FOURTEENTH ANNUAL REPORT OF THE CONTINUING SURFACE WATER QUALITY MONITORING PROGRAM FOR THE CATFISH AND NORTH CREEKS OF THE PALMER RANCH SARASOTA COUNTY, FLORIDA JANUARY - DECEMBER, 1998

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Submitted To:

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SARASOTA COUNTY, FLORIDA

1.0 INTRODUCTION

A master development plan for the Palmer Ranch is being implemented pursuant to the terms and conditions of the **Amended and Restated Master Development Order** (Amended MDO) for the Palmer Ranch Development of Regional Impact (DRI) which was adopted on July 12, 1991, by the Board of County Commissioners of Sarasota County. The amended and original MDO's call for planning and developing the 5,119-acre Palmer Ranch DRI in incremental developments. Construction of the first incremental development (Prestancia) was initiated in 1986. The Palmer Ranch is located in west-central Sarasota County as shown in **Figure 1.1**.

Pursuant to the conditions of the original MDO, a "Continuing Surface Water Quality Monitoring Program" was required to be performed before and during construction, except during the period in which a "Pollutant Loading Monitoring Program" was to be performed as specified in the Agreement of Understanding between Sarasota County and Palmer Venture established during August 1987.

The original monitoring program, which was initiated in May 1984 by GeoScience, Inc., employed a bimonthly sampling frequency as required for the first year of monitoring. Subsequently, the scope of the monitoring program for the following two-year period was

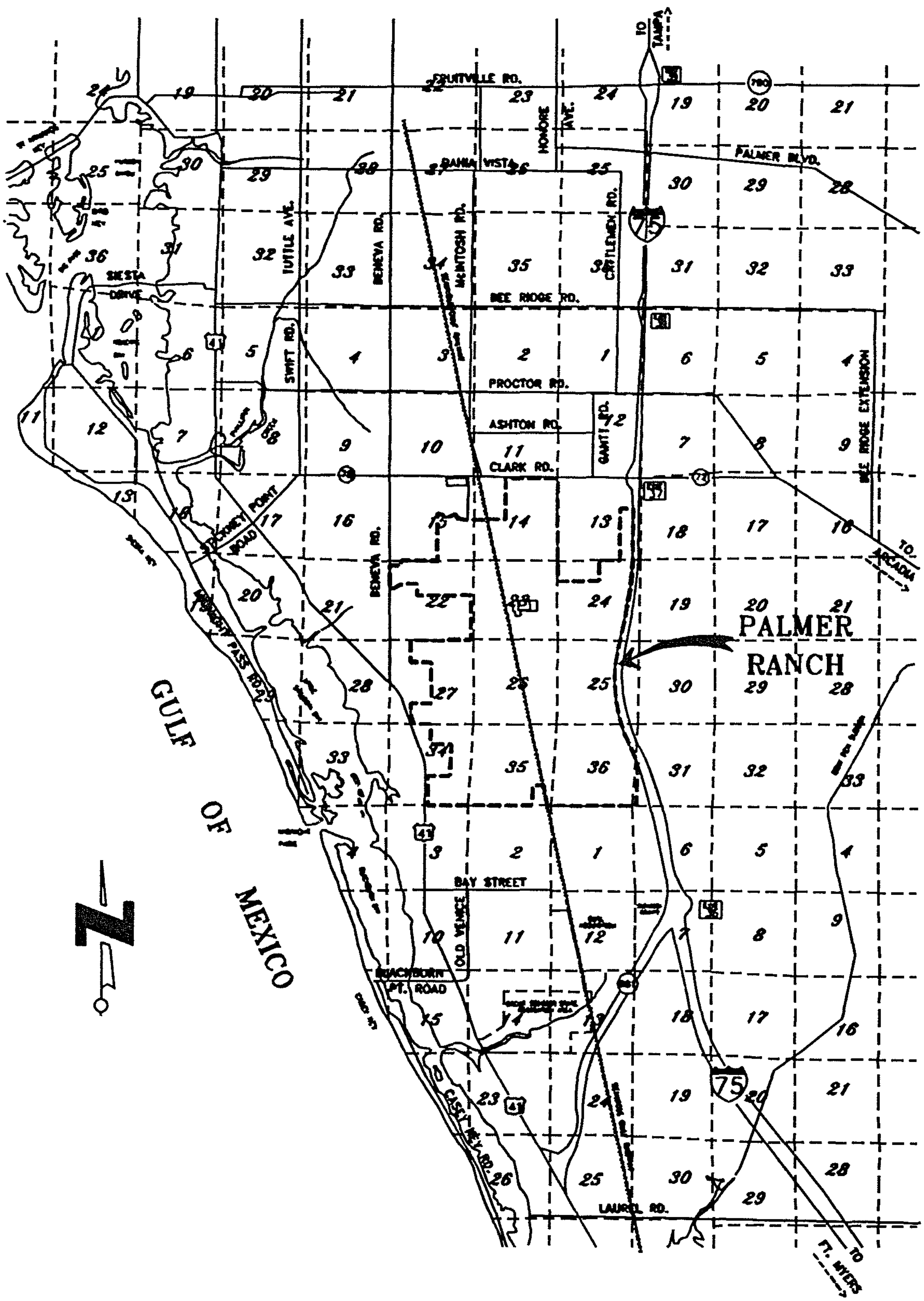


Figure 1.1. General Site Location.

revised during an agency review meeting in June 1985. This meeting involved the developer's representative, Mr. T. W. Goodell, and Mr. Russ Klier of Sarasota County Pollution Control Division (personal communication with Mr. T. W. Goodell). The revised work scope entailed a 13-station network with a quarterly sampling frequency for the parameters monitored during the first year, except trace elements and organochlorine pesticides that would receive annual audits (refer to July 24, 1986 correspondence of Mr. T. W. Goodell to Mr. Russ Klier).

Palmer Ranch Development, Ltd. *(f.k.a.* Palmer Venture) contracted CCI Environmental Services, Inc. *(f.k.a.* Conservation Consultants, Inc.) to implement the "Continuing Surface Water Quality Monitoring Program" during the second year of the monitoring program. CCI Environmental Services, Inc. (CCI) began monitoring on September 16, 1985, pursuant to the instructions provided by Palmer Ranch Development, Ltd. Except an annual sampling event conducted in September 1988, the "Continuing Surface Water Quality Monitoring Program" was suspended in June 1988, due to the initiation of the "Pollutant Loading Monitoring Program". The Stormwater Pollutant Loading Monitoring Program was performed between June 1988 and December 1989 and a report submitted to Sarasota County on May 29, 1992. Subsequent to an agreement between the Sarasota County Pollution Control Division and Palmer Ranch Development, Ltd., the "Continuing Surface Water Quality Monitoring Program" was resumed in December 1989 with a single annual sampling event conducted during the fifth monitoring year. After resumption of monitoring in December 1989, the surface water quality monitoring was performed quarterly at all stations until December 10, 1991.

With adoption of **Exhibit "E" to the Amended and Restated Master Development Order for the Palmer Ranch Development of Regional Impact** (**Appendix A**), a revised water quality monitoring program was implemented in 1992. This revised monitoring program consists of quarterly water quality measurements and grab sample collection in Catfish Creek, North Creek and South Creek at a total of 10 monitoring stations. In accordance with Exhibit "E", monitoring in the South Creek Basin was suspended until one month before any development activity occurring in the basin. Upon intent to reinitiate monitoring of the South Creek Basin, Sarasota County Pollution Control Division was notified of dates of sampling and stations to be sampled. As specified in Exhibit "E", this pre-development monitoring event will include water quality grab sampling and *in situ* measurements at four (4) monitoring stations along South Creek. Following this initial monitoring event, all subsequent monitoring shall be performed quarterly during the development phase. During development, all stations located downstream of an area under development shall be monitored. Additionally, one sampling site located upstream of a development area shall also be monitored to determine baseline water quality conditions. Once an area is substantially developed as agreed to by the Sarasota County Pollution Control Division and the Palmer Ranch Development, Ltd., a modification of the monitoring program shall be subject to discussion for change in water quality monitoring frequency from quarterly to semi-annually or to be discontinued.

Under the amended and approved monitoring plan as stated in Exhibit "E", monitoring of Catfish Creek and North Creek is to continue quarterly for a maximum of two years or until substantial development occurs. Once substantial development or a two-year period occurs and is agreed to by both Sarasota County Pollution Control Division and the Palmer Ranch, the monitoring frequency for sites in Catfish Creek and North Creek shall be subject to change from quarterly to semi-annually depending on results obtained up to that time. On April 29, 1994, Mr. Kent Kimes of the Sarasota County Pollution Control Division approved a reduction in sampling frequency for the Catfish Creek and North Creek monitoring stations from quarterly to semi-annually.

Monitoring of the South Creek Basin was reinitiated with the first quarterly sampling occurring on January 13, 1994. Results of the water quality monitoring performed in the South Creek Basin during the 1998 monitoring year are presented in a separate narrative report.

The water quality conditions recorded during semi-annual sampling events conducted during the period from January through December 1998 in the Catfish Creek and North Creek basins are reported herein. This report includes a discussion of the results with respect to applicable water quality criteria, observed spatial and temporal trends, and comparisons with results obtained during previous monitoring events.

