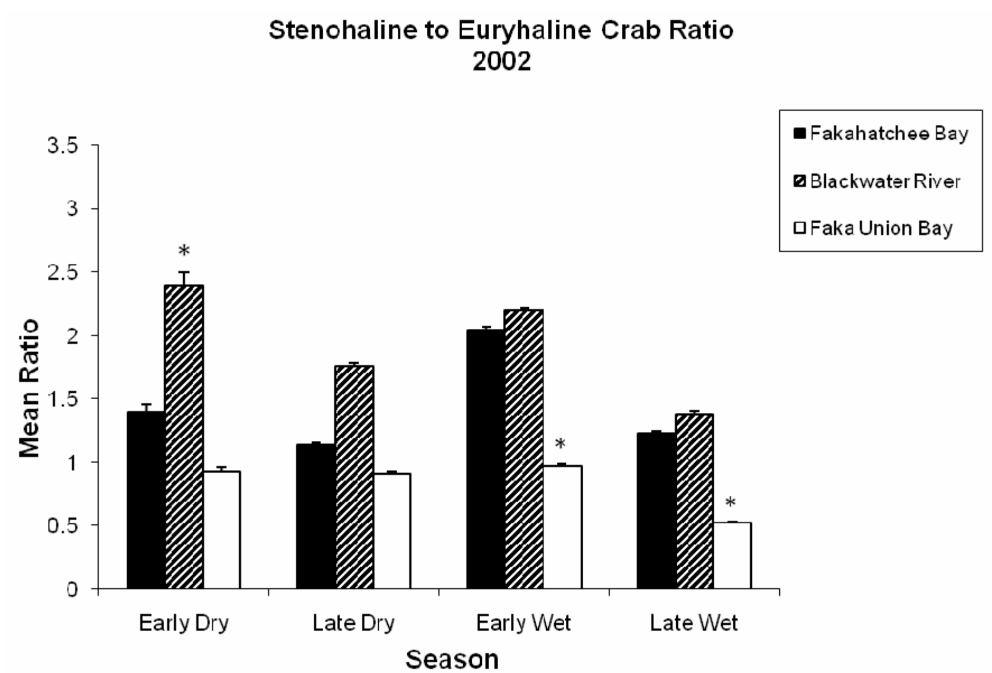

Figure 117. Mean stenohaline to euryhaline crab abundance for Fakahatchee and Faka Union bays and Blackwater River in 2002. Asterisks indicate a significant difference in this value compared with Fakahatchee Bay.

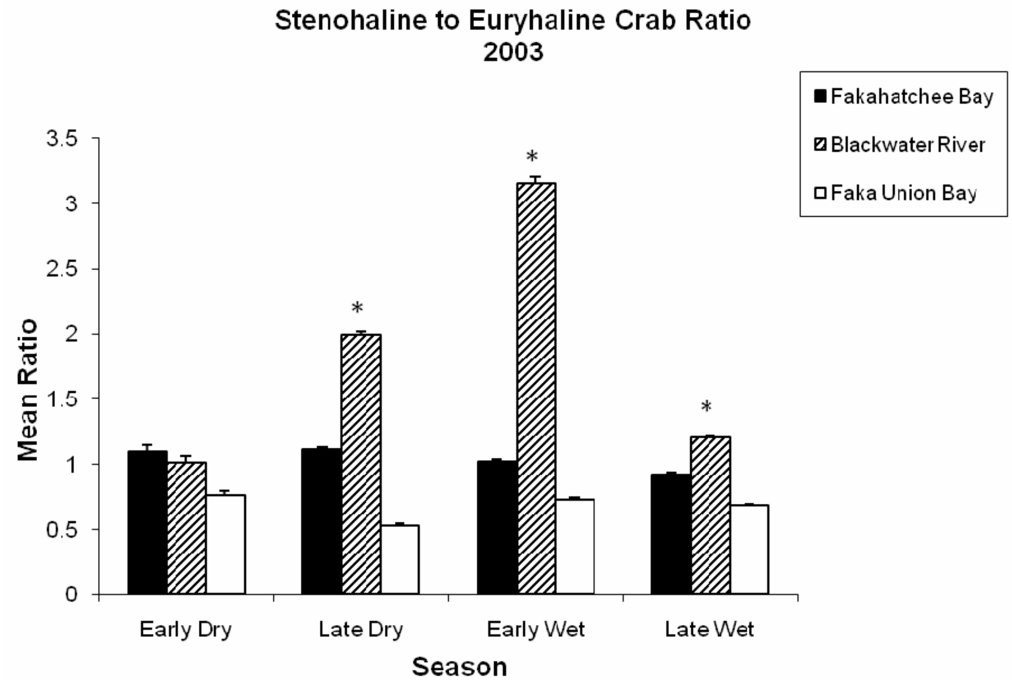

Figure 118. Mean stenohaline to euryhaline crab abundance for Fakahatchee and Faka Union bays and Blackwater River in 2003. Asterisks indicate a significant difference in this value compared with Fakahatchee Bay.

In 2001, for both the late dry season and the early wet season, the mean ratio of stenohaline to euryhaline crabs was greater in Fakahatchee Bay than in Faka Union Bay, but no significant difference was found between Fakahatchee Bay and Blackwater River for any season during that year (**Figure 116**). Again, in 2002, the mean ratio of stenohaline to euryhaline crabs was greater for Fakahatchee Bay compared with Faka Union Bay in the early wet season. In contrast to the previous year, the mean ratio for Fakahatchee Bay compared with Faka Union Bay was not significantly different during the late dry season. In addition, Faka Union Bay had a significantly lower mean ration than Fakahatchee Bay during the late wet season. During the early dry season that year, the Blackwater River mean ratio was greater than that of Fakahatchee Bay, a trend that began in the late wet season of 2001 (**Figure 116**). In 2003, the mean ration of stenohaline to euryhaline crabs in Blackwater River was greater than that of Fakahatchee Bay during the late dry and early wet and late wet seasons. The mean values for Fakahatchee Bay compared with Faka Union Bay were not significantly different for any season.

The management strategy of quickly draining the watershed to prevent upstream flooding of residential areas delivers unnaturally large volumes of fresh water into this estuary and extends the influence of the wet season into the early dry season. This effect would explain the consistently low stenohaline to euryhaline crab ratio values in Faka Union Bay relative to Fakahatchee Bay.

Freshwater inflow into Blackwater River is thought to be restricted by the Southern Golden Gate Canal system that intercepts natural watershed sheetflow and shunts it to Faka Union Bay. This change in flow is reflected in the higher stenohaline to euryhaline crabs ratio values observed for this estuary relative to Fakahatchee Bay during the early dry season of 2002 and the late dry and early wet seasons of 2003. Although not always statistically significant, the observed stenohaline to euryhaline crabs ratio values tended to be higher in Blackwater River than in Fakahatchee Bay for nine of the 12 seasons studied. Furthermore, during eight of these seasons, the stenohaline to euryhaline crab ratio values for the Faka Union estuary tended to be lower relative to Fakahatchee Bay.

It is important to understand that the response of the crab populating to salinity conditions is delayed by a season. A delayed response to stress may be a result of mortality to existing stenohaline populations, adult emigration, reduction in stenohaline recruits, or a combination of these factors.

WATER QUALITY

Canal Stations

Water quality has been monitored at six canal stations in the Picayune Strand Restoration Project Area. Three of the monitoring stations (BC9, BC10, and BC11) are located in the northern section of the study area. Two stations (BC7 and BC8) are located in the southern portion of the canal system with one station (FAKA) located at the outflow to FAKA Union Bay. The location of these monitoring stations is provided in **Figure 119**. A period of record from January 2002 through August 2007 was used to characterize the water quality baseline for the SGGE study area. Water quality data for these six canal stations are summarized in **Tables 14** through **19**.

During the period of record, only four parameters (conductivity, dissolved oxygen, pH, and total iron) measured at canal stations exhibited concentrations not meeting from Florida Class III water quality standards. Dissolved oxygen (DO) was the parameter with most excursions. Approximately 37 percent of measured DO values were below the 5.0 milligrams per liter (mg/L) threshold specified in Section 62-302.530, Florida Administrative Code (F.A.C.) These excursions were not geographic in nature and occurred at all canal monitoring stations. Time-series plots showing DO levels and excursions from the Florida Class III criterion at the six monitoring stations are provided in **Figure 120**.

Approximately four percent of conductivity measurements measured at the canal stations exceeded the Florida Class III criterion of less than 1,275 microsiemens per centimeter (μS/cm) (Section 62-302.530, F.A.C.) **Figure 121** shows the time-series plots of conductivity at the six monitoring stations during the baseline period. All the excursions appeared to be both spatial and temporal in nature and occurred at the southern canal monitoring stations (BC7 and BC8) and the FAKA outflow station, as shown in the plots. To support this observation, daily flow at FAKA along with corresponding measured conductivity and pH values are plotted in **Figure 122**. Based on the information shown in this figure, all conductivity excursions at FAKA occurred when recorded flows at the weir of the Faka Union Canal were less than or equal to 0 acre-feet (ac-ft). Flows less than 0 ac-ft (reversed flows) suggest backflow across the weir due to saltwater intrusion. As a result, conductivity levels reached a maximum value of approximately 16,000 μS/cm in June, 2007, when the first 16 days of flow at the weir totaled approximately -1,860 ac-ft (**Figure 122**). The timing of the excursions at FAKA during the baseline coincided with those observed at BC7 and BC8 (**Figure 121**) suggesting that the increase in conductivity may have resulted from the upstream movement of the saltwater wedge.

Mean daily flow data from FAKA shows a seasonal pattern with a general increase in flow from June through September (**Figure 123**). A decrease mean daily flow is observed from September through May. Reversed flows (shown as negative flows) readily occurred from March through June (**Figure 123**). These reversed flows probably suggest saltwater intrusion from FAKA Union Bay or groundwater and are associated with the driest period of the year.

DO measured in the three regions (northern canal, southern canal, and FAKA) exhibited a seasonal pattern (**Figure 124**). Higher DO levels were recorded during the drier part of the year (January through May) and lower levels were recorded during the wetter period (June through December). Based on the median values shown in **Figures 123** and **124**, flow and DO appear to be inversely correlated. A seasonal pattern was also observed for conductivity. The range in conductivity levels generally increased during the wet season (**Figure 123**). This was especially evident for the northern canal stations, which were not influenced by saltwater intrusion. Seasonal patterns were not as evident at the southern canal stations and FAKA.

Both water pH and total iron had less than one percent excursions during the baseline period. Station BC10 had three monitoring events where water pH exceeded the upper limit of the acceptable pH range of 6.0 to 8.0 in fresh water (**Figure 125**), as specified in Section 62-302.530, F.A.C. These pH values in excess of 8.0 probably occurred during periods of high photosynthesis. DO levels for these three monitoring events at BC10 were above 8.0 mg/L (**Figure 120**). Station BC9 was the only station to exceed the 1 mg/L (or 1,000 µg/L) iron criterion for fresh water (**Figure 126**). A total iron concentration of 1,390 microgram/liter (µg/L) was reported in January 2003 for this station.

Median concentrations of total nitrogen (TN) and total phosphorus (TP) at the six canal stations (**Tables 14** to **19**) were below the established typical median concentrations of 1.2 mg/L TN and 90 µg/L TP, for Florida streams (Hand et al., 2000). Spatial differences were observed for both nutrient concentrations. Median TN concentrations ranged from 0.50 to 0.57 mg/L at the three northern canal stations (BC9, BC10, and BC11) compared to slightly lower median concentrations (0.43 to 0.49 mg/L) at the three southern canal stations (BC7, BC8, and FAKA). Median TP concentrations at the northern canal stations ranged from 12 to 20 µg/L compared to 11 to 12 µg/L at the southern stations. Time-series plots for these parameters at the six canal stations are provided in **Figures 127** and **128**.

Box-and-whisker plots showing monthly distributions of TP and TN concentrations for the period of record do not show a pronounced seasonal pattern (**Figure 129**). The large variability of TN concentrations observed for TN at FAKA in May could be associated with saltwater intrusion.

Marsh Stations

During January 2003 through August 2007, seven marsh stations were monitored in the Picayune Strand Restoration Project Area (see **Figure 119)**. Summary of water quality for these marsh monitoring stations are provided in **Tables 20** through **23** at the end of the water quality section. Sampling frequencies varied for each of the monitoring stations. Station SGGE10SW located in the northeast central portion of the study area was sampled more frequently than the other marsh stations (**Table 20**). Stations SGGE5SW, SGGE16SW, SGGE23SW, and SGGE24SW were only sampled one time each during the five years of sample collection (**Table 23**).

DO concentrations measured at six marsh stations were below the acceptable limit of 5.0 mg/L as specified in Subsection 62.302-530, F.A.C. Only SGGE24SW had DO greater than 5.0 mg/L. DO concentrations are typically low in macrophyte-dominated marsh environments due to natural processes of photosynthesis and respiration (Belanger and Platko, 1986; McCormick et al., 1997). These observed excursions from the Florida Class III DO standard may reflect natural process rather than anthropogenic effects. In addition, most stations were sampled less than three times during the period of record. It is difficult to determine if these DO concentrations reflect typical levels for these marsh stations. All other parameters were within the acceptable numeric criteria for Florida Class III fresh water.