2.0 General Environmental Setting

2.1 Climate

Prevailing climatic conditions in west-central Florida are subtropical, characterized by abundant rainfall and moderate temperatures. Average monthly temperatures derived from two separate 30-year periods of record are provided in **Table 2.1** below:

Table 2.1. Average Monthly Air Temperatures (National Weather Service, Tampa, Florida)

Month	Air Temperature			
	1941-1970A		1931-1960[b]	
	°C	°F	°C	°F
January	16.4	61.6	16.9	62.4
February	17.2	62.9	17.7	63.8
March	19.4	66.9	19.4	67.0
April	22.3	72.1	22.1	71.8
May	24.8	76.7	24.9	76.8
June	26.8	80.3	26.9	80.4
July	27.6	81.6	27.6	81.6
August	27.7	81.9	27.8	82.0
September	26.9	80.5	27.0	80.6
October	23.9	75.0	23.9	75.1
November	19.8	67.7	19.9	67.9
December	17.1	62.8	17.4	63.4
Annual Average	22.5	72.5	22.6	72.7

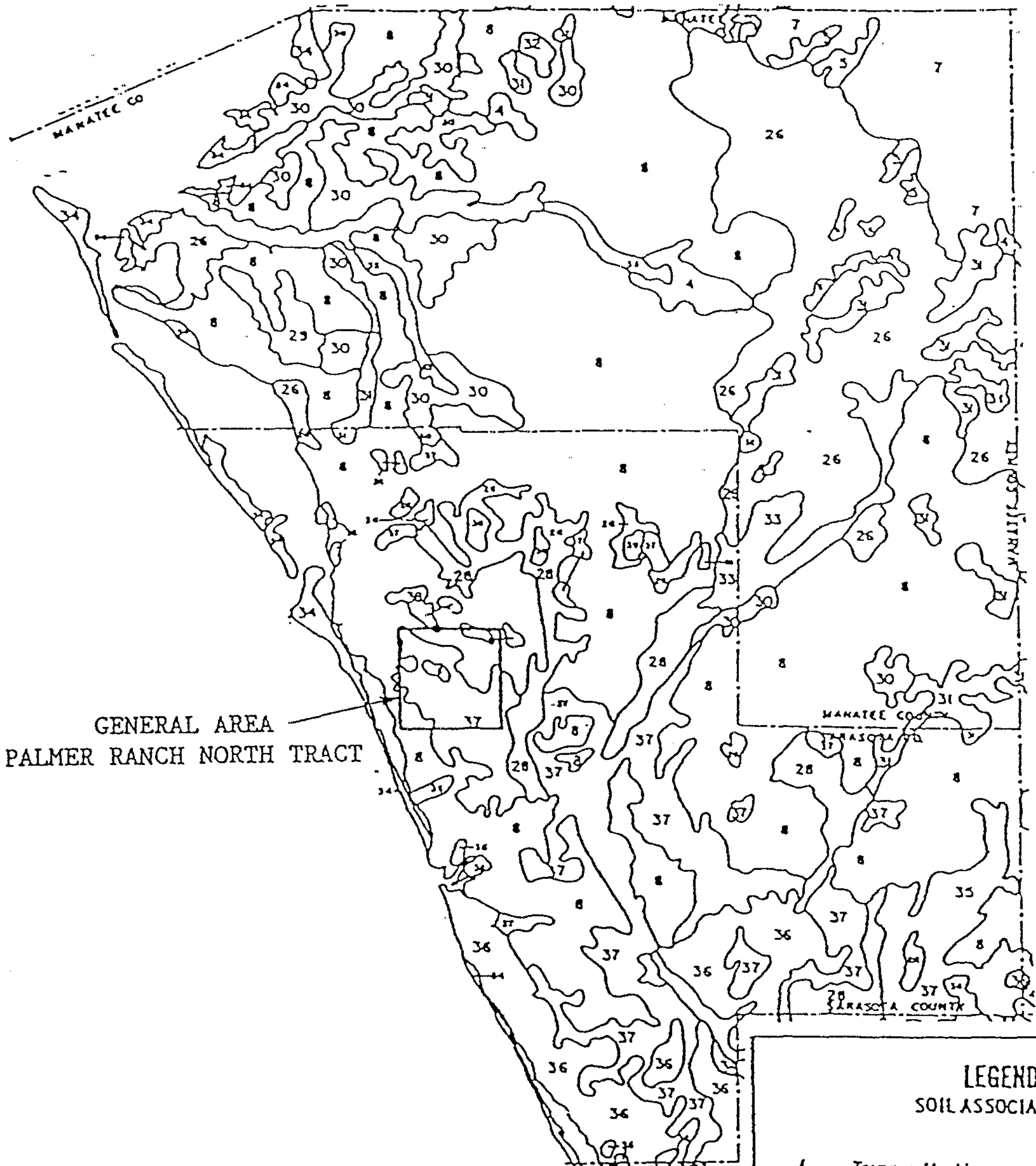
[a]Thompson, 1976
[b]Bradley, 1974

Based on a 30-year period of record, rainfall in Bradenton, Florida (NOAA, 1977) averages 56 inches per year. The minimum annual rainfall recorded during the 30-year period was 29 inches while the maximum was 93 inches. Historical rainfall trends for this area show that a wet season occurs during the period of June through September followed by a dry season during the period of October through January. On the average 62 percent (35 inches) of the annual rainfall occurs during the summer with only 13 percent (7 inches) during the fall. The dry season is followed by a short wet period during February and March and subsequently a short dry period during April and May.

2.2 Soils

Soils in the area of the Palmer Ranch are generally sandy except in areas of low relief and poor drainage where peaty mucks are common (Florida Division of State Planning, 1975). Upland soils found throughout the Palmer Ranch are predominately of the Myakka-Immokalee-Basinger Association. This soil association is defined as nearly level with poorly drained sandy soils (Florida Division of State Planning, 1975).

Along the well-incised banks of several drainage ditches traversing the Palmer Ranch (*e.g.*, lower reach of Catfish Creek), it is evident that a natural marine deposit exists a few feet below the ground surface. This marine deposit contains a thin layer of shells and shell fragments. **Figure 2.1** and **Table 2.2** provide the locations and descriptions of the soil associations that occur in the area of the Palmer Ranch.



LEGEND
SOIL ASSOCIATIONS

4	Tavares-Myakka
5	Pomello-St. Lucie
7	Myakka-Pomello-Basinger
8	Myakka-Immokalee-Basinger
26	Immokalee-Pomello
28	Pompano-Charlotte-Delray
30	Wabasso-Bradenton-Myakka
31	Placid-Basinger
32	Delray-Manatee-Pompano
33	Fresh Water Swamp & Marsh
34	Tidal Marsh & Swamp-Coastal Beach Ridges
35	Pomello-Paola-St. Lucie
36	Immokalee-Myakka-Pompano
37	Adamsville-Pompano
38	Scranton, var.-Ona-Placid
39	Terra Ceia

Source: The Florida General Soils Atlas, Florida Division of State Planning (1975)

Figure 2.1. Soil Associations in the Region.

TABLE 2.2. DESCRIPTIONS OF SOIL ASSOCIATIONS

Area Definition	Map Unit No.	Soil Association Description
Areas dominated by moderately well to poorly drained soils not subject to flooding.	4	Tavares-Myakka association: Nearly level to gently sloping, moderately well-drained soils sandy throughout and poorly drained sandy soils with weakly cemented sub-soils.
	5	Pomello-St. Lucie association: Nearly level to sloping, moderately well drained, sandy soils with weakly cemented sandy subsoil and excessively drained soils sandy throughout.
	7	Myakka-Pomello-Bassinger association: Nearly level, poorly and moderately well drained, sandy soils with weakly cemented sandy subsoil and poorly drained sandy soils throughout.
	8	Myakka-Immokalee-Bassinger association: Nearly level, poorly drained, sandy soils with weakly cemented sandy subsoil and poorly drained sandy soils throughout.
	26	Immokalee-Pomello association: Nearly level to gently sloping, poorly and moderately well drained, sandy soils with weakly cemented sandy subsoil.
	30	Wabasso-Bradenton-Myakka association: Nearly level, poorly drained, sandy soils with a weakly cemented sandy subsoil layer underlain by loamy subsoil; poorly drained soils with thin, sandy layers over loamy subsoil and poorly drained soils with weakly cemented sand subsoil.

TABLE 2.2. (CONTINUED)

Area Definition	Map Unit No.	Soil Association Description
Areas dominated by moderately well to poorly drained soils subject to flooding.	35	Pomello-Paola-St. Lucie association: Nearly level to sloping, moderately well drained sandy soils with weakly cemented sandy not subject to flooding (continued)subsoil and excessively drained soils, sandy throughout.
	36	Immokalee-Myakka-Pompano association: Nearly level, poorly drained, sandy soils with weakly cemented sandy subsoil and poorly drained soils, sandy throughout.
	37	Adamsville-Pompano association: Nearly level, somewhat poorly and poorly drained, soils, sandy throughout.
	38	Scranton, var.-Ona-Placid association: Nearly level, somewhat poorly drained, dark surface soils, sandy throughout; poorly drained soils with thin, sandy layers over weakly cemented sandy subsoil and very poorly drained soils, sandy throughout.
Areas dominated by poorly and very poorly drained soils subject to flooding.	28	Pompano-Charlotte-Delray association: Nearly level, poorly drained soils, sandy throughout, and very poorly drained soils with thick sandy layers over loamy sub-soil.
	31	Placid-Bassinger association: Nearly level, very poorly and poorly drained soils, sandy throughout.
	32	Delray-Manatee-Pompano association: Nearly level, very poorly drained soils with thick, sandy layers over loamy subsoil; very poorly drained sandy soils, with loamy subsoil and poorly drained soils, sandy throughout.

TABLE 2.2. (CONTINUED)

Area Definition	Map Unit No.	Soil Association Description
Areas dominated by poorly and very poorly drained soils subject to flooding (continued)	33	Fresh Water Swamp and Marsh association: Nearly level, very poorly drained soils subject to prolonged flooding.
	34	Tidal Marsh and Swamp-Coastal Beach Ridges/Dune association: Nearly level, very poorly drained soils subject to frequent tidal flooding, high-lying coastal dune-like ridges and deep, droughty sands.
	39	Terra Ceia association: Nearly level, very poorly drained, well-decomposed, organic soils 40-91 cm (16-36 inches) thick over loamy material.

2.3 Land Use and Vegetation

Historically, the primary land use within the Palmer Ranch has been cattle ranching. However, recent changes in land uses on the Palmer Ranch have included the following: construction of a surface water management system; construction of roads, golf courses, homes and wastewater treatment facilities and associated domestic wastewater spray effluent fields; and, land disposal of sludge. During the second monitoring year (April 1985 - March 1986), the land application of sludge wastes on the Palmer Ranch was discontinued and construction of the Central County Utilities Regional Treatment Plant and an adjacent golf course was completed. Subsequently, construction of a residential development was initiated during the third monitoring year.

Land uses adjacent to the ranch that are located upstream in several drainage basins covering portions of the ranch include golf courses, roads and highways, residential developments, a mobile home park, commercial businesses, a dairy farm that was changed to a sod farm (effective August 1, 1987), light industry, and a metal salvage operation.

The primary vegetation associations found on the undeveloped areas of the ranch include pine flatwoods, improved and semi-improved pastures, wet prairies, marshes and sloughs, swamps, and mesic hammocks.

2.4 Drainage

The Palmer Ranch DRI is divided into six primary drainage basins that ultimately discharge into Little Sarasota Bay and Drymond Bay. Two basins, the Catfish Creek/Trunk Ditch

Basin and the South Creek Basin, drain most of the North Tract. Approximately 2,590 acres of the Catfish Creek-Trunk Ditch Basin, that has a total drainage area of 3,700 acres, and approximately 1,770 acres of the South Creek Basin, that has a total drainage area of approximately 12,000 acres, are located on the North Tract. Four minor basins also drain portions of the property. These include Matheny Creek Basin (40 acres), Elligraw Bayou Basin (180 acres), North Creek Basin (460 acres), and Clower Creek Basin (80 acres). A general description of the major streams in these basins is provided in the following sections.

2.4.1 *Catfish Creek*

Catfish Creek within the limits of the Palmer Ranch DRI was a man-made ditch/channel system that flowed southwest to the southern boundary of the property, intersecting Trunk Ditch, a straight man-made canal, at five locations. The upper portion of Catfish Creek receives off-site drainage from commercial and industrial areas near Clark Road. Many of these commercial and industrial areas lack stormwater management systems. The lower portion of the Catfish Creek drainage system receives stormwater runoff from various stormwater management systems located throughout the Palmer Ranch residential development.

Immediately downstream of the Palmer Ranch, the Catfish Creek drainage system receives drainage and at times "overflow" from the wastewater treatment ponds associated with a mobile home park. Farther downstream, drainage from residential areas and runoff from U.S. Highway 41 enter the creek. Beyond U.S. Highway 41, Catfish Creek is affected by tidal changes from Little Sarasota Bay.

2.4.2 *Trunk Ditch*

Trunk Ditch was originally constructed to improve drainage. Initially, it extended from the northern boundary of the Palmer Ranch property to North Creek and resulted in scouring velocities during major storm events. These high velocities resulted in out-of-bank flooding and sediment transport. During early 1986, a segment of Trunk Ditch was reconstructed in association with the Development of Prestancia. This reconstruction resulted in an improved channel and the placement of two water level control weirs. Because of these two weirs, lentic conditions occur during the dry season. Vegetation in Trunk Ditch is dominated by hydrilla, water-weed, cattail, and other aquatic weeds. As mentioned earlier, Catfish Creek intersects Trunk Ditch at five locations.

Runoff entering the upper reaches of Trunk Ditch originates along Clark Road, including the adjacent commercial and industrial areas. Downstream, runoff enters Trunk Ditch from Prestancia's golf course and residential development, the Country Club of Sarasota and associated residential area, as well as pine flatwoods, improved pastures, and wetlands of the Palmer Ranch.

Subsequently, three (3) additional weirs were added in the reconstructed portion of the Trunk Ditch during 1988 to 1991. Also, a drainage-basin divide between Catfish Creek and North Creek was created at that time with the construction of Central Sarasota Parkway.

2.4.3 *North Creek*

North Creek is connected to Trunk Ditch by a dredged tributary located near the southern boundary of the North Tract. The banks of this tributary are vegetated with grasses and trees resulting in a partially overhanging canopy. Most of the drainage into this dredged tributary originates from residential development, roadways, a marsh/slough system, and an off-site metal salvage operation. Downstream of the North Tract, Trunk Ditch enters the main channel of North Creek, which subsequently flows into Little Sarasota Bay. Residential areas, U. S. Highway 41, and pine flatwoods drain into the downstream reach of North Creek.

2.4.4 *South Creek*

South Creek within the Palmer Ranch is largely a shallow ditch system constructed through historic, broad sloughs or interconnecting previously isolated marshes. The banks of South Creek are vegetated with grasses and occasional pines, while its channel is generally void of aquatic vegetation. Upstream of the Palmer Ranch, South Creek receives drainage in its western tributary from a golf course and a mobile home park. At its eastern boundary, it receives drainage from agricultural and recreational land uses, as well as Interstate I-75. Before mid-1987, much of the area upstream of I-75 was used as a dairy farm.

Within the Palmer Ranch, South Creek receives drainage primarily from improved pastures, pine flatwoods and the newly constructed residential developments. Downstream of the Ranch, South Creek flows through Oscar Scherer State Park and subsequently into the tidal waters of Drymond Bay.

2.4.5 *Elligraw Bayou*

Elligraw Bayou is a channelized stream that flows southwesterly to Little Sarasota Bay. The banks of Elligraw Bayou are sloped and vegetated with grasses and trees. On the Ranch, Elligraw Bayou receives drainage from Increment II development areas and Prestancia (Increment I). Downstream of the Palmer Ranch, Elligraw Bayou flows through Ballantrae and several other residential areas before entering Little Sarasota Bay.

2.4.6 *Matheny Creek*

Matheny Creek is a channelized stream that originates in the marshes and sloughs northwest of the Palmer Ranch. It flows southwest and eventually discharges into Little Sarasota Bay. The banks of Matheny Creek are steep and vegetated with grasses and some trees. Drainage enters Matheny Creek from residential developments, commercial and industrial areas, and golf courses.

2.4.7 *Clower Creek*

Clower Creek forms the south border of the 70-acre Sarasota Square Mall. A 1.6 acre wet prairie located east of the mall on the Palmer Ranch most likely represents the headwaters of Clower Creek during the wet season. Drainage conveyed by Clower Creek flows westerly for 1,350 feet, and subsequently, through an underground pipeline along the north and west borders of a trailer park adjacent to the Sarasota Square Mall. After flowing underground for about 650 feet, drainage enters the mall's stormwater management system. Subsequently, discharge from the mall's stormwater management system drains through swales into culverts and underneath U.S. 41 to Little Sarasota Bay.

2.5 Water Quality Classification

The segments of the streams traversing the North Tract of the Palmer Ranch are non-tidal freshwater systems designated by the State as Class III waters pursuant to Subsection 17-302.400(1) of the Florida Administrative Code (FAC). Downstream, these streams flow into an estuarine system (Little Sarasota and Drymond Bays) which are classified as an Outstanding Florida Waters (OFW). In addition, the segment of South Creek that flows through the Oscar Scherer State Recreational Area is classified as an OFW. State and Sarasota County water quality standards applicable to the "Continuing Water Quality Monitoring Program" (*i.e.*, those applicable to Class III, predominantly fresh surface waters) are listed in **Table 2.3**.