TP and TN concentrations measured at the seven marsh stations were compared with typical median concentrations for Florida streams (Hand et al., 2000). One TP measurement (6 percent of all measurements) exceeded the 90 µg/L screening level for typical Florida streams. In contrast, 25 percent of TN concentrations (three out of 12) exceeded the 1.2 mg/L screening level for typical Florida streams.

Median levels for DO, conductivity, total iron, TP, and TN were plotted for each marsh station (**Figure 130**). This plot includes the Florida Class III standard for DO and screening concentration for TP and TN.

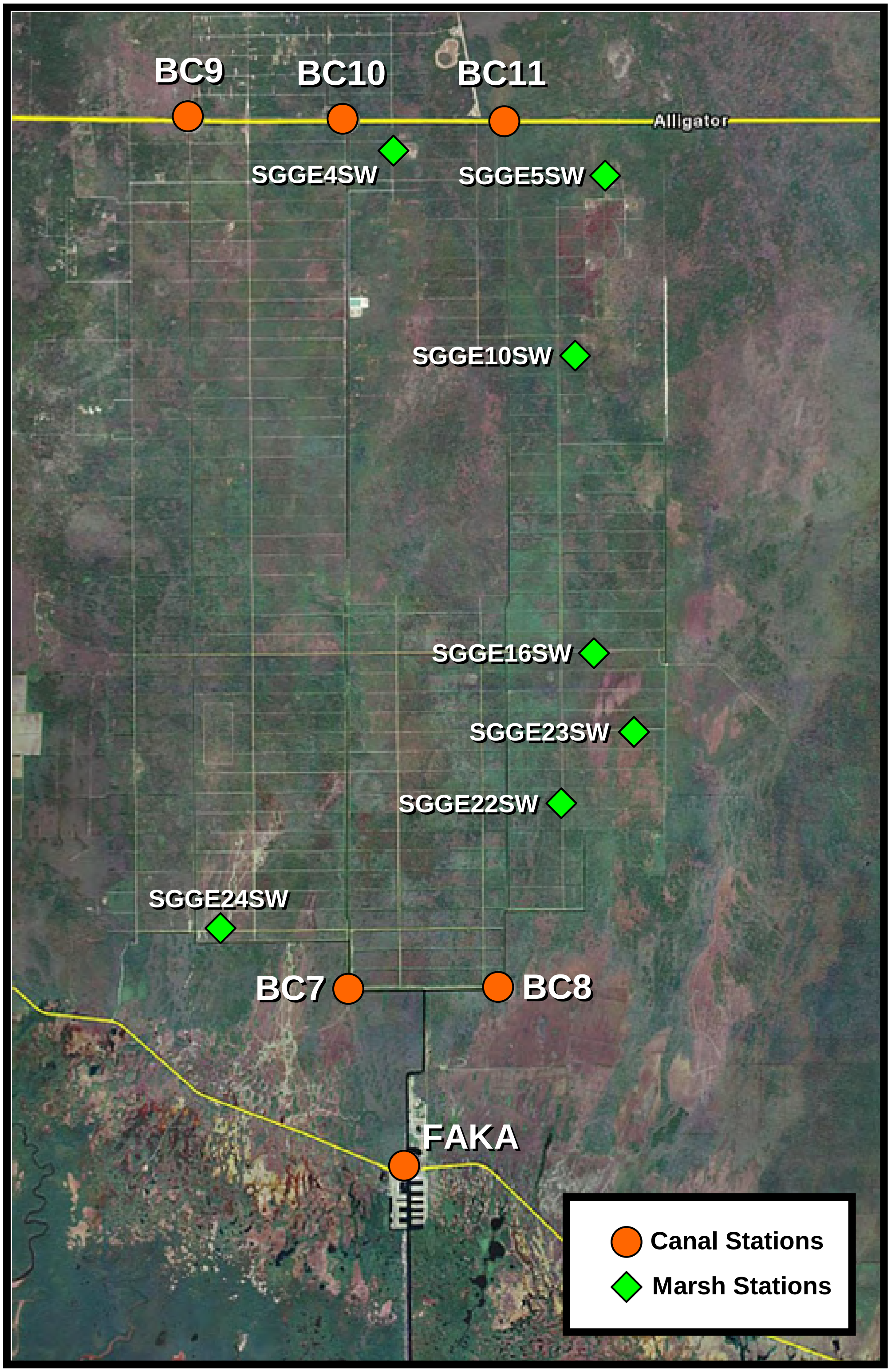

Figure 119. Location of canal and marsh monitoring stations.

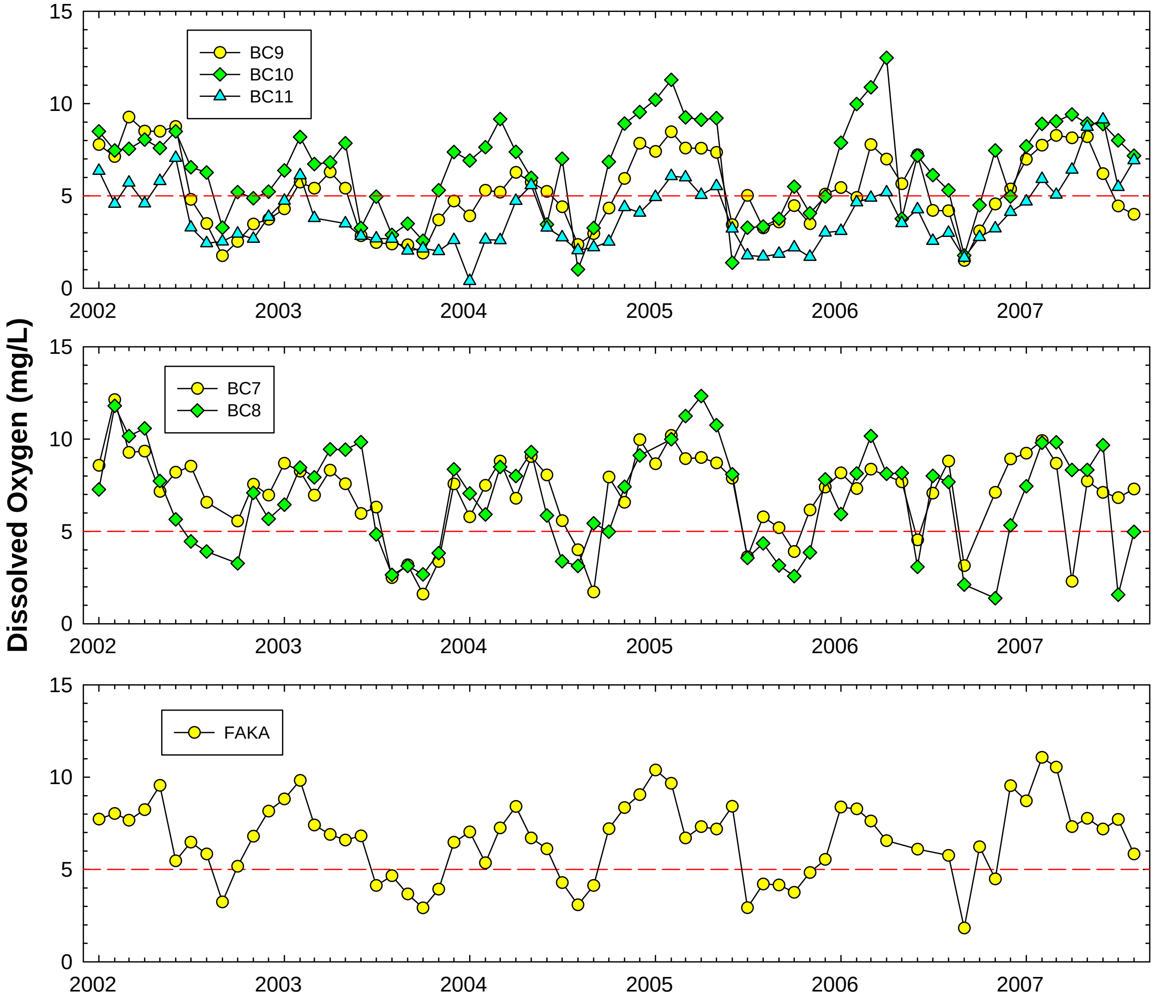

Figure 120. Monthly dissolved oxygen in milligrams per liter (January 2002–August 2007) measured at canal stations located in the northern portion (BC9, BC10, and BC11), southern portion (BC7 and BC8), and outflow (FAKA) of the Picayune Strand Restoration Project Area. The dashed red lines on each plot depict the limit of 5.0 mg/L for Florida Class III fresh water.

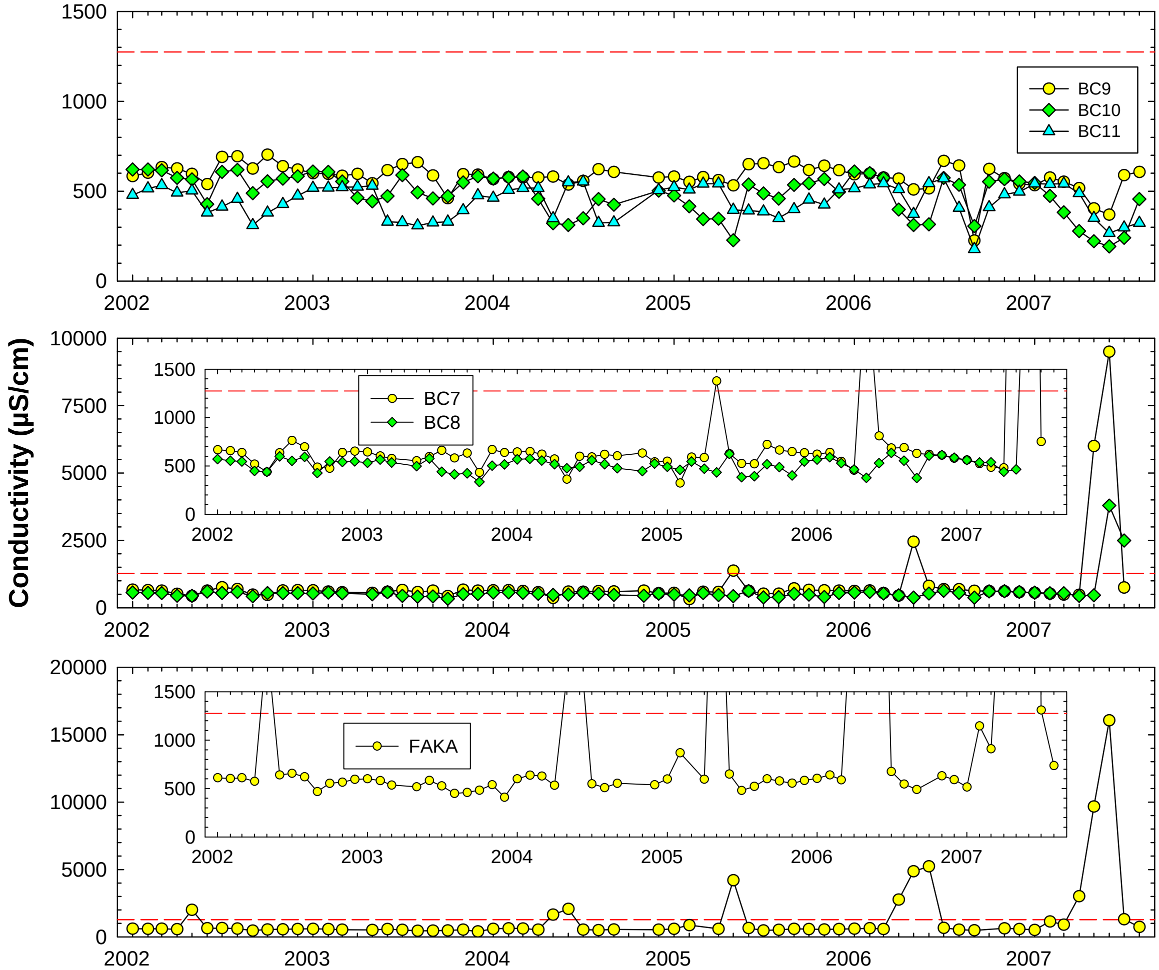

Figure 121. Monthly conductivity (January 2002–August 2007) measured at canal stations located in the northern portion (BC9, BC10, and BC11), southern portion (BC7 and BC8), and outflow (FAKA) of the Picayune Strand Restoration Project Area. The dashed red lines on each plot depict the limit of 1,275 microsiemens per centimeter (µS/cm) for Class III fresh water. Inset plots were included to show the monthly conductivity fluctuations below 1.500 uS/cm.