TABLE 2.3. APPLICABLE STATE AND COUNTY WATER QUALITY CRITERIA FOR CLASS III, PREDOMINATELY FRESH WATERS

Parameter	Water Quality Standard[a]
Arsenic	Not >50 μg/L
Biochemical Oxygen Demand	Not to be increased in a manner that would depress Dissolved Oxygen levels below criteria.
Fecal Coliform Bacteria	Not >800/100 mL
Total Coliform Bacteria	Not >2,400/100 mL
Specific Conductance	Shall not be increased more than 50% above background or to 1,275 μmhos/cm, whichever is greater, in predominantly fresh waters.
Copper	Not >12.8 μg/L at a Total Hardness of 110 mg/L
Dissolved Oxygen	Not <5 mg/L
Lead	Not >3.6 μg/L at a Total Hardness of 110 mg/L
Nutrients	Concentrations in a body of water shall not be altered in such a manner as to cause an imbalance in natural populations of aquatic flora or fauna.
Ammonia Nitrogen (ionic plus non-ionic)	See Nutrients
Nitrite Nitrogen	See Nutrients
Nitrate Nitrogen	See Nutrients

TABLE 2.3. (CONTINUED)

Parameter	Water Quality Standard[a]
Total Nitrogen	See Nutrients
Organic Nitrogen	See Nutrients
Oil and Greases	Not >5 mg/L
Orthophosphate	See Nutrients
Total Phosphorus	See Nutrients
pH	6.0 - 8.5
Total Suspended Solids	-----
Turbidity	Not >29 NTU above background
Zinc	Not >115 µg/L at a Total Hardness of 110 mg/L

[a]State surface water quality criteria as listed in Chapter 62-302, Florida Administrative Code, and Sarasota County Ordinance No. 96-020.

3.0 FIELD AND LABORATORY PROCEDURES

3.1 Station Locations and General Descriptions

The "Continuing Surface Water Quality Monitoring Program" employs a network of 10 sampling stations located at various sites along South Creek, Catfish Creek, North Creek, and Trunk Ditch (**Figure 3.1**). A general description of the characteristics of the 10 sampling stations is provided in **Table 3.1.**

As stated previously, monitoring in South Creek was reinitiated in January 1994, approximately one month before development activity in the basin. Results of the 1998 water quality monitoring events performed at stations in the South Creek basin are presented in a separate report (CCI, 1999).

In Catfish Creek, inflow into the Palmer Ranch was monitored at Station CC-1 while outflow was monitored at Station CC-5. Station CC-1 receives drainage from Clark Road, McIntosh Road, and various commercial/industrial developments. Two tributaries of Catfish Creek were also monitored near their confluences with Trunk Ditch (Stations CC-2 and CC-3). These two stations represent stream segments that receive drainage from Prestancia and backwater effects of Trunk Ditch.

Trunk Ditch was monitored within its realigned segment within the Catfish Creek-Trunk Ditch Drainage Basin at Station CC-4. This site lays adjacent to and receives drainage from both the Country Club of Sarasota and Prestancia and sources farther upstream, as well as

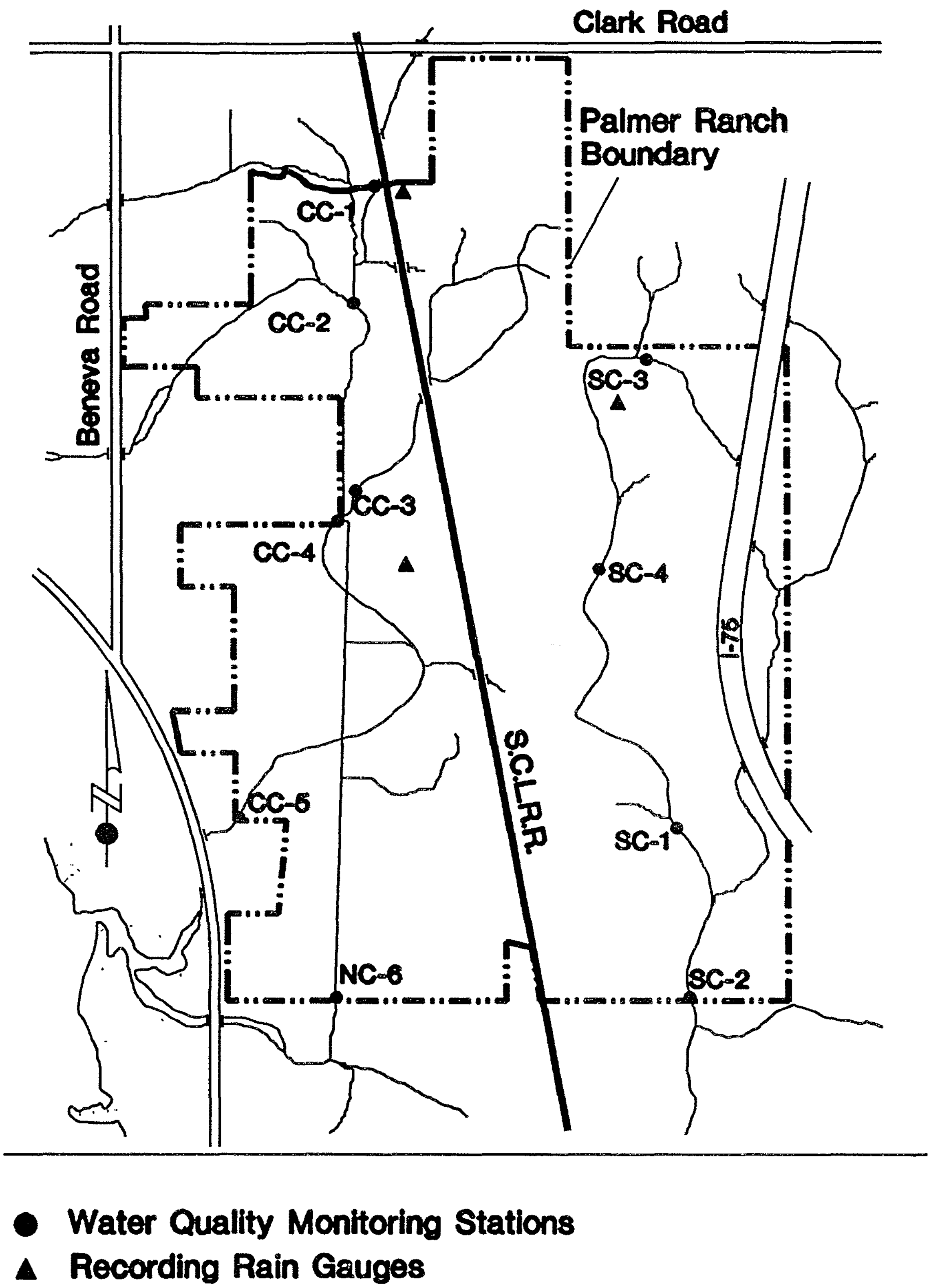


Figure 3.1. Location of Surface Water Monitoring Stations.

TABLE 3.1. GENERAL DESCRIPTIVE CHARACTERISTICS OF SURFACE WATER QUALITY SAMPLING STATIONS

Station	General Location	Water Depth[a] (ft)	Channel Width (ft)	Habitat
CC-1	Catfish Creek Site Entry	1.0-1.6	10	75-100% Canopy of *Salix*, Rooted Emergents, Incised Banks.
CC-2	Catfish Creek Upstream of Trunk Ditch	0.0-0.45	12	Aquatic Vegetation, Shallow Sloped Banks.
CC-3	Catfish Creek Upstream of Trunk Ditch	0.3-0.6	6	Aquatic Vegetation, Incised Banks.
CC-4[b]	Trunk Ditch Downstream of Catfish Creek Confluence	0.6-2.2	50	Sodded Banks, Rooted Emergents.
CC-5	Catfish Creek Outfall from Site	0.3-0.8	50	Shading in by Oaks, Willows, and Wax Myrtle, Sodded Banks.
NC-6	Trunk Ditch Downstream of Catfish Creek	1.7-2.7	12	Aquatic Vegetation.
SC-1	South Creek Mid-property	0.6-0.7	12	Sand covered with Organic Matter.
SC-2	South Creek at Site Exit	0.5-1.2	17	Rooted Emergents, Floating Aquatics, Palm Trees Shade Channel in A.M.
SC-3	South Creek Outfall from Large Wetland	0.0-0.7	10	Shallow banks, Aquatic Vegetation.
SC-4	South Creek near Honore Avenue	0.7-1.2	8	Rooted Emergents Cover 33% of Channel, Canopy of Pine.

[a]Range in Depth recorded during monitoring period of April, 1987 - March, 1988.
[b]Depths reported are depths at sampling location - total depth at site averages 8.0 feet.

pine flatwoods, improved pastures, and wetlands of the Palmer Ranch. Farther to the South, Trunk Ditch was monitored at a location within the North Creek Basin, *i.e.*, Station NC-6.

3.2 Parameters and Sampling Frequency

Semi-annual sampling was performed during March and September 1998. The analysis of the annual parameters was performed for samples collected during the September 1998 monitoring event. The dates and times of all sample collections are provided in **Table 3.2**.