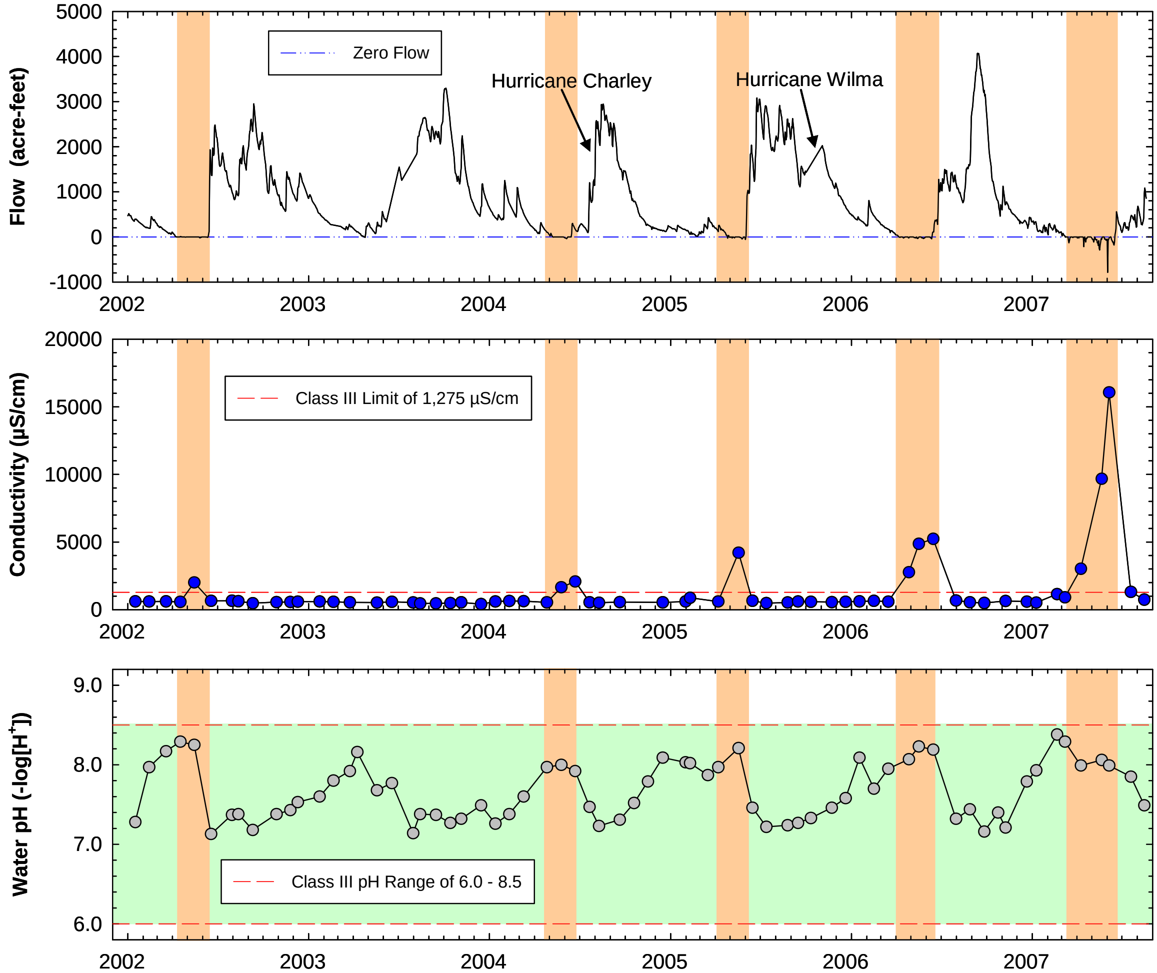

Figure 122. Daily flow, conductivity, and pH measured at station FAKA from January 2002–August 2007 in the Picayune Strand Restoration Project Area. Vertical shading shows periods when flow from FAKA was ≤ 0 acre-feet and corresponded with saltwater intrusion as depicted by the conductivity plots.

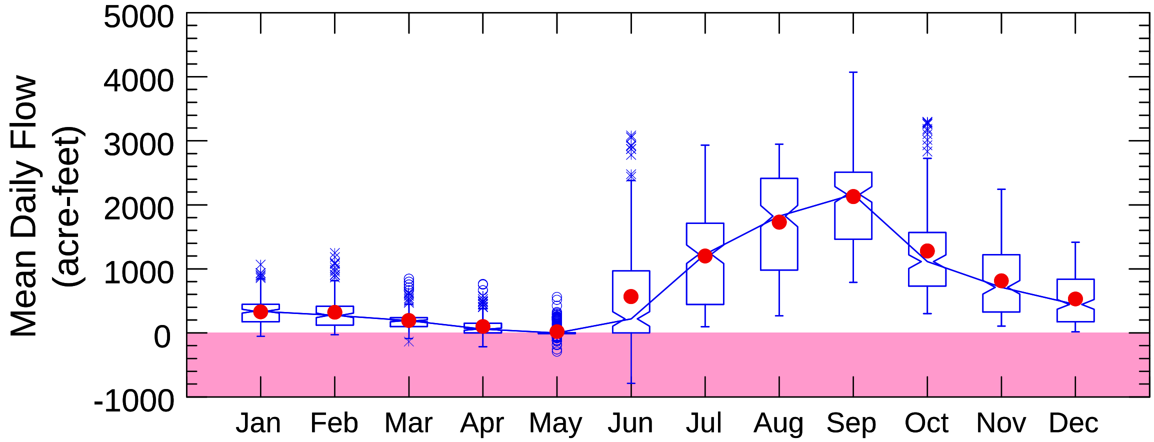

Figure 123. Box–and-whisker plot showing the distribution of monthly flows at FAKA for the period from January 2002–August 2007. The shaded area represents flows at or below 0 acre-feet. Solid circles (●) shown on the plot represent mean values.

NOTE: The notch on a box plot represents the 95% confidence interval (C.I.) about the median, which is represented by the narrowest part of the notch. The top and bottom of the box represent the 75th and 25th percentiles, respectively. The whiskers represent the highest and lowest data values that are within two standard deviations of the median. Values above and below the whiskers are greater than two standard deviations from the median. Notches that do not overlap indicate that the data represented by the boxes being compared are significantly different at the 95% C.I.

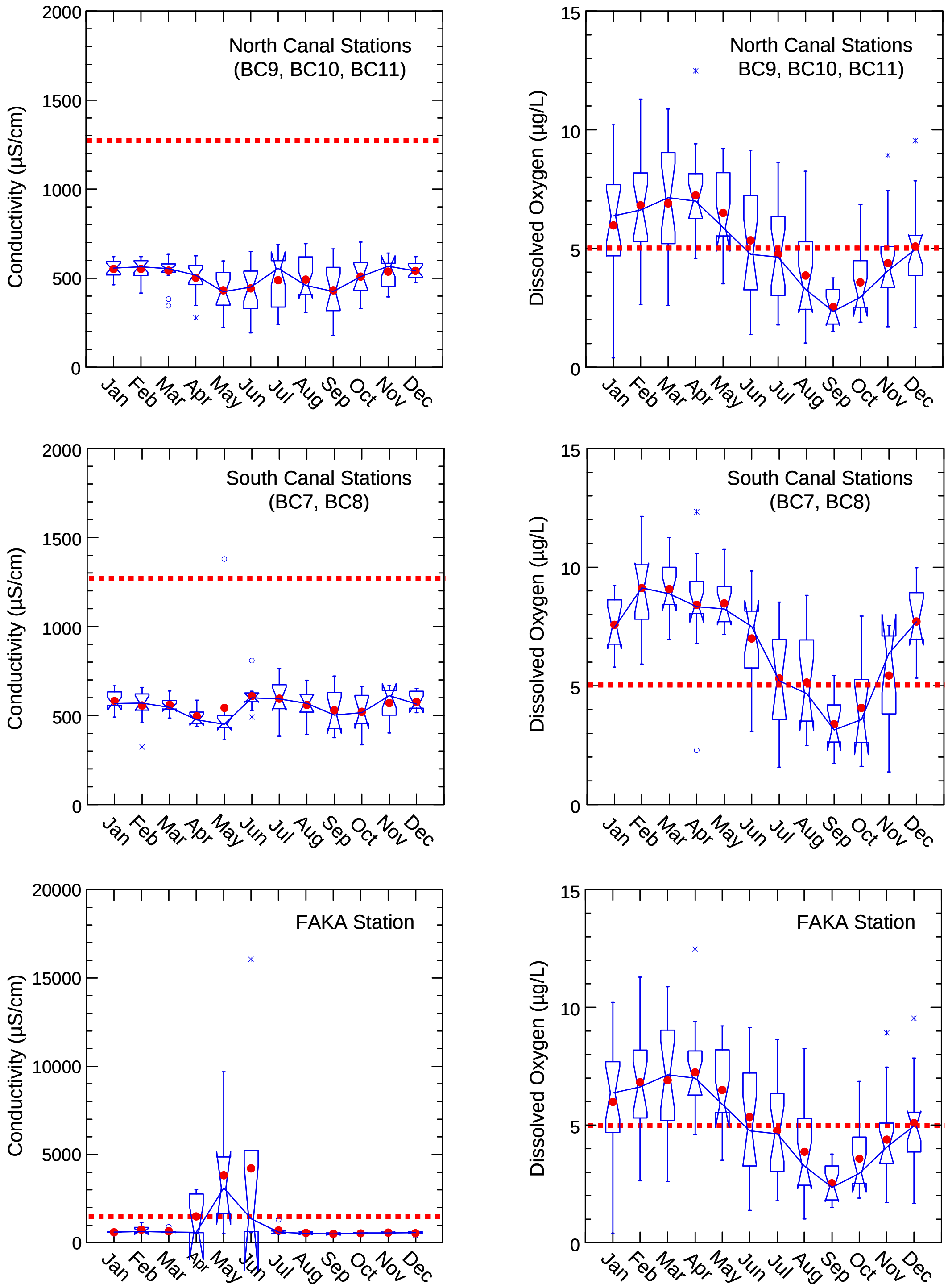

Figure 124. Box-and-whisker plots showing regional monthly distributions of conductivity and dissolved oxygen in the Picayune Strand Restoration Project Area canals from January 2002–August 2007. Dashed lines indicate the Class III standards for conductivity and dissolved oxygen.

Figure 125. Monthly pH (January 2002–August 2007) measured at canal stations located in the northern portion (BC9, BC10, and BC11), southern portion (BC7 and BC8) and outflow (FAKA) of the Picayune Strand Restoration Project Area. The dashed red lines on each plot depict the acceptable pH range of 6.0 to 8.5 for Florida Class III fresh water.

Figure 126. Monthly total iron (January 2002–August 2007) measured at canal stations located in the northern portion (BC9, BC10, and BC11), southern portion (BC7 and BC8) and outflow (FAKA) of the Picayune Strand Restoration Project Area. The dashed red lines on each plot depict the upper limit of 1,000 µg/L for Florida Class III fresh water.

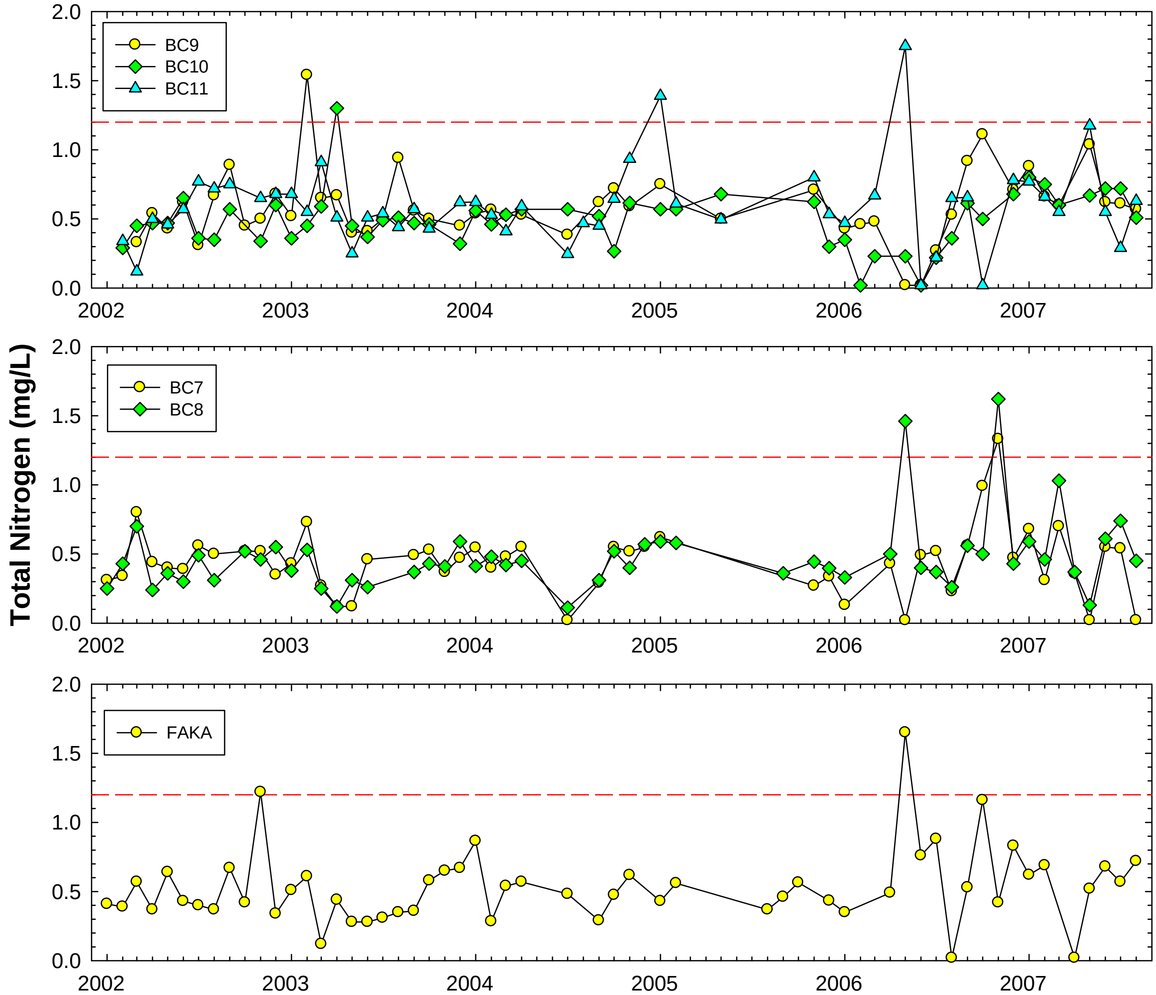

Figure 127. Monthly total nitrogen (January 2002–August 2007) measured at canal stations located in the northern portion (BC9, BC10, and BC11), southern portion (BC7 and BC8) and outflow (FAKA) of the Picayune Strand Restoration Project Area. Dashed red lines on each plot represent typical median total nitrogen concentrations (1.2 mg/L) in Florida streams as observed by Hand et al., 2000.