Surface water quality monitoring from January through December 1998 was performed by: (1) the use of field instrumentation and *in situ* measurements; and (2) the collection of grab samples for subsequent laboratory analyses. A digital readout Hydrolab or YSI/Endeco multi-parameter water quality meter was used for *in situ* measurements of dissolved oxygen, pH, specific conductance, and water temperature. Prior to deployment in the field, all instrumentation was calibrated according to the manufacturer's recommended procedures. All *in situ* measurements were taken at approximate midstream and mid-depth at each station. Grab samples were collected at each station during the two semi-annual events, preserved, and analyzed in the laboratory within the recommended hold times for the following parameters:

- Ammonia Nitrogen
- Nitrate Nitrogen
- Nitrite Nitrogen
- Oil and Grease
- Total Suspended Solids
- Turbidity

TABLE 3.2 DATE AND TIME OF SAMPLING FOR THE THIRTEENTH ANNUAL MONITORING PERIOD OF JANUARY THROUGH DECEMBER, 1998

Event No.	Date of Sampling	Monitoring Stations					
		CC-1	CC-2	CC-3	CC-4	CC-5	NC-6
1	March 9, 1998	10:20	10:40	11:00	11:15	11:30	11:50
2	September 2, 1998	10:40	DRY	11:20	11:30	12:05	12:20

- Organic Nitrogen[1]
- Total Nitrogen
- Orthophosphate
- Total Phosphorus
- Biochemical Oxygen Demand
- Fecal Coliform Bacteria
- Total Coliform Bacteria

Additional surface water grab samples were collected at each of the six monitoring stations during the September 1998 monitoring event for the laboratory analysis of the following parameters:

- Arsenic
- Lead
- Copper
- Zinc

All sampling was performed in accordance with CCI's Comprehensive Quality Assurance Plan (CompQAP No. 87201G) on file with the Florida Department of Environmental Protection. Laboratory analyses were performed in accordance with the procedures described in the 18th edition of *Standard Methods for the Examination of Water and Wastewater* (APHA, 1992), *Methods for Chemical Analysis of Water and Wastes* (USEPA, 1983) or other FDEP/USEPA approved methodology. The methods used in the collection, preservation, handling, storage, and analysis of all surface water samples are provided by parameter in **Table 3.3**.

Laboratory analyses were performed by CCI's or P. E. Lamoreaux's laboratory that are certified by Florida Department of Health and Rehabilitative Services for the analyses of

[1]Organic Nitrogen = Total Kjeldahl Nitrogen - Ammoniacal Nitrogen.

TABLE 3.3. COLLECTION AND ANALYTICAL METHODS USED DURING THE CONTINUING SURFACE WATER QUALITY MONITORING PROGRAM

Parameter	Sample Type	Field Handling	Hold Time	Laboratory Handling	Analytical Method	Method Reference
Total Arsenic	Grab	HNO_3 to pH <2, Stored on Ice	6 Months	Stored at Room Temperature	Digestion, Atomic Absorption - Furnace Technique	EPA 206.2
Fecal Coliform Bacteria	Grab	Stored on Ice	30 Hours	Immediate Analysis	Multiple Tube Fermentation	APHA 9221 C
Total Coliform Bacteria	Grab	Stored on Ice	30 Hours	Immediate Analysis	Multiple Tube Fermentation	APHA 9221 A
Biochemical Oxygen Demand (BOD-5 Day)	Grab	Stored on Ice	48 Hours	Immediate Analysis	Membrane Electrode	APHA 5210 B
Conductivity	*In situ*	----	----	----	Hydrolab - Wheatstone Bridge	APHA 2510 B
Total Copper	Grab	HNO_3 to pH <2, Stored on Ice	6 Months	Stored at Room Temperature	Digestion, Atomic Absorption	EPA 220.1
Total Lead	Grab	HNO_3 to pH <2, Stored on Ice	6 Months	Stored at Room Temperature	Digestion, Atomic Absorption	EPA 239.1
Ammonia Nitrogen	Grab	H_2SO_4 to pH <2, Stored on Ice	28 Days	Stored at 4 °C	Automated Phenate	EPA 350.1
Nitrate + Nitrite Nitrogen	Grab	H_2SO_4 to pH <2,	28 Days	Stored at 4 °C Stored on Ice	Automated Cadmium Reduction	EPA 353.2
Nitrite Nitrogen	Grab	Stored on Ice	48 Hours	Stored at 4 °C	Automated Autoanalyzer	EPA 353.2
Nitrate Nitrogen	Grab	----	----	----	Calculation	EPA 353.2
Total Kjeldahl Nitrogen	Grab	H_2SO_4 to pH <2, Stored on Ice	28 Days	Stored at 4 °C	Automated Block Digestion, Autoanalyzer	EPA 351.2
Total Nitrogen	Grab	----	----	----	Calculation	EPA 351.2
Oil and Grease	Grab	H_2SO_4 to pH <2,	28 Days	Stored at 4 °C Stored on Ice	Gravimetric	EPA 413.1
Dissolved Oxygen	*In situ*	----	----	----	Hydrolab - Membrane Electrode	APHA 4500 G

TABLE 3.3. (CONTINUED)

Parameter	Sample Type	Field Handling	Hold Time	Laboratory Handling	Analytical Method	Method Reference
pH	*In situ*	----	----	----	Hydrolab - Electrometric	APHA 4500-H^+
Orthophosphate	Grab	Stored on Ice	48 Hours	Immediate Analysis	Automated, Ascorbic Acid	EPA 365.1
Total Phosphorus	Grab	H_2SO_4 to pH <2, Stored on Ice	28 Days	Stored at 4 °C	Automated Block Digestion, Autoanalyzer	EPA 365.4
Total Suspended Solids (TSS)	Grab	Stored on Ice	7 Days	Stored at 4 °C	Glass Fiber Filtration, Dried at 105 °C	APHA 2540 C
Temperature	*In situ*	----	----	----	Hydrolab - Thermistor	APHA 2550 B
Turbidity (NTU)	Grab	Stored on Ice	48 Hours	Stored at 4 °C	Nephelometric	APHA 2130 B
Total Zinc	Grab	HNO_3 to pH <2, Stored on Ice	6 Months	Stored at Room Temperature	Digestion, Atomic Absorption	EPA 289.1
Flow/Direction	*In situ*	----	----	----	Marsh-McBirney Flow Meter - Electromagnetic Sensor	Manufacturer's Specifications

APHA - American Public Health Association, American Water Works Association and Water Pollution Control Federation, 1992. *Standard Methods for the Examination of Water and Wastewater*, 18th Edition. American Public Health Association.

EPA - U.S. Environmental Protection Agency, 1983. *Methods for Chemical Analysis of Water and Wastes*, EPA - 600/4-79-020, National Environmental Research Center, Cincinnati, Ohio.

environmental and drinking water samples. Copies of the data tables for the 1998 monitoring events are provided in **Appendix C**.

Two additional parameters, stream flow and stream depth, were monitored at each sampling point concurrently with water quality monitoring as an aid in evaluating the water quality data although not formally part of the "Continuing Surface Water Quality Monitoring Program." Water velocity was determined using a Marsh-McBirney model 201D flow meter. Stream flows were subsequently determined in accordance with the USGS two-point (*i.e.*, area/velocity) method (USGS, 1982). Stream depth was measured with a weighted fiberglass tape at each point of water quality sampling.

4.0 RESULTS AND DISCUSSION

During the fourteenth year of the "Continuing Surface Water Quality Monitoring Program" (*i.e.*, January through December 1998) semi-annual surface water quality monitoring was conducted by CCI. Sampling was conducted on March 9 and September 2, 1998, in compliance with the conditions of the Amended and Restated Master Development Order for the Palmer Ranch Development of Regional Impact (**Appendix A**).

Individual results for the two semi-annual events performed during the 1998 monitoring year for the "Continuing Surface Water Quality Monitoring Program" are tabulated by parameter in **Appendix B**. For each parameter, statistics (*i.e.*, mean, range, standard deviation, and number of observations) are calculated across sampling events and sampling locations. Also, applicable water quality criteria are footnoted below each table.

Copies of the laboratory reports of data tables for the samples collected during the 1998 monitoring year are provided in **Appendix C**. Comparison of the data with previous results and general conclusions are included with the discussion for each parameter or group of related parameters.

4.1 Rainfall and Hydrology

4.1.1 *Rainfall*

The annual rainfall amount recorded on the Palmer Ranch during the fourteenth year of the "Continuing Surface Water Quality Monitoring Program" is below the historical average annual rainfall of approximately 54.8 inches based on a 30-year period of record (NOAA, 1982), but is about the same as the 22-year period of record average of 47.19 for Oscar Scherer State Park. Approximately 47.69 inches of precipitation were recorded during 1998 (**Table 4.1**) in comparison to 38 to 65 inches recorded during previous monitoring years (CCI, 1988a, 1988b, 1991, 1992a, 1993, 1994, 1995, 1996, 1997 and 1998). **Figure 4.1** provides a comparison of the monthly distribution of rainfall measured in the South Creek Basin of the Palmer Ranch during the 1998 monitoring year with the monthly distribution of historical rainfall for the 30-year period of record (NOAA, 1982).

Rainfall recorded during the 1998 monitoring year exhibited a somewhat abnormal seasonal trend for this region of Florida. Despite the slightly below normal annual rainfall total, the cumulative amount of precipitation for the primary wet season (i.e., June - September) was only 17.00 inches. Recorded rainfall amounts of nine inches during both February and March 1998 elevated the annual rainfall total to near historic levels (**Figure 4.1**). During the 1998 monitoring year, below-normal rainfall was observed during eight months of the year (*i.e.*, April, May, June, July, August, September, October and December), whereas above-normal rainfall occurred during January, February, March and November (**Figure 4.1**). The highest monthly rainfall totals during 1998 were observed in February and March when 9.12 and 9.93 inches of precipitation were recorded, respectively. Historically, only 2.8 and 3.6 inches of rainfall occur during February and March, respectively.