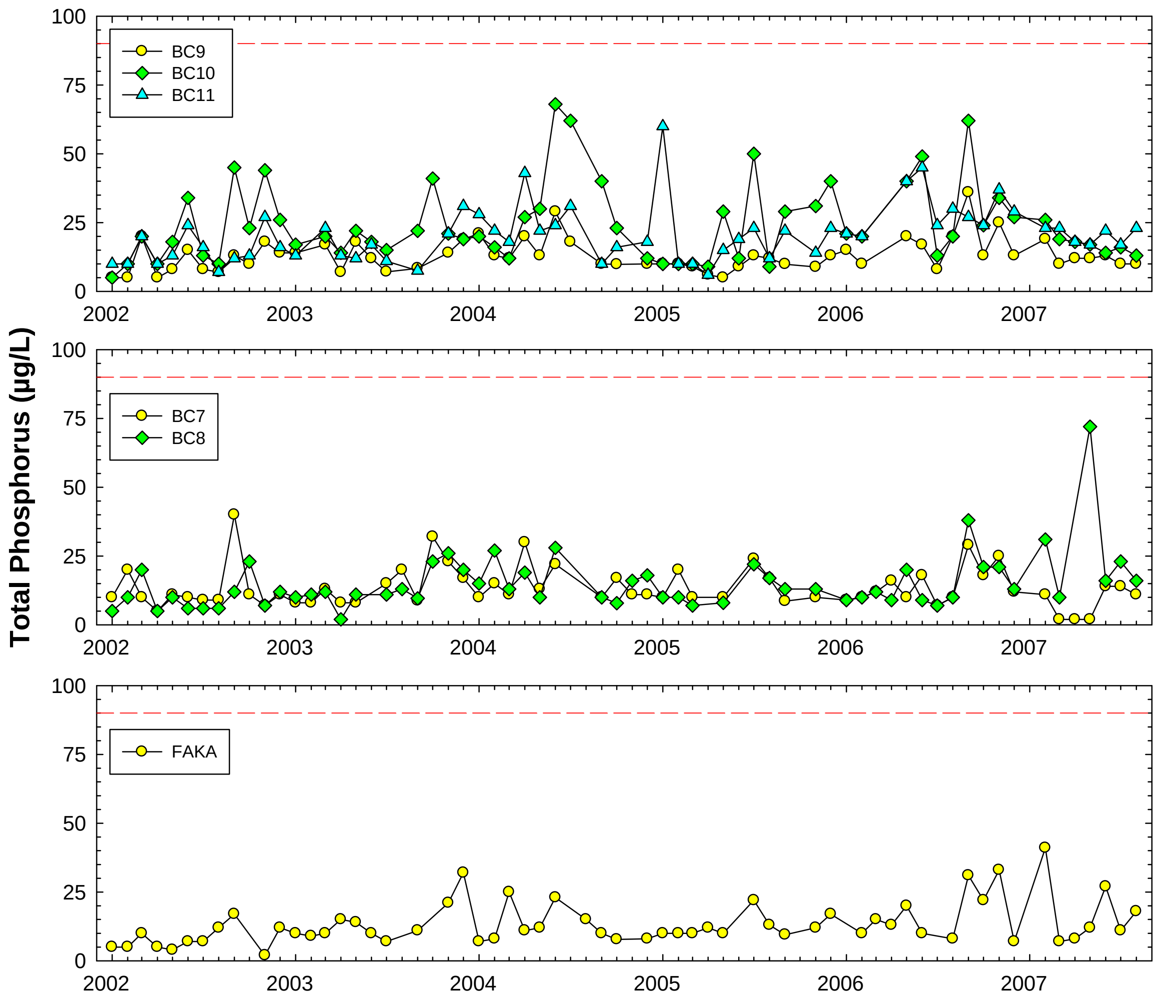

Figure 128. Monthly total phosphorus (January 2002–August 2007) measured at canal stations located in the northern portion (BC9, BC10, and BC11), southern portion (BC7 and BC8) and outflow (FAKA) of the Picayune Strand Restoration Project Area. Dashed red lines on each plot represent typical median total phosphorus concentrations (90 µg/L) in Florida streams as observed by Hand et al., 2000.

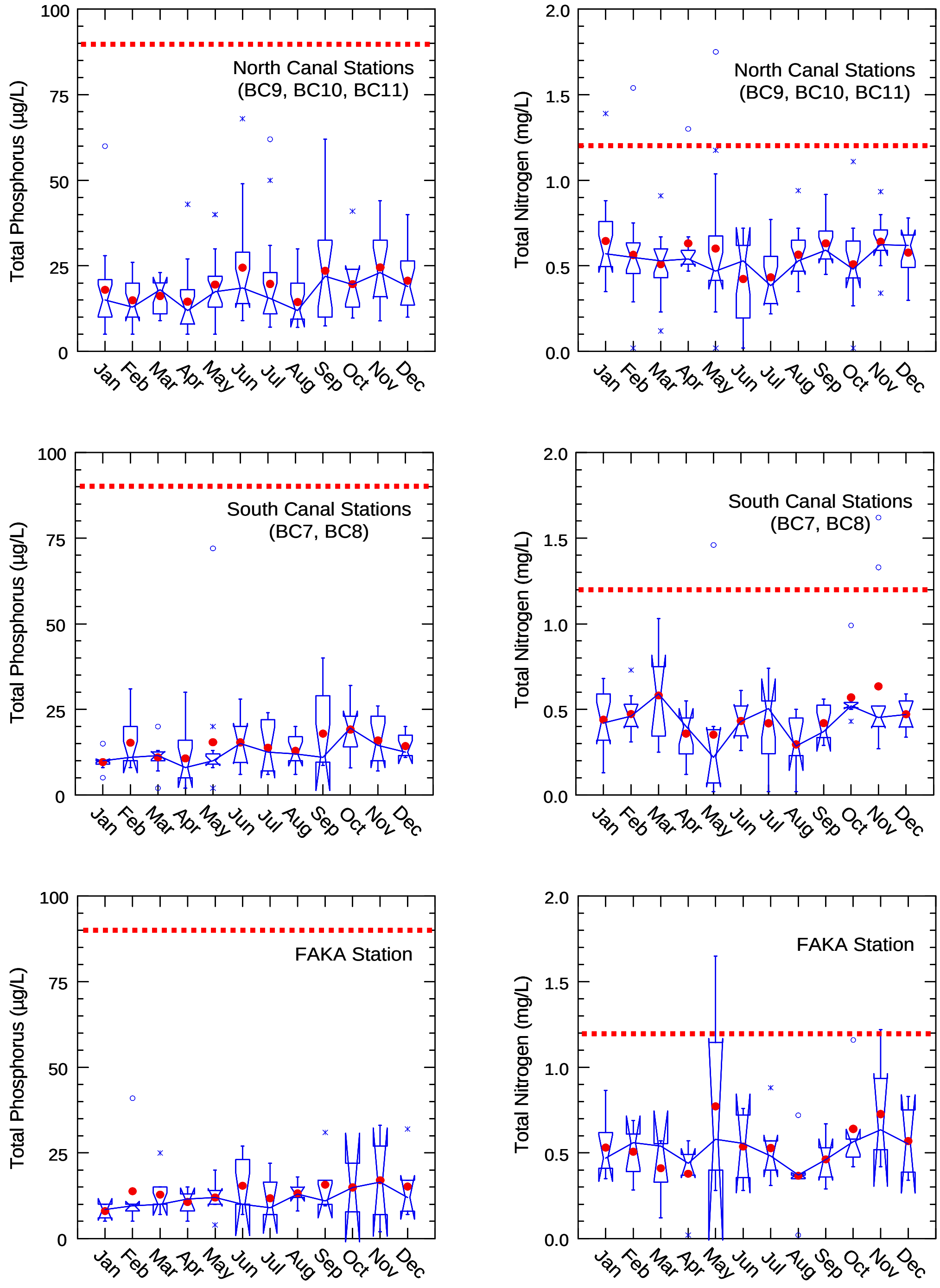

Figure 129. Box-and-whisker plots showing regional monthly distributions of total phosphorus and total nitrogen in the Picayune Strand Restoration Project Area canals from January 2002–August 2007. Dashed lines indicate typical median nutrient concentrations in Florida streams (Hand et al., 2000).

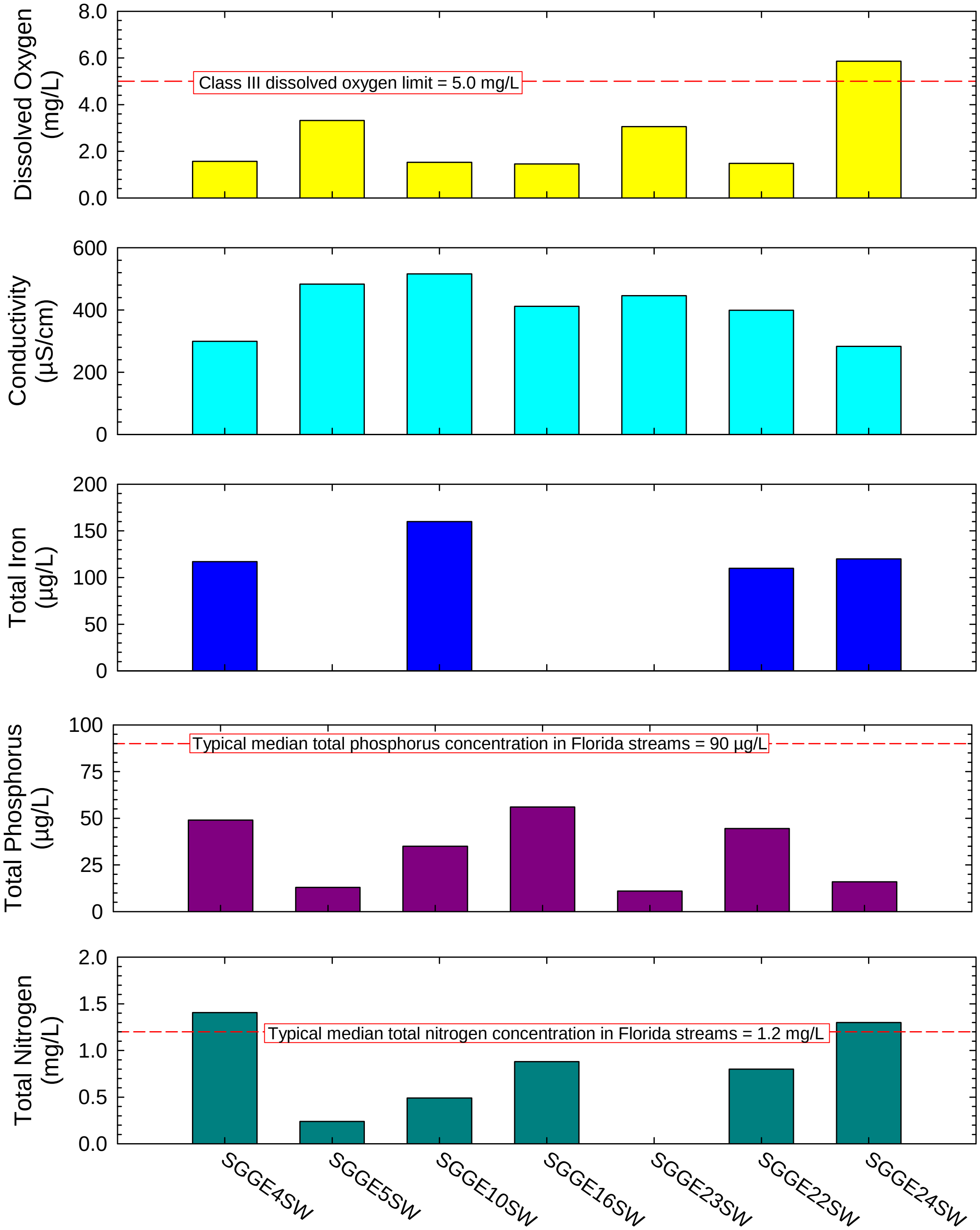

Figure 132. Median parameter concentrations measured at seven marsh stations in the Picayune Strand Restoration Project Area from January 2002–August 2007. Stations SGGE5SW, SGGE16SW, SGGE23SW, and SGGE24SW were only sampled once each during this period.