As provided in **Table 4.1**, the seasonal amounts of rainfall recorded on-site during the winter and spring quarters totaled 21.86 and 2.05 inches, respectively. Rainfall amounts recorded during the summer and fall quarters were 16.53 and 7.25 inches, respectively. In the four-

TABLE 4.1. RAINFALL RECORDED ON THE PALMER RANCH DURING THE PERIOD OF JANUARY THROUGH DECEMBER 1998

Date	Monthly Rainfall (inches)	Seasonal Rainfall (inches)	Pre-Event Rainfall (inches)		
			2 Day	2 Week	2 Month
January 1998	2.81				
February 1998	9.12				
March 1998	9.93		0.99	1.51	12.32
Winter		**21.86**			
April 1998	0.42				
May 1998	1.13				
June 1998	0.47				
Spring		**2.05**			
July 1998	6.36				
August 1998	6.68				
September 1998	3.49		0.08	2.16	12.52
Summer (Wet Season)		**16.53**			
October 1998	2.93				
November 1998	3.69				
December 1998	0.63				
Fall (Dry Season)		**7.25**			
Yearly Total		**47.69**			

[a]Seasonal Rainfall (inches):

Primary Wet Season (June - September):	17.00
Primary Dry Season (October - January):	10.06
Secondary Wet Season (February - March):	19.05
Secondary Dry Season (April - May):	1.58

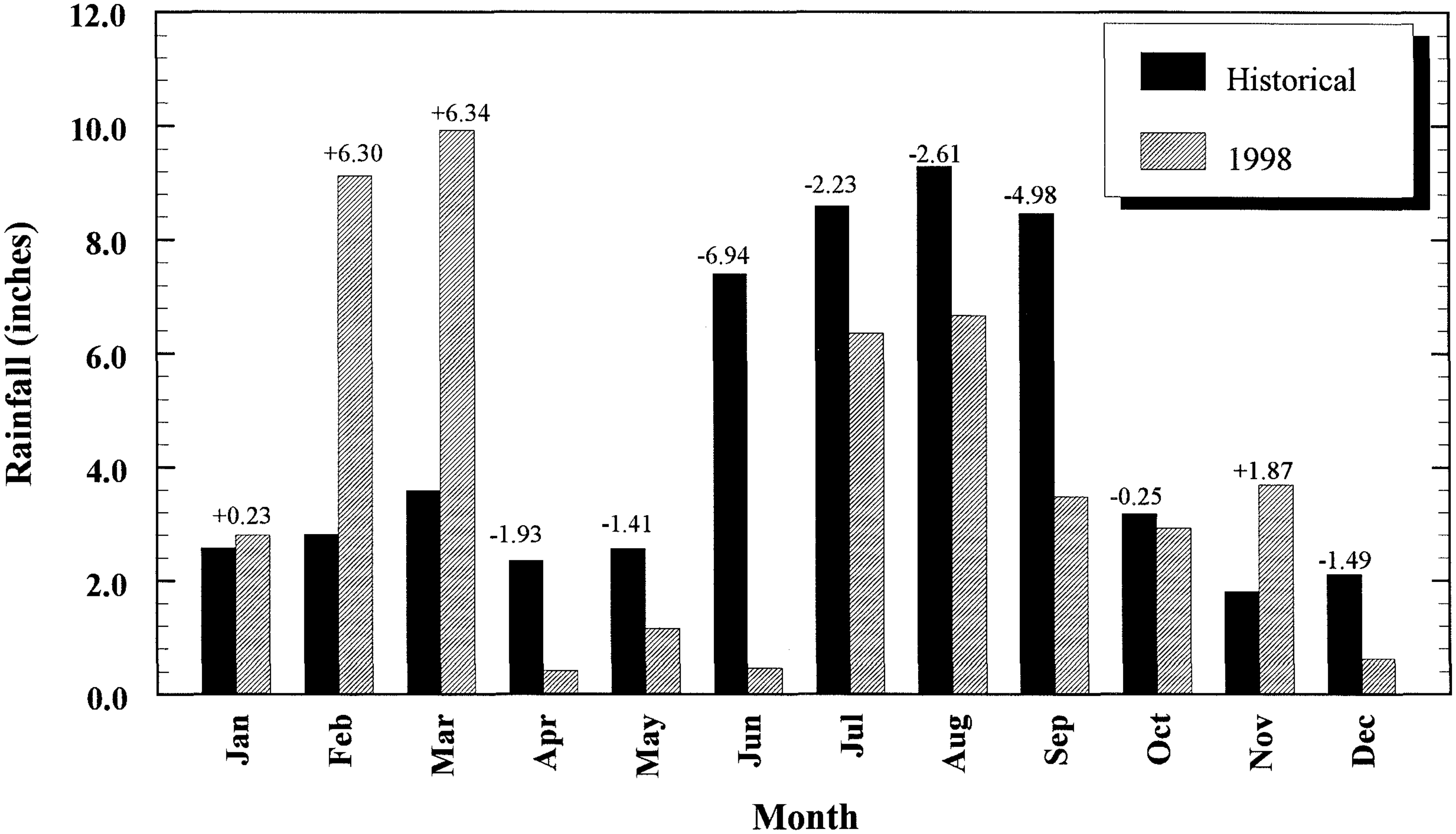


Figure 4.1 Historic Rainfall for Sarasota County Versus Actual Rainfall Recorded on the Palmer Ranch During January Through December 1998. (Numbers above bars indicate difference between 1998 and historical monthly rainfall amounts).

month period from June through September, when the primary wet season normally occurs, 17.00 inches (or 36 percent of the total annual rainfall) was recorded on the Palmer Ranch. The total rainfall recorded during the primary wet season for 1998 was one of the lowest observed on the Palmer Ranch property during the fourteen-year monitoring period. As described previously, the 19.05 inches of rainfall that occurred during the 1998 secondary dry season (*i.e.*, February and March) was abnormally high and represented 40 percent of the annual total.

Antecedent rainfall accumulations during 2-day, 2-week and 2-month periods before each quarterly monitoring event are also presented in **Table 4.1**. As evident in this table, 0.99 and 0.08 inches of rain were recorded during the 2-day antecedent period prior to the March and September monitoring events, respectively. Slightly more rainfall was recorded during the 2-week antecedent period for the September sampling event than for the March event. Both 1998 sampling events exhibited similar rainfall amounts during the 2-month antecedent period (12.32 and 12.52 inches for March and September, respectively).

4.1.2 *Stream Stage*

Water depths measured at each station during the semi-annual sampling events performed during 1998 are tabulated in **Appendix Table B-1**. Stream stages determined during 1998 averaged 0.7 feet and ranged from 0.0 to 2.6 feet. Overall, stream stages measured during 1998 are comparable to those measured during 1996 and 1997, but are lower than those measured during the 1995 monitoring year. During 1997, stream stages for the Catfish Creek and North Creek monitoring stations averaged 0.8 feet with a range of 0.0 to 2.8 feet (CCI,

1998) compared with an average of 1.2 feet recorded during the 1995 monitoring year (CCI, 1996). The higher stream stages reported during the 1995 monitoring year are not unexpected considering that greater rainfall amount recorded compared with that determined during 1996, 1997 and 1998.

The deepest waters of the streams traversing the North Tract of the Palmer Ranch are located in Trunk Ditch. Here, depths of approximately 8 feet can be found near the center of its reconstructed segment that runs adjacent to the Country Club of Sarasota and Prestancia. Although Station CC-4 is located on the reconstructed segment of Trunk Ditch, it exhibited an average depth of 0.8 feet because the depth measurements are taken in the littoral zone of the ditch. Therefore, stream stages measured at Station CC-4 were comparable to other stations. Station CC-1, which is located in Trunk Ditch, had the highest average stream stage during the 1998 monitoring year at 1.5 feet.

Seasonally, stream levels in the Catfish Creek\North Creek basin were the highest during the September 1998 monitoring event as compared to the March event. The higher water levels measured in September are usually associated with the greater amount of rainfall which typically occurs during the summer wet season. However, this year's results are somewhat surprising considering the high levels of rainfall received prior to the March event. The greater depths may be attributable to sampling at slightly different locations because stream flows, as discussed in the next section, were higher in March. As during the 1996 and 1997 monitoring years, stream stages for Stations CC-2, CC-3, CC-4 and CC-5 during 1998 were all less than 1.0 feet during both semi-annual monitoring events with Station CC-2 exhibiting dry conditions (*i.e.*, stream stage of 0.0 feet) during the September 1998 sampling event (**Appendix Table B-1**).

4.1.3 *Stream Flow*

As evident in **Appendix Table B-2**, stream flows measured during the 1998 monitoring year for all six monitoring stations in Catfish and North Creeks ranged from 0.0 to 7082.1 gallons per minute (GPM) and averaged 1439.9 GPM. During the fourteenth year of monitoring, stream flows in the Catfish Creek/Trunk Ditch Basin ranged from 0.0 to 2840.9 GPM in its upper reaches (CC-1 and CC-2) and from 0.0 to 2499.8 GPM in its mid-reach (CC-3 and CC-4). Stream flows recorded for the six monitoring stations during the 1998 monitoring year are illustrated in **Figure 4.2**

Seasonally, the highest steam flows during 1998 occurred during the March monitoring event with stream flows in Catfish Creek averaging 2744.9 GPM. High stream flows measured in March coincide with the high 2-month antecedent rainfall amount which followed above average rainfall for the four preceding months as well (**Table 4.1**). The higher rainfall amounts reported for this period resulted in an elevated groundwater table and a higher percentage of runoff, both of which increased stream flow.

Spatially, low flow conditions were observed in the Catfish Creek/Trunk Ditch Basin at Station CC-1, CC-2 and CC-3. During 1998, stream flow at Station CC-2 averaged 110.0 GPM with a range from 0.0 to 219.9 GPM. Station CC-2 also exhibited the lowest flow

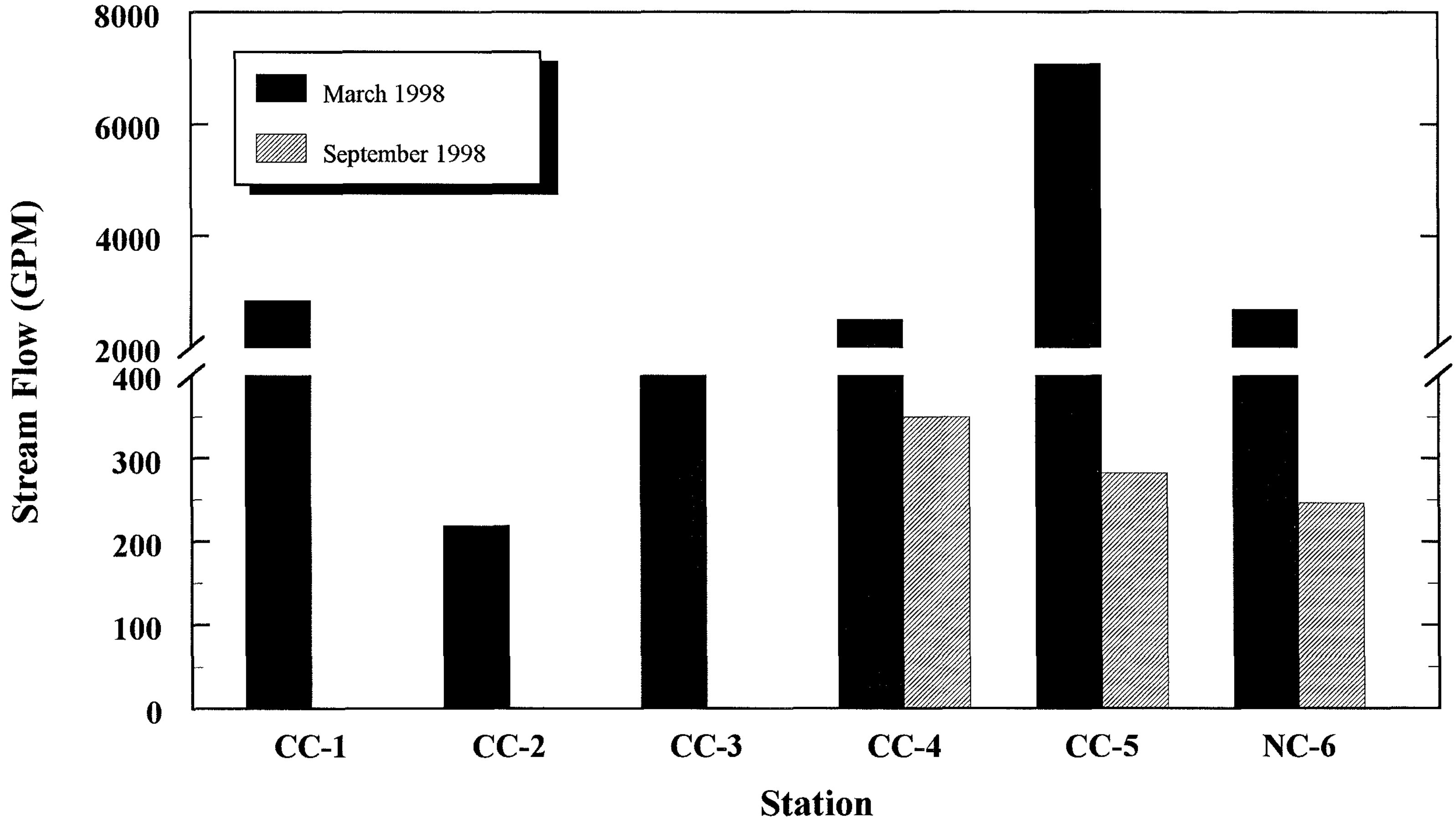


Figure 4.2 Stream Flows Measured During Semi-annual Monitoring Events Conducted on the Palmer Ranch from January through December 1998.

conditions during the previous monitoring years. The highest stream flows were determined for Station CC-5 with an average of 3682.4 GPM and range from 282.7 to 7082.1 GPM.

During the 1998 monitoring year, positive stream flows (*i.e.*, measurable flows) were recorded for 9 of the 12 measurements (*i.e.*, 75 percent) taken. The percentage of positive flows measured during 1998 is similar to those reported for previous monitoring years (CCI, 1986, 1988a, 1988b, 1990, 1991, 1992a, 1993, 1994, and 1997). A higher incident of positive flows (*i.e.*, 100 percent) was observed during the 1995 monitoring year and is directly attributed to the wetter conditions reported with the annual rainfall being 11 inches higher than the 30-year average. The relatively high percentage of positive flows in these two basins can be attributed to improved basin geometry and hydraulic residence time in the watershed resulting in a more efficient drainage system.

4.2 Physical Water Quality Parameters

4.2.1 *Water Temperature*

Appendix Table B-3 presents the surface water temperature measurements acquired during the 1998 monitoring year. Results indicate that the water temperature of the streams of the North Tract of the Palmer Ranch averaged 25.4°C and ranged from 21.1 to 30.9°C during the two monitoring events. This range is similar to those recorded during previous years of monitoring (Palmer Venture, 1986; and CCI, 1986, 1988a, 1988b, 1991, 1992a, 1993, 1994, 1995, 1996, 1997 and 1998).

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As expected, the lowest water temperatures were recorded in the streams of the North Tract during the March 1998 event with the highest water temperatures recorded during the September monitoring event. Water temperatures averaged 28.5 °C during the September 1998 event, while an average temperature of 22.9 °C was observed during the March event. Average temperatures for Catfish Creek and North Creek for each event are very similar with differences among stations generally being 4 °C or less.

An evaluation of diurnal variations in water temperature in the Catfish Creek and South Creek Basins was performed during the 1985 dry season and the 1986 wet season (CCI, 1987). Results of the diurnal evaluation showed increases in water temperature to maximum levels by mid-afternoon followed by declines during the evening to minimal levels by early morning. The results of the diurnal study are provided in the report prepared by CCI (CCI, 1987).

4.2.2 *Specific Conductance*

As evidenced in **Appendix Table B-4**, Catfish Creek and North Creek exhibited an average specific conductance of 663 µmhos/cm with a range from 366 to 1,157 micromhos per centimeter (µmhos/cm) during 1998. Specific conductance levels measured at the six monitoring stations during the 1998 monitoring year are illustrated in **Figure 4.3**. In previous studies, Catfish Creek and North Creek exhibited specific conductance ranges of 421 to 1,625 µmhos/cm (CCI, 1991, 1992a, 1993, 1994, 1995, 1996, 1997 and 1998). A higher range of conductivity levels (567 to 1,625 µmhos/cm) was reported for the sixth monitoring year and probably resulted from the relatively low amount of rainfall that