Table 14. Summary water quality data collected at Station BC9 in the Picayune Strand Restoration Project Area from January 2002–August 2007. Compliance with Florida Class III water quality state standards is also included.

Parameter Name (units)	No. of Samples	Min	Percentiles			Max	Mean	Standard Deviation	No. of Excursions	Percent Excursions	Surface Water Criteria Class III 62-302.530 FAC
			25^{th}	50^{th} (Median)	75^{th}						
Physical Parameters											
Water Temperature (°C)	70	15.7	23.5	25.7	27.3	32	25.3	3.2	---	---	---
Conductivity (µS/cm)	68	225	560	588	623	703	582.4	72.9	---	---	≤1275 µS/cm
Dissolved Oxygen (mg/L)	70	1.50	3.59	5.15	7.13	9.27	5.25	2.02	33	47.1%	≥5.0 mg/L
Water pH	69	6.97	7.16	7.32	7.67	7.96	7.38	0.27	---	---	6.0 - 8.5
Salinity (psu)	68	0.1	0.3	0.28	0.30	0.4	0.28	0.04	---	---	---
Total Dissolved Solids (mg/L)	57	<2	335.5	368	406	3680	417.6	449.2	---	---	---
Color (PCU)	62	30	50	60	90	180	73.1	30.1	---	---	---
Total Suspended Solids (mg/L)	65	<2	<2	<2	<2	3.0	1.2	0.5	---	---	---
Turbidity (NTU)	67	0.7	1.6	2.7	3.6	6.5	2.8	1.4	---	---	29 NTU above background
Ions											
Calcium (mg/L)	30	44.2	97.8	109.5	120.0	279	111.5	36.8	---	---	---
Magnesium (mg/L)	33	2.4	2.7	3.0	3.9	7.1	3.3	0.9	---	---	---
Alkalinity (mg/L)	20	190	249	266	277	301	262.9	24.4	---	---	≥20 mg/L
Chloride (mg/L)	20	<1	14.3	17.9	22.3	34.0	17.1	8.9	---	---	---
Sulfate (mg/L)	21	13.4	22.9	31.2	42.6	58.5	34.6	13.7	---	---	---
Fluoride (mg/L)	20	<0.05	0.10	0.11	0.13	0.18	0.10	0.04	---	---	---
Nutrients											
Ammonia as N (mg/L)	57	0.004	0.005	0.020	0.040	0.120	0.029	0.031	---	---	The discharge of nutrients shall continue to be limited as needed to prevent violations of other standards. In no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of aquatic flora or fauna.
Nitrate + Nitrite as N (mg/L)	59	<0.01	<0.01	0.020	0.054	0.140	0.031	0.032	---	---	
Total Kjeldahl Nitrogen (mg/L)	54	<0.04	0.43	0.53	0.64	1.50	0.56	0.25	---	---	
Total Nitrogen (mg/L)	49	<0.04	0.46	0.56	0.67	1.54	0.59	0.25	---	---	
Soluble Reactive Phosphorus (µg/L)	63	<4	<4	<4	5	25	4.3	3.9	---	---	
Total Phosphorus (µg/L)	59	<10	<10	12	17	36	13.0	5.9	---	---	
Total Organic Carbon (mg/L)	58	8	10	11	12	19	11.4	1.9	---	---	
Silica (mg/L)	21	3.5	5.7	6.2	6.8	10.2	6.3	1.5	---	---	
Biological											
5-Day Biochemical Oxygen Demand (mg/L)	26	<1.6	<1.6	<1.6	1.6	8.5	1.6	1.5	---	---	---
Chlorophyll *a* (mg/m^3)	64	<3	<3	<3	3.1	10.7	2.4	1.9	---	---	---
Pheophytin (mg/m^3)	66	<3	<3	<3	<3	10	1.8	1.2	---	---	---
Bacteriological											
Fecal Coliform Bacteria (MF/100 ml)	66	<1	7.0	12	31	210	25.3	35.9	---	---	≤800 MF/100 ml
Total Coliform Bacteria (MF/100 ml)	63	12	65	129	199	843	154.8	144.1	---	---	---
Trace Metals in Water (Total)											
Arsenic (µg/L)	20	<1	1.1	2.0	3.0	3.8	2.1	1.0	---	---	≤50 µg/L
Cadmium (µg/L)	22	<0.06	<0.06	<0.06	<0.06	1.0	0.1	0.2	---	---	$\leq e^{(0.7409\ln(Hardness)-4.719)}$
Chromium (µg/L)	14	<1	<1	1.0	1.0	1.6	0.9	0.3	---	---	$\leq e^{(0.819\ln(Hardness)+0.6848)}$
Copper (µg/L)	18	<0.3	<0.3	0.5	0.8	4.0	0.8	1.1	---	---	$\leq e^{(0.8545\ln(Hardness)-1.702)}$
Iron (µg/L)	22	<120	250	595	780	1390	577	335	1	4.5%	≤1000 µg/L
Lead (µg/L)	23	<0.06	<0.06	0.1	0.5	5.7	0.5	1.2	---	---	$\leq e^{(1.273\ln(Hardness)-4.705)}$
Zinc (µg/L)	12	5.4	8.8	10	20	30	13.3	7.4	---	---	$\leq e^{(0.8473\ln(Hardness)+0884)}$

Table 15. Summary water quality data collected at Station BC10 in the Picayune Strand Restoration Project Area from January 2002–August 2007. Compliance with Florida Class III water quality state standards is also included.

Parameter Name (units)	No. of Samples	Min	Percentiles			Max	Mean	Standard Deviation	No. of Excursions	Percent Excursions	Surface Water Criteria Class III 62-302.530 FAC
			25th	50th (Median)	75th						
Physical Parameters											
Water Temperature (°C)	71	16.3	23.5	26.6	28.0	32	25.8	3.5	---	---	---
Conductivity (µS/cm)	69	193	414	497	571	621	479.0	116.2	---	---	$\leq$1275 µS/cm
Dissolved Oxygen (mg/L)	71	1.02	4.96	7.18	8.50	12.48	6.65	2.50	20	28.2%	$\geq$5.0 mg/L
Water pH	71	7.02	7.18	7.52	7.80	9.27	7.55	0.43	3	4.2%	6.0 - 8.5
Salinity (psu)	69	0.1	0.2	0.24	0.28	0.3	0.23	0.06	---	---	---
Total Dissolved Solids (mg/L)	57	90.0	240.5	298	337	2840	324.4	347.4	---	---	---
Color (PCU)	63	5	30	40	50	120	42.9	23.7	---	---	---
Total Suspended Solids (mg/L)	64	<2	<2	<2	<2	8.0	1.2	0.9	---	---	---
Turbidity (NTU)	67	0.1	0.9	1.1	1.4	3.2	1.2	0.5	---	---	29 NTU above background
Ions											
Calcium (mg/L)	30	22.4	62.8	79.7	93.0	136	76.5	26.2	---	---	---
Magnesium (mg/L)	33	3.4	4.5	4.8	5.1	7.0	4.9	0.8	---	---	---
Alkalinity (mg/L)	21	68	182	232	257	308	211.7	65.9	---	---	$\geq$20 mg/L
Chloride (mg/L)	20	<1	17.8	21.0	22.4	25.0	18.1	7.8	---	---	---
Sulfate (mg/L)	21	<1	16.0	18.6	22.4	27.6	18.7	5.8	---	---	---
Fluoride (mg/L)	20	<0.05	0.08	0.10	0.11	0.14	0.09	0.03	---	---	---
Nutrients											
Ammonia as N (mg/L)	54	0.004	0.005	0.020	0.030	0.100	0.024	0.022	---	---	The discharge of nutrients shall continue to be limited as needed to prevent violations of other standards. In no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of aquatic flora or fauna.
Nitrate + Nitrite as N (mg/L)	60	<0.01	<0.01	<0.01	0.012	0.060	0.011	0.011	---	---	
Total Kjeldahl Nitrogen (mg/L)	56	<0.04	0.35	0.47	0.59	1.30	0.48	0.22	---	---	
Total Nitrogen (mg/L)	51	<0.04	0.36	0.50	0.60	1.30	0.49	0.21	---	---	
Soluble Reactive Phosphorus (µg/L)	63	<4	<4	5	10	27	7.7	6.8	---	---	
Total Phosphorus (µg/L)	60	<10	14	20	30	68	24.2	14.2	---	---	
Total Organic Carbon (mg/L)	58	7	8	9	10	14	9.2	1.7	---	---	
Silica (mg/L)	21	1.2	3.8	5.9	6.5	11.2	5.5	2.2	---	---	
Biological											
5-Day Biochemical Oxygen Demand (mg/L)	28	<0.8	1.0	1.0	1.0	2.8	1.1	0.5	---	---	---
Chlorophyll (mg/m^3)	64	<3	<3	<3	4.8	16.9	3.6	3.3	---	---	---
Pheophytin (mg/m^3)	66	<3	<3	<3	<3	10	1.9	1.2	---	---	---
Bacteriological											
Fecal Coliform Bacteria (MF/100 ml)	66	<1	2.0	7	18	96	17.2	24.8	---	---	$\leq$800 MF/100 ml
Total Coliform Bacteria (MF/100 ml)	64	12	78	141	307	1486	245.8	281.4	---	---	---
Trace Metals in Water (Total)											
Arsenic (µg/L)	20	<1	1.0	1.5	2.1	4.2	1.7	1.1	---	---	$\leq$50 µg/L
Cadmium (µg/L)	22	<0.06	<0.06	<0.06	<0.06	1.0	0.1	0.2	---	---	$\leq e^{(0.7409 \ln(Hardness)-4.719)}$
Chromium (µg/L)	15	0.3	0.5	1.0	1.0	40.8	3.4	10.3	---	---	$\leq e^{(0.819 \ln(Hardness)+0.6848)}$
Copper (µg/L)	18	<0.3	0.5	0.5	0.8	4.0	0.9	1.0	---	---	$\leq e^{(0.8545 \ln(Hardness)-1.702)}$
Iron (µg/L)	22	<100	120	265	350	610	264	174	---	---	$\leq$1000 µg/L
Lead (µg/L)	23	<0.06	0.1	0.1	0.5	5.7	0.5	1.2	---	---	$\leq e^{(1.273 \ln(Hardness)-4.705)}$
Zinc (µg/L)	13	<2.2	8.7	10	10	13	8.6	3.5	---	---	$\leq e^{(0.8473 \ln(Hardness)+0884)}$

Table 16. Summary water quality data collected at Station BC11 in the Picayune Strand Restoration Project Area from January 2002–August 2007. Compliance with Florida Class III water quality state standards is also included.