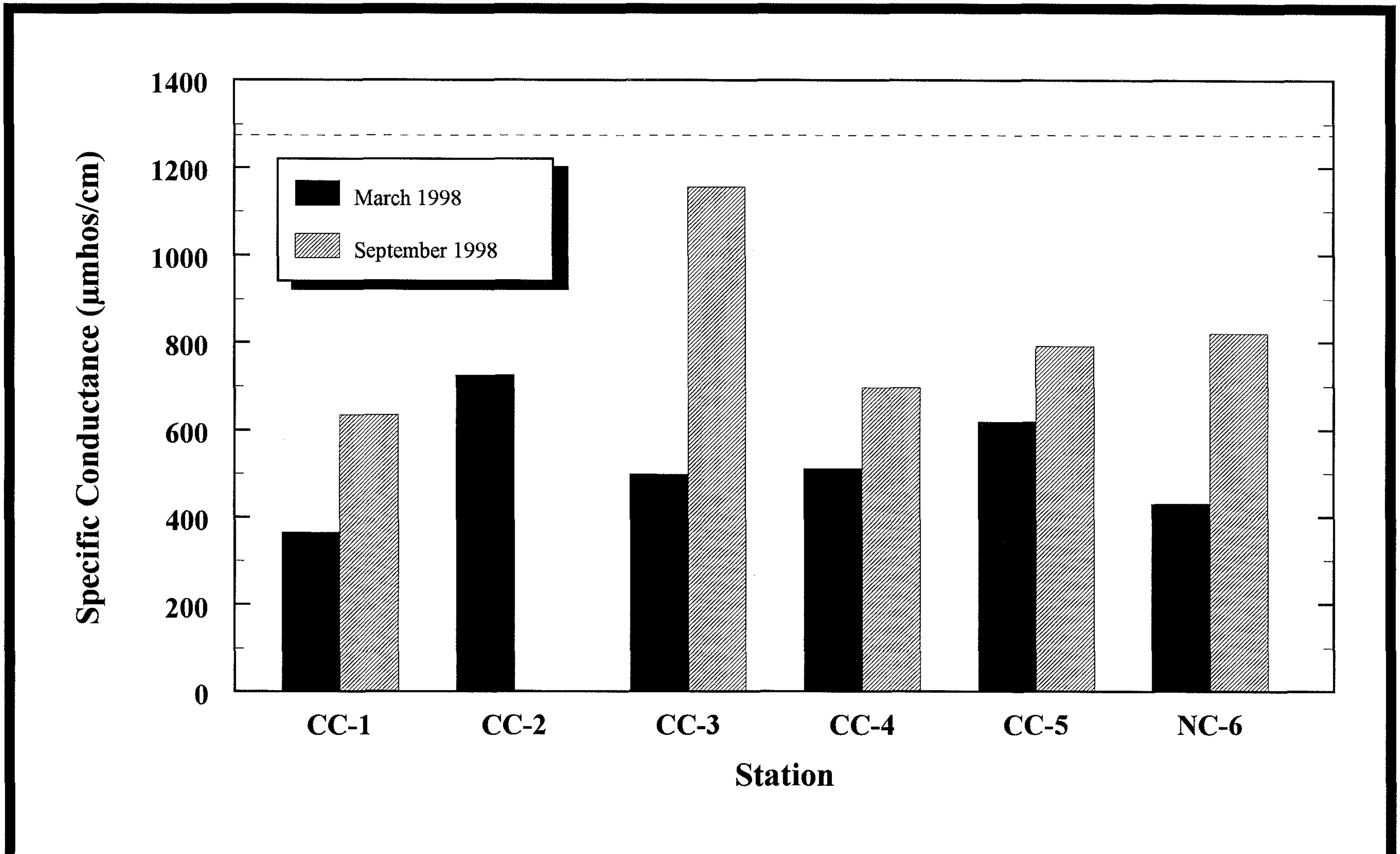


Figure 4.3 **Specific Conductance Levels Measured During Quarterly Monitoring Events Conducted on the Palmer Ranch from January through December 1998. Dashed Line Depicts State Standard**

occurred during 1990. As discussed in the previous annual reports (CCI 1988a, 1988b, and 1991), during times of drought, such as occurred during the second and sixth monitoring years, the lack of precipitation resulted in minimal runoff of low conductivity storm water thereby allowing the conductivity in the streams of the ranch to increase due to evaporation. In addition, a larger portion of the streams' surface waters probably originated from groundwater exfiltration. Since groundwater normally has a higher conductivity than rainwater and surface runoff, an increase in the conductivity of the streams would be expected.

Seasonally, the lowest average conductivity of 532 µmhos/cm was recorded for the March 1998 event with a higher average conductivity of 821 µmhos/cm determined for the September sampling event. The lower conductivities levels measured in March most likely resulted from the cumulative effects of greater rainfall and subsequent increases in surface runoff of low conductivity storm water during the *El Nino* weather pattern (refer to **Table 4.1**).

In a comparison of both streams monitored during 1998 within the Palmer Ranch, the overall annual mean conductivities for North Creek and Catfish Creek Basins were 627 and 671 µmhos/cm, respectively. Spatially, the lowest conductivity levels in the Catfish Creek/Trunk Ditch Basin were determined in the upper reaches of the basin with higher conductivities in the mid- and lower portions of the basin. Specific conductivities in the upper reaches of Catfish Creek averaged 588 µmhos/cm compared with an average of 717 µmhos/cm observed for the mid-reach.

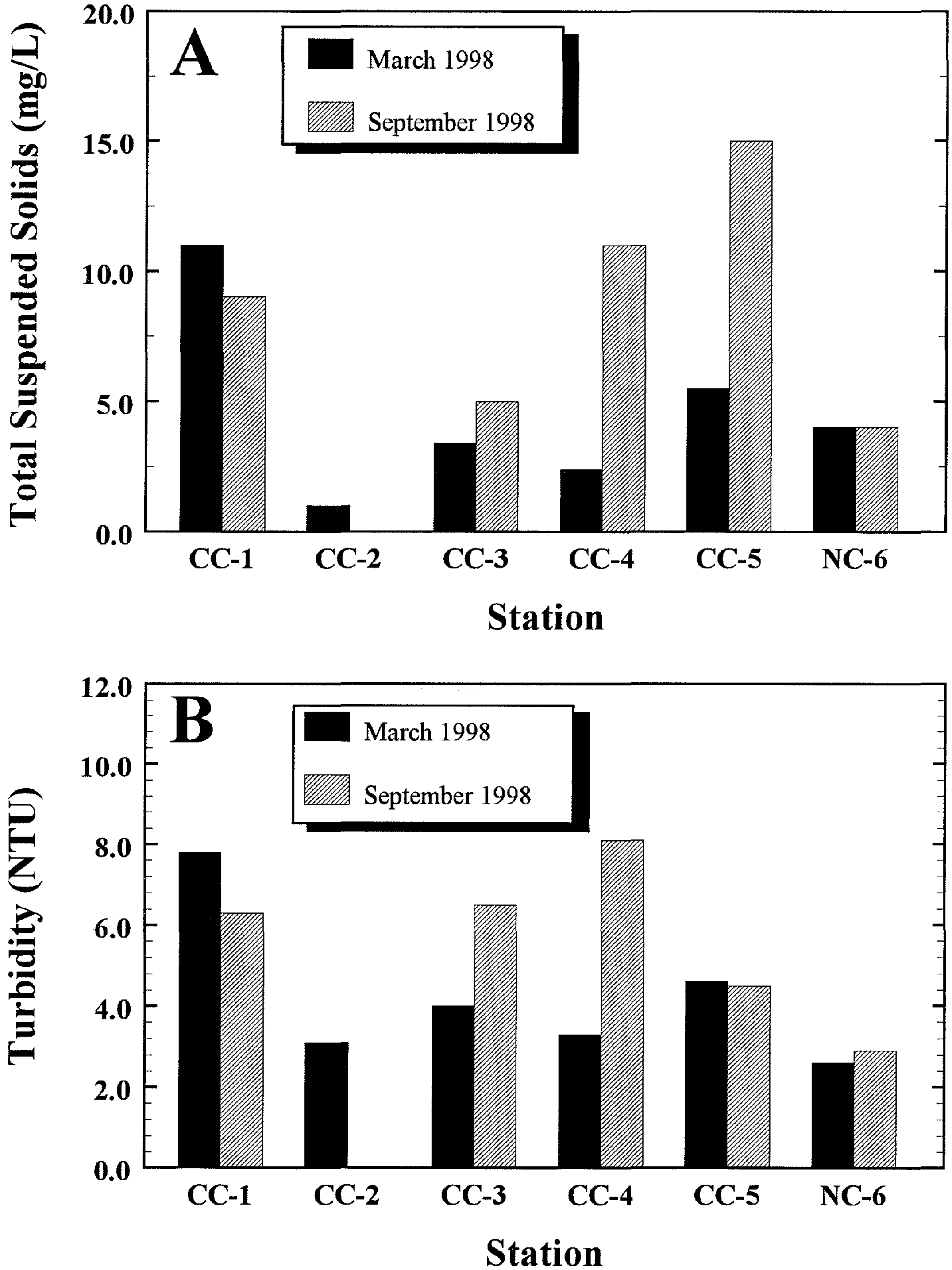


Figure 4.4 Total Suspended Solids (A) and Turbidity (B) Levels Measured During Quarterly Monitoring Events Conducted on the Palmer Ranch from January through December 1998

The State and County specific conductance criterion applicable to the streams of the Palmer Ranch allows an increase of not more than 50 percent above background levels or to a level of 1,275 µmhos/cm whichever is greater. All of the 11 conductivity measurements made during the 1998 monitoring year were below the 1,275 µmhos/cm threshold (**Figure 4.3**). Therefore, no violations of the State criteria for specific conductivity occurred during 1998.

4.2.3 *Total Suspended Solids*

During the fourteenth year of monitoring, Catfish Creek and North Creek in the Palmer Ranch exhibited a range of total suspended solids (TSS) from 1.0 to 15.0 mg/L with an annual average of approximately 6.5 mg/L (**Appendix Table B-5**). **Figure 4.4A** illustrates the distribution of TSS levels during the 1998 monitoring year for Catfish Creek and North Creek. Total suspended solid levels observed during 1998 were slightly higher than those determined in 1996 and 1997 (CCI, 1997 and 1998) and generally comparable to those recorded during previous monitoring years (Palmer Venture, 1986; CCI, 1986, 1987, 1988a, 1988b, 1991, 1992a, 1993, 1994, 1995, and 1996).

The highest TSS levels during 1998 were recorded in the lower-reach of Catfish Creek (*i.e.*, CC-5). The lowest TSS levels were recorded in the upper-reach of Catfish Creek (*i.e.*, CC-2). Interestingly, the highest average TSS level (*i.e.*, 8.8 mg/L) was recorded at the end of the typically wet season (*i.e.*, September). The higher TSS values reported for the September sampling event are probably due to higher rainfall recorded at the end of the summer wet season, after a period of lower rainfall, and the subsequent increase in surface water runoff which carries particulate matter to the creek. The low concentrations of TSS recorded during 1998 monitoring year may be attributed to well-established littoral zones around the Catfish Creek basin, as well as the storm water management system in Prestancia.

An average TSS concentration of 9.4 mg/L was reported for the 1995 monitoring year (CCI, 1996). During that same year, TSS levels ranged