Parameter Name (units)	No. of Samples	Min	Percentiles			Max	Mean	Standard Deviation	No. of Excursions	Percent Excursions	Surface Water Criteria Class III 62-302.530 FAC
			25^{th}	50^{th} (Median)	75^{th}						
Physical Parameters											
Water Temperature (°C)	71	14.7	22.6	25.1	27.0	30	24.5	3.0	---	---	---
Conductivity (µS/cm)	69	178	368	477	518	571	442.7	91.7	---	---	≤1275 µS/cm
Dissolved Oxygen (mg/L)	70	0.39	2.60	3.52	5.19	9.14	3.95	1.79	50	71.4%	≥5.0 mg/L
Water pH	71	7.06	7.22	7.34	7.46	8.17	7.36	0.19	---	---	6.0 - 8.5
Salinity (psu)	69	0.1	0.2	0.23	0.25	0.3	0.21	0.05	---	---	---
Total Dissolved Solids (mg/L)	57	<2	195.3	260	293	3100	293.0	384.9	---	---	---
Color (PCU)	63	10	30	50	80	120	53.7	28.4	---	---	---
Total Suspended Solids (mg/L)	64	<2	<2	<2	<2	13.0	1.3	1.5	---	---	---
Turbidity (NTU)	67	0.3	0.5	0.7	1.0	4.4	0.9	0.6	---	---	29 NTU above background
Ions											
Calcium (mg/L)	30	41.1	54.2	75.1	92.6	108	74.2	20.3	---	---	---
Magnesium (mg/L)	32	3.2	3.8	4.4	4.9	7.0	4.5	0.9	---	---	---
Alkalinity (mg/L)	20	104	172	217	241	264	202.6	44.2	---	---	≥20 mg/L
Chloride (mg/L)	20	<1	19.6	23.1	26.0	29.6	20.3	9.2	---	---	---
Sulfate (mg/L)	18	<1	<1	<1	2.3	11.0	2.3	3.3	---	---	---
Fluoride (mg/L)	20	<0.05	0.08	0.10	0.11	0.15	0.09	0.03	---	---	---
Nutrients											
Ammonia as N (mg/L)	50	0.004	0.012	0.030	0.047	0.180	0.035	0.033	---	---	The discharge of nutrients shall continue to be limited as needed to prevent violations of other standards. In no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of aquatic flora or fauna.
Nitrate + Nitrite as N (mg/L)	60	0.003	0.005	0.008	0.020	0.090	0.015	0.018	---	---	
Total Kjeldahl Nitrogen (mg/L)	58	<0.04	0.45	0.56	0.68	1.66	0.58	0.27	---	---	
Total Nitrogen (mg/L)	51	<0.04	0.46	0.57	0.68	1.75	0.59	0.30	---	---	
Soluble Reactive Phosphorus (µg/L)	64	<4	<4	6	10	27	7.1	5.1	---	---	
Total Phosphorus (µg/L)	59	6	13	20	24	60	20.6	10.1	---	---	
Total Organic Carbon (mg/L)	59	6	9	11	14	19	11.3	3.0	---	---	
Silica (mg/L)	20	1.4	4.4	5.2	6.6	9.9	5.5	2.0	---	---	
Biological											
5-Day Biochemical Oxygen Demand (mg/L)	28	<0.8	1.0	1.0	1.0	3.1	1.2	0.6	---	---	---
Chlorophyll (mg/m^3)	63	<3	<3	<3	4.3	27.8	3.7	4.2	---	---	---
Pheophytin (mg/m^3)	66	<3	<3	<3	<3	9	1.9	1.3	---	---	---
Bacteriological											
Fecal Coliform Bacteria (MF/100 ml)	66	<1	9.0	24	45	440	40.6	61.3	---	---	≤800 MF/100 ml
Total Coliform Bacteria (MF/100 ml)	64	<1	103	203	447	3200	395.2	545.1	---	---	---
Trace Metals in Water (Total)											
Arsenic (µg/L)	20	<1	1.1	1.4	2.2	3.8	1.6	0.9	---	---	≤50 µg/L
Cadmium (µg/L)	22	<0.06	<0.06	<0.06	<0.06	1.0	0.1	0.2	---	---	$\leq e^{(0.7409 \ln(Hardness)-4.719)}$
Chromium (µg/L)	14	<0.25	0.5	0.8	1.0	1.1	0.7	0.3	---	---	$\leq e^{(0.819 \ln(Hardness)+0.6848)}$
Copper (µg/L)	19	<0.15	0.2	0.5	0.8	4.0	0.7	0.9	---	---	$\leq e^{(0.8545 \ln(Hardness)-1.702)}$
Iron (µg/L)	22	<100	140	200	260	860	232	161	---	---	≤1000 µg/L
Lead (µg/L)	23	<0.06	0.1	0.1	0.5	5.7	0.5	1.2	---	---	$\leq e^{(1.273 \ln(Hardness)-4.705)}$
Zinc (µg/L)	14	<2.2	2.7	8	10	20	7.2	5.2	---	---	$\leq e^{(0.8473 \ln(Hardness)+0884)}$

Table 17. Summary water quality data collected at Station BC7 in the Picayune Strand Restoration Project Area from January 2002–August 2007. Compliance with Florida Class III water quality state standards is also included.

Parameter Name (units)	No. of Samples	Min	Percentiles 25th	50th (Median)	75th	Max	Mean	Standard Deviation	No. of Excursions	Percent Excursions	Surface Water Criteria Class III 62-302.530 FAC
Physical Parameters											
Water Temperature (°C)	68	17.1	22.2	26.4	28.0	32	25.2	3.8	---	---	---
Conductivity (µS/cm)	65	324	553	622	654	9496	857.6	1302.0	4	6.2%	≤1275 µS/cm
Dissolved Oxygen (mg/L)	65	1.61	5.93	7.50	8.67	12.14	7.04	2.21	11	16.9%	≥5.0 mg/L
Water pH	67	6.79	7.19	7.42	7.78	8.26	7.46	0.35	---	---	6.0 - 8.5
Salinity (psu)	67	0.2	0.3	0.30	0.32	5.3	0.43	0.72	---	---	---
Total Dissolved Solids (mg/L)	59	69.0	334.0	374	434	6680	630.0	1086.5	---	---	---
Color (PCU)	63	<5	30	40	50	100	43.0	19.1	---	---	---
Total Suspended Solids (mg/L)	65	<2	<2	<2	<2	8.0	1.5	1.5	---	---	---
Turbidity (NTU)	67	<0.1	0.7	1.0	1.4	3.1	1.1	0.6	---	---	29 NTU above background
Ions											
Calcium (mg/L)	31	13.8	79.8	103.8	114.3	127	93.9	25.8	---	---	---
Magnesium (mg/L)	33	3.8	4.4	4.8	5.5	20.0	5.9	3.3	---	---	---
Alkalinity (mg/L)	21	112	213	246	268	288	231.6	49.2	---	---	≥20 mg/L
Chloride (mg/L)	22	<1	28.7	32.5	35.3	75.0	32.0	18.4	---	---	---
Sulfate (mg/L)	21	16.5	28.0	33.3	40.0	54.3	34.1	9.8	---	---	---
Fluoride (mg/L)	18	<0.05	0.07	0.09	0.10	0.17	0.09	0.03	---	---	---
Nutrients											
Ammonia as N (mg/L)	49	0.004	0.005	0.005	0.020	0.080	0.012	0.013	---	---	The discharge of nutrients shall continue to be limited as needed to prevent violations of other standards. In no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of aquatic flora or fauna.
Nitrate + Nitrite as N (mg/L)	61	0.003	0.005	0.005	0.026	0.080	0.017	0.019	---	---	
Total Kjeldahl Nitrogen (mg/L)	54	<0.04	0.31	0.45	0.52	1.31	0.43	0.23	---	---	
Total Nitrogen (mg/L)	51	<0.04	0.32	0.47	0.55	1.33	0.44	0.24	---	---	
Soluble Reactive Phosphorus (µg/L)	61	<4	<4	<4	5	15	4.1	3.3	---	---	
Total Phosphorus (µg/L)	60	<4	10	11	17	40	13.4	7.3	---	---	
Total Organic Carbon (mg/L)	55	5	8	9	10	12	8.9	1.3	---	---	
Silica (mg/L)	21	1.6	3.3	5.2	6.2	7.3	4.8	1.6	---	---	
Biological											
5-Day Biochemical Oxygen Demand (mg/L)	27	<0.8	1.0	1.0	1.0	1.6	0.9	0.3	---	---	---
Chlorophyll (mg/m^3)	61	<3	<3	<3	3.2	16.6	2.8	3.0	---	---	---
Pheophytin (mg/m^3)	64	<3	<3	<3	<3	15	2.3	2.4	---	---	---
Bacteriological											
Fecal Coliform Bacteria (MF/100 ml)	65	<1	2.0	6	14	430	18.9	57.9	---	---	≤800 MF/100 ml
Total Coliform Bacteria (MF/100 ml)	62	<1	59	135	320	5600	411.0	877.2	---	---	---
Trace Metals in Water (Total)											
Arsenic (µg/L)	21	<1	<1	1.3	1.5	3.8	1.3	0.7	---	---	≤50 µg/L
Cadmium (µg/L)	22	<0.06	<0.06	<0.06	<0.06	1.0	0.1	0.2	---	---	$\leq e^{(0.7409\ln(Hardness)-4.719)}$
Chromium (µg/L)	13	0.5	0.5	1.0	1.0	1.1	0.8	0.3	---	---	$\leq e^{(0.819\ln(Hardness)+0.6848)}$
Copper (µg/L)	18	<0.15	0.4	0.5	0.8	2.4	0.7	0.6	---	---	$\leq e^{(0.8545\ln(Hardness)-1.702)}$
Iron (µg/L)	23	<100	140	240	303	960	240	189	---	---	≤1000 µg/L
Lead (µg/L)	22	<0.06	<0.06	0.3	0.5	5.7	0.6	1.2	---	---	$\leq e^{(1.273\ln(Hardness)-4.705)}$
Zinc (µg/L)	17	<0.96	1.7	10	13	50	11.1	12.3	---	---	$\leq e^{(0.8473\ln(Hardness)+0884)}$

Table 18. Summary water quality data collected at Station BC8 in the Picayune Strand Restoration Project Area from January 2002–August 2007. Compliance with Florida Class III water quality state standards is also included.

Parameter Name (units)	No. of Samples	Min	Percentiles			Max	Mean	Standard Deviation	No. of Excursions	Percent Excursions	Surface Water Criteria Class III 62-302.530 FAC
			25^{th}	50^{th} (Median)	75^{th}						
Physical Parameters											
Water Temperature (°C)	68	16.7	22.0	26.3	27.0	32	24.9	3.5	---	---	---
Conductivity (µS/cm)	65	336	463	530	562	3793	591.4	477.2	2	3.1%	≤1275 µS/cm
Dissolved Oxygen (mg/L)	65	1.38	4.25	7.42	8.65	12.33	6.75	2.80	21	32.3%	≥5.0 mg/L
Water pH	68	7.07	7.25	7.42	7.68	8.23	7.46	0.25	---	---	6.0 - 8.5
Salinity (psu)	67	0.2	0.2	0.26	0.27	2.0	0.29	0.25	---	---	---
Total Dissolved Solids (mg/L)	60	48.0	268.0	305	331	3160	402.7	505.0	---	---	---
Color (PCU)	63	10	21	30	50	100	37.8	18.7	---	---	---
Total Suspended Solids (mg/L)	66	<2	<2	<2	<2	24.0	2.0	3.4	---	---	---
Turbidity (NTU)	67	0.3	0.6	0.9	1.2	6.9	1.1	0.9	---	---	29 NTU above background
Ions											
Calcium (mg/L)	31	53.0	74.7	84.6	95.1	604	100.7	94.8	---	---	---
Magnesium (mg/L)	32	2.9	3.6	4.0	4.4	33.0	4.9	5.2	---	---	---
Alkalinity (mg/L)	21	140	181	216	236	276	210.7	34.3	---	---	≥20 mg/L
Chloride (mg/L)	22	<1	24.6	32.1	37.7	655.0	55.9	134.4	---	---	---
Sulfate (mg/L)	21	<1	8.6	12.1	14.6	94.0	15.2	18.6	---	---	---
Fluoride (mg/L)	18	<0.05	0.06	0.08	0.09	0.11	0.07	0.03	---	---	---
Nutrients											
Ammonia as N (mg/L)	48	0.004	0.005	0.010	0.020	0.047	0.014	0.011	---	---	The discharge of nutrients shall continue to be limited as needed to prevent violations of other standards. In no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of aquatic flora or fauna.
Nitrate + Nitrite as N (mg/L)	64	0.003	0.005	0.005	0.012	0.050	0.012	0.011	---	---	
Total Kjeldahl Nitrogen (mg/L)	55	0.09	0.32	0.42	0.53	1.62	0.46	0.27	---	---	
Total Nitrogen (mg/L)	53	0.11	0.35	0.43	0.54	1.62	0.47	0.27	---	---	
Soluble Reactive Phosphorus (µg/L)	62	<4	<4	<4	6	16	4.0	2.9	---	---	
Total Phosphorus (µg/L)	59	<4	10	12	20	72	14.9	10.4	---	---	
Total Organic Carbon (mg/L)	54	4	7	8	9	14	8.0	2.1	---	---	
Silica (mg/L)	21	2.0	3.0	4.4	5.4	6.7	4.1	1.4	---	---	
Biological											
5-Day Biochemical Oxygen Demand (mg/L)	27	<0.8	1.0	1.0	1.0	2.1	1.0	0.3	---	---	---
Chlorophyll (mg/m^3)	61	<3	<3	<3	<3	9.1	2.3	1.8	---	---	---
Pheophytin (mg/m^3)	64	<3	<3	<3	<3	15	2.0	1.9	---	---	---
Bacteriological											
Fecal Coliform Bacteria (MF/100 ml)	67	<1	4.5	11	23	420	33.9	70.8	---	---	≤800 MF/100 ml
Total Coliform Bacteria (MF/100 ml)	66	<1	106	214	340	4350	327.8	590.4	---	---	---
Trace Metals in Water (Total)											
Arsenic (µg/L)	21	<1	1.2	2.1	2.8	3.8	2.0	1.0	---	---	≤50 µg/L
Cadmium (µg/L)	22	<0.06	<0.06	<0.06	<0.06	1.0	0.1	0.2	---	---	$\leq e^{(0.7409\ln(Hardness)-4.719)}$
Chromium (µg/L)	13	0.3	0.5	0.6	1.0	1.0	0.7	0.3	---	---	$\leq e^{(0.819\ln(Hardness)+0.6848)}$
Copper (µg/L)	18	<0.15	0.2	0.5	0.9	2.4	0.8	0.7	---	---	$\leq e^{(0.8545\ln(Hardness)-1.702)}$
Iron (µg/L)	23	<100	<100	200	295	540	216	144	---	---	≤1000 µg/L
Lead (µg/L)	22	<0.06	0.1	0.3	0.5	5.7	0.6	1.2	---	---	$\leq e^{(1.273\ln(Hardness)-4.705)}$
Zinc (µg/L)	16	<0.96	5.1	10	10	31	10.0	7.8	---	---	$\leq e^{(0.8473\ln(Hardness)+0884)}$

Table 19. Summary water quality data collected at Station FAKA in the Picayune Strand Restoration Project Area from January 2002–August 2007. Compliance with Florida Class III water quality state standards is also included.

Parameter Name (units)	No. of Samples	Min	Percentiles			Max	Mean	Standard Deviation	No. of Excursions	Percent Excursions	Surface Water Criteria Class III 62-302.530 FAC
			25^{th}	50^{th} (Median)	75^{th}						
Physical Parameters											
Water Temperature (°C)	68	17.6	22.6	27.0	27.9	33	25.5	3.7	---	---	---
Conductivity (µS/cm)	63	410	541	598	670	16063	1328.5	2402.2	11	17.5%	≤1275 µS/cm
Dissolved Oxygen (mg/L)	66	1.83	5.17	6.81	8.16	11.07	6.63	2.08	16	24.2%	≥5.0 mg/L
Water pH	68	7.13	7.37	7.60	7.99	8.38	7.68	0.36	---	---	6.0 - 8.5
Salinity (psu)	65	0.0	0.3	0.29	0.32	9.3	0.68	1.36	---	---	---
Total Dissolved Solids (mg/L)	57	246.0	317.5	350	534	9260	807.9	1420.1	---	---	---
Color (PCU)	62	5	30	40	50	80	38.1	17.9	---	---	---
Total Suspended Solids (mg/L)	65	<2	<2	<2	2.0	8.0	1.7	1.6	---	---	---
Turbidity (NTU)	66	0.4	0.7	0.9	1.1	3.2	1.0	0.5	---	---	29 NTU above background
Ions											
Calcium (mg/L)	28	61.8	80.6	89.4	106.0	124	91.8	15.7	---	---	---
Magnesium (mg/L)	32	3.7	4.3	4.6	12.5	243.0	18.7	43.9	---	---	---
Alkalinity (mg/L)	21	138	205	226	248	276	221.7	32.3	---	---	≥20 mg/L
Chloride (mg/L)	22	<1	29.3	34.4	55.4	4048	263.8	862.1	---	---	---
Sulfate (mg/L)	21	13.3	20.6	26.1	30.7	210.0	39.3	45.9	---	---	---
Fluoride (mg/L)	18	<0.05	0.06	0.09	0.10	0.12	0.08	0.03	---	---	---
Nutrients											
Ammonia as N (mg/L)	51	0.004	0.005	0.005	0.019	0.050	0.011	0.011	---	---	The discharge of nutrients shall continue to be limited as needed to prevent violations of other standards. In no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of aquatic flora or fauna.
Nitrate + Nitrite as N (mg/L)	62	<0.01	<0.01	<0.01	0.020	0.049	0.013	0.012	---	---	
Total Kjeldahl Nitrogen (mg/L)	59	<0.04	0.37	0.46	0.62	1.65	0.52	0.26	---	---	
Total Nitrogen (mg/L)	55	<0.04	0.37	0.49	0.64	1.65	0.53	0.27	---	---	
Soluble Reactive Phosphorus (µg/L)	64	<4	<4	<4	5	11	3.8	2.5	---	---	
Total Phosphorus (µg/L)	58	<4	8	11	15	41	13.3	7.9	---	---	
Total Organic Carbon (mg/L)	63	5	8	9	9	13	8.6	1.5	---	---	
Silica (mg/L)	21	1.7	3.6	4.7	6.1	10.3	4.8	1.9	---	---	
Biological											
5-Day Biochemical Oxygen Demand (mg/L)	27	<0.8	1.0	1.0	1.0	2.5	1.0	0.4	---	---	---
Chlorophyll (mg/m^3)	63	<3	<3	<3	<3	11.7	1.9	1.5	---	---	---
Pheophytin (mg/m^3)	65	<3	<3	<3	<3	9	1.8	1.1	---	---	---
Bacteriological											
Fecal Coliform Bacteria (MF/100 ml)	65	<1	4.0	12	42	560	41.0	87.4	---	---	≤800 MF/100 ml
Total Coliform Bacteria (MF/100 ml)	63	6	67	124	313	5400	350.6	757.4	---	---	---
Trace Metals in Water (Total)											
Arsenic (µg/L)	21	<1	1.0	1.4	1.9	3.8	1.6	0.9	---	---	≤50 µg/L
Cadmium (µg/L)	21	<0.06	<0.06	<0.06	<0.06	1.0	0.1	0.2	---	---	$\leq e^{(0.7409\ln(Hardness)-4.719)}$
Chromium (µg/L)	13	0.4	0.5	0.7	1.0	1.0	0.8	0.2	---	---	$\leq e^{(0.819\ln(Hardness)+0.6848)}$
Copper (µg/L)	19	<0.3	0.4	0.5	0.8	7.8	1.3	2.1	---	---	$\leq e^{(0.8545\ln(Hardness)-1.702)}$
Iron (µg/L)	23	<100	105	150	218	520	169	111	---	---	≤1000 µg/L
Lead (µg/L)	22	<0.06	0.1	0.1	0.5	5.7	0.5	1.2	---	---	$\leq e^{(1.273\ln(Hardness)-4.705)}$
Zinc (µg/L)	15	<0.96	3.2	10	10	20	8.1	5.7	---	---	$\leq e^{(0.8473\ln(Hardness)+0884)}$

Table 20. Summary water quality data collected at Station SGGE10SW in the Picayune Strand Restoration Project Area from January 2002–August 2007. Compliance with Florida Class III water quality state standards is also included.

Parameter Name (units)	No. of Samples	Min	Percentiles 25th	50th (Median)	75th	Max	Mean	Standard Deviation	No. of Excursions	Percent Excursions	Surface Water Criteria Class III 62-302.530 FAC
Physical Parameters											
Water Temperature (°C)	10	20.1	25.1	26.1	26.9	28	25.5	2.2	---	---	---
Conductivity (µS/cm)	9	385	490	516	541	582	507.4	59.7	---	---	$\leq$1275 µS/cm
Dissolved Oxygen (mg/L)	9	0.41	1.08	1.53	2.12	3.54	1.65	0.92	9	100.0%	$\geq$5.0 mg/L
Water pH	10	6.82	7.22	7.24	7.33	7.39	7.23	0.16	---	---	6.0 - 8.5
Salinity (psu)	10	0.18	0.24	0.26	0.26	0.29	0.25	0.03	---	---	---
Total Dissolved Solids (mg/L)	9	130	246	282	310	349	268.4	63.5	---	---	---
Color (PCU)	1	20	-----	20	-----	20	20.0	0.0	---	---	---
Total Suspended Solids (mg/L)	9	<2	<2	3	5.3	7	3.6	2.2	---	---	---
Turbidity (NTU)	2	0.6	0.6	0.6	0.7	0.7	0.6	0.0	---	---	29 NTU above background
Ions											
Calcium (mg/L)	10	62.2	75.1	98.8	103.0	137	93.5	22.5	---	---	---
Magnesium (mg/L)	9	2.0	2.2	2.3	3.0	4.8	2.7	0.9	---	---	---
Alkalinity (mg/L)	5	222	235	260	265	267	250.4	19.3	---	---	$\geq$20 mg/L
Chloride (mg/L)	1	12.0	-----	12.0	-----	12.0	12.0	0.0	---	---	---
Sulfate (mg/L)	8	<1	0.9	3.2	11.6	40.0	9.0	13.3	---	---	---
Fluoride (mg/L)	1	0.25	<0.25	0.25	<0.25	0.25	0.25	0.00	---	---	---
Nutrients											
Ammonia as N (mg/L)	11	<0.001	0.004	0.033	0.050	0.114	0.037	0.037	---	---	The discharge of nutrients shall continue to be limited as needed to prevent violations of other standards. In no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of aquatic flora or fauna.
Nitrate + Nitrite as N (mg/L)	8	0.003	0.005	0.005	0.010	0.100	0.018	0.033	---	---	
Total Kjeldahl Nitrogen (mg/L)	7	<0.21	0.27	0.33	0.70	2.24	0.66	0.73	---	---	
Total Nitrogen (mg/L)	6	<0.21	0.33	0.49	0.72	2.24	0.73	0.77	---	---	
Soluble Reactive Phosphorus (µg/L)	9	<2	<2	<2	9	330	41.0	108.5	---	---	
Total Phosphorus (µg/L)	9	8	24	35	41	489	80.9	153.4	---	---	
Silica (mg/L)	8	4.1	4.4	5.1	6.5	9.6	5.7	1.8	---	---	
Biological											
5-Day Biochemical Oxygen Demand (mg/L)	6	<0.8	0.4	1.0	3.2	5.0	1.8	1.9	---	---	---
Pheophytin (mg/m^3)	8	<3	<3	<3	3.1	5.8	2.4	1.5	---	---	---
Trace Metals in Water (Total)											
Arsenic (µg/L)	1	1.2	-----	1.2	-----	1.2	1.2	0.0	---	---	$\leq$50 µg/L
Cadmium (µg/L)	1	<0.13	-----	<0.13	-----	<0.13	<0.13	0.0	---	---	$\leq e^{(0.7409\ln(Hardness)-4.719)}$
Copper (µg/L)	1	<0.25	-----	<0.25	-----	<0.25	<0.25	0.0	---	---	$\leq e^{(0.8545\ln(Hardness)-1.702)}$
Iron (µg/L)	9	<100	<100	160	258	387	186	113	---	---	$\leq$1000 µg/L
Lead (µg/L)	1	<0.03	-----	<0.03	-----	<0.03	<0.03	0.0	---	---	$\leq e^{(1.273\ln(Hardness)-4.705)}$

Table 21. Summary water quality data collected at Station SGGE4SW in the Picayune Strand Restoration Project Area from January 2002–August 2007. Compliance with Florida Class III water quality state standards is also included.

Parameter Name (units)	No. of Samples	Min	Percentiles			Max	Mean	Standard Deviation	No. of Excursions	Percent Excursions	Surface Water Criteria Class III 62-302.530 FAC
			25th	50th (Median)	75th						
Physical Parameters											
Water Temperature (°C)	2	25.2	25.2	26.0	26.8	27	26.0	1.1	---	---	---
Conductivity (µS/cm)	2	274	274	299	324	324	299.0	35.4	---	---	≤1275 µS/cm
Dissolved Oxygen (mg/L)	2	1.23	1.23	1.57	1.90	1.90	1.57	0.47	2	100.0%	≥5.0 mg/L
Water pH	1	6.98	-----	6.98	-----	6.98	6.98	0.00	---	---	6.0 - 8.5
Salinity (psu)	2	0.13	0.13	0.14	0.15	0.15	0.14	0.01	---	---	---
Total Dissolved Solids (mg/L)	2	142	142	176	209	209	175.5	47.4	---	---	---
Color (PCU)	1	100	-----	100	-----	100	100	0.0	---	---	---
Total Suspended Solids (mg/L)	2	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	0.0	---	---	---
Turbidity (NTU)	1	0.9	-----	0.9	-----	0.9	0.9	0.0	---	---	29 NTU above background
Ions											
Calcium (mg/L)	2	45.9	45.9	49.9	53.8	54	49.9	5.6	---	---	---
Magnesium (mg/L)	2	3.1	3.1	3.2	3.3	3.3	3.2	0.1	---	---	---
Alkalinity (mg/L)	2	121	121	126	130	130	125.5	6.4	---	---	≥20 mg/L
Chloride (mg/L)	1	13	-----	13	-----	13	13	0.0	---	---	---
Sulfate (mg/L)	2	1.3	1.3	1.3	1.3	1.3	1.3	0.0	---	---	---
Nutrients											
Ammonia as N (mg/L)	3	<0.001	0.009	0.033	0.046	0.050	0.028	0.025	---	---	The discharge of nutrients shall continue to be limited as needed to prevent violations of other standards. In no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of aquatic flora or fauna.
Nitrate + Nitrite as N (mg/L)	2	<0.01	<0.01	0.053	0.100	0.100	0.053	0.067	---	---	
Total Kjeldahl Nitrogen (mg/L)	2	1.20	1.20	1.41	1.61	1.61	1.41	0.29	---	---	
Total Nitrogen (mg/L)	2	1.20	1.20	1.41	1.61	1.61	1.41	0.29	---	---	
Soluble Reactive Phosphorus (µg/L)	2	<4	<4	7	12	12	7.0	7.1	---	---	
Total Phosphorus (µg/L)	2	28	28	49	70	70	49.0	29.7	---	---	
Total Organic Carbon (mg/L)	1	14	-----	14	-----	14	14	0.0	---	---	
Silica (mg/L)	1	5.0	-----	5.0	-----	5.0	5.0	0.0	---	---	
Biological											
5-Day Biochemical Oxygen Demand (mg/L)	2	2.6	2.6	6.3	10.0	10.0	6.3	5.2	---	---	---
Pheophytin (mg/m^3)	1	10.8	-----	10.8	-----	10.8	10.8	0.0	---	---	---
Trace Metals in Water (Total)											
Arsenic (µg/L)	1	0.5	-----	0.5	-----	0.5	0.5	0.0	---	---	≤50 µg/L
Cadmium (µg/L)	1	<0.13	-----	<0.13	-----	<0.13	<0.13	0.00	---	---	$\leq e^{(0.7409\ln(Hardness)-4.719)}$
Copper (µg/L)	1	<0.25	-----	<0.25	-----	<0.25	<0.25	0.00	---	---	$\leq e^{(0.819\ln(Hardness)+0.6848)}$
Iron (µg/L)	2	44.1	44.1	117.1	190.0	190	117.1	103.2	---	---	≤1000 µg/L
Lead (µg/L)	1	<0.032	-----	<0.032	-----	<0.032	<0.032	0.000	---	---	$\leq e^{(1.273\ln(Hardness)-4.705)}$

Table 22. Summary water quality data collected at Station SGGE22SW in the Picayune Strand Restoration Project Area from January 2002–August 2007. Compliance with Florida Class III water quality state standards is also included.

Parameter Name (units)	No. of Samples	Min	Percentiles 25th	50th (Median)	75th	Max	Mean	Standard Deviation	No. of Excursions	Percent Excursions	Surface Water Criteria Class III 62-302.530 FAC
Physical Parameters											
Water Temperature (°C)	1	25.5	-----	25.5	-----	25.5	25.5	0.0	---	---	---
Conductivity (µS/cm)	1	399	-----	399	-----	399	399	0.0	---	---	≤1275 µS/cm
Dissolved Oxygen (mg/L)	1	1.48	-----	1.48	-----	1.48	1.48	0.00	1	100.0%	≥5.0 mg/L
Water pH	1	7.25	-----	7.25	-----	7.25	7.25	0.00	---	---	6.0 - 8.5
Salinity (psu)	1	0.19	-----	0.19	-----	0.19	0.19	0.00	---	---	---
Total Dissolved Solids (mg/L)	1	188	-----	188	-----	188	188	0.0	---	---	---
Total Suspended Solids (mg/L)	2	<2	<2	<2	<2	<2	<2	0.0	---	---	---
Ions											
Calcium (mg/L)	2	65.3	65.3	73.1	80.8	81	73.1	11.0	---	---	---
Magnesium (mg/L)	2	2.6	2.6	3.0	3.3	3.3	3.0	0.5	---	---	---
Alkalinity (mg/L)	1	190	<190	190	<190	190	190.0	0.0	---	---	≥20 mg/L
Sulfate (mg/L)	2	<1	<1	<1	<1	<1	<1	0.0	---	---	---
Nutrients											
Ammonia as N (mg/L)	2	0.020	0.020	0.035	0.050	0.050	0.035	0.021	---	---	The discharge of nutrients shall continue to be limited as needed to prevent violations of other standards. In no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of aquatic flora or fauna.
Nitrate + Nitrite as N (mg/L)	1	0.010	-----	0.010	-----	0.010	0.010	0.000	---	---	
Total Kjeldahl Nitrogen (mg/L)	1	0.79	-----	0.79	-----	0.79	0.79	0.00	---	---	
Total Nitrogen (mg/L)	1	0.80	-----	0.80	-----	0.80	0.80	0.00	---	---	
Soluble Reactive Phosphorus (µg/L)	2	8	8	10	12	12	10.0	2.8	---	---	
Total Phosphorus (µg/L)	2	40	40	45	49	49	44.5	6.4	---	---	
Silica (mg/L)	2	4.4	4.4	5.4	6.4	6.4	5.4	1.4	---	---	
Biological											
5-Day Biochemical Oxygen Demand (mg/L)	1	2.0	-----	2.0	-----	2.0	2.0	0.0	---	---	---
Pheophytin (mg/m^3)	2	<3	1.5	1.5	1.5	1.5	1.5	0.0	---	---	---
Trace Metals in Water (Total)											
Iron (µg/L)	1	110	-----	110	-----	110	110	-----	---	---	≤1000 µg/L

Table 23. Summary water quality data collected at four marsh stations in the Picayune Strand Restoration Project Area from January 2002–August 2007. These stations were only sampled once during this period. Compliance with Florida Class III water quality standards is also included.

Parameter Name (units)	Marsh Stations				Surface Water Criteria Class III 62-302.530 FAC
	SGGE5SW	SGGE16SW	SGGE23SW	SGGE24SW	
Physical Parameters					
Water Temperature (°C)	28.5	26.9	27.3	28.6	---
Conductivity (µS/cm)	483	412	446	283	≤1275 µS/cm
Dissolved Oxygen (mg/L)	***3.32***	***1.46***	***3.06***	5.86	≥5.0 mg/L
Water pH	7.22	7.05	7.1	7.61	6.0 - 8.5
Salinity (psu)	0.2	0.2	0.2	0.1	---
Total Dissolved Solids (mg/L)	244	190	210	152	---
Total Suspended Solids (mg/L)	<2	<2	<2	<2	---
Ions					
Calcium (mg/L)	95.9	72.9	80.1	49.8	---
Magnesium (mg/L)	2.1	3.1	1.9	2.5	---
Alkalinity (mg/L)	-----	186	191	-----	---
Sulfate (mg/L)	<1	<1	10.4	<1	---
Nutrients					
Ammonia as N (mg/L)	0.030	0.040	0.050	0.040	The discharge of nutrients shall continue to be limited as needed to prevent violations of other standards. In no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of aquatic flora or fauna.
Nitrate + Nitrite as N (mg/L)	0.010	0.020	-----	0.010	
Total Kjeldahl Nitrogen (mg/L)	0.23	0.86	0.27	1.29	
Total Nitrogen (mg/L)	0.24	0.88	-----	1.30	
Soluble Reactive Phosphorus (µg/L)	<4	8	<4	<4	
Total Phosphorus (µg/L)	13	56	11	16	
Silica (mg/L)	3.5	5.8	3.8	8.1	
Biological					
5-Day Biochemical Oxygen Demand (mg/L)	<0.8	3.0	<0.8	3.0	---
Pheophytin (mg/m3)	<3	<3	<3	<3	---
Trace Metals in Water (Total)					
Total Iron (µg/L)	-----	-----	-----	120	≤1.0 mg/L or ≤1000 µg/L

CURRENT STATUS OF PRAIRIE CANAL FILLING AND PHASE 1 ROAD REMOVAL

A portion of the restoration plan for Picayune Strand has been accomplished. Seven miles of Prairie Canal, the easternmost canal along the border shared with Fakahatchee Strand Preserve State Park (see **Figures 2** and **3**), has been filled with adjacent spoil and excess material from leveling all roads east of the Merritt Canal (see **Figure 3**). **Figure 133** shows one of these canals before, during, and after filling. A weir structure and a bridge have been removed. This work was completed in late spring 2007. These activities have resulted in some improvement in hydrology. Also, exotic and nuisance species monitoring and removal continues in the footprints of the roads that were removed and the canal that was filled.

Figure 133. A Picayune Strand Restoration Project Area canal (a) before, (b) during, and (c) after filling (photos by the SFWMD).

HYDROLOGY

Hydrologic restoration resulting from filling Prairie Canal is continuing through natural process. **Figures 134** and **135** present water levels along Transects 2 and 3. The wells along these transects are shown in **Figure 4** (SGT2 and SGT3 wells). These plots show reduced water level drawdowns in the Prairie Canal vicinity since it was filled compared to those near the Merritt Canal, which has not been filled, and halfway between the two canals.

Drawdowns have also decreased in Fakahatchee Strand Preserve State Park. The effects can be seen by comparing the drawdowns experienced in 2007 (**Figures 78** and **79**) and 2008 (**Figures 80** and **81**) to those of years prior to the filling of the Prairie Canal and phase 1 of the road removal (**Figures 40** through **71**). They are evidenced both in terms of how low the water is drawn down and how far the drawdown effects extend into Fakahatchee Strand Preserve State Park. There still appears to be evidence of a drawdown, which could have two possible explanations. One is atypically dry wet seasons since the canal was filled. The other is that water is still flowing through the fill more rapidly than it does through the area's undisturbed substrates.

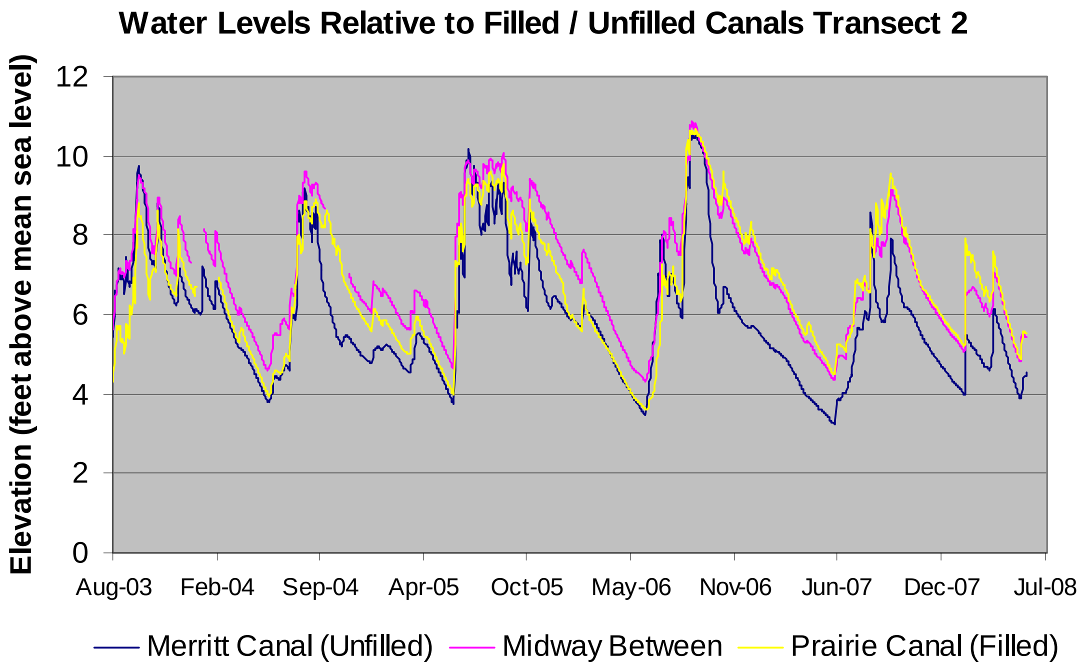

Figure 134. Transect 2 (see **Figure 4**) water levels relative to filled and unfilled canals.

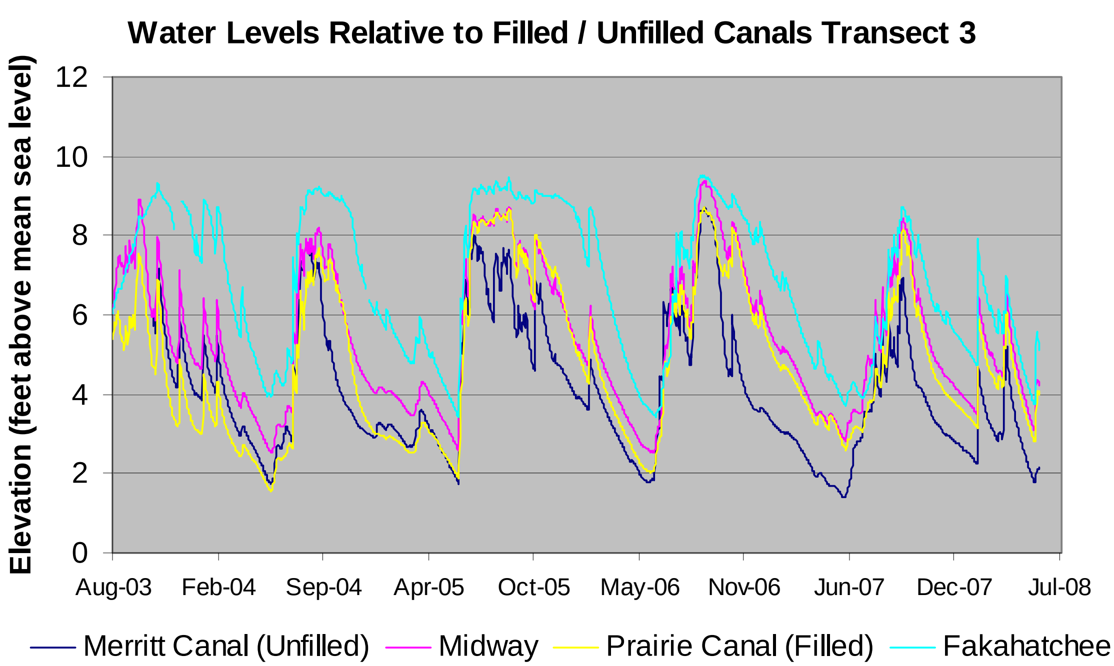

Figure 135. Transect 3 (see **Figure 4**) water levels relative to filled and unfilled canals.

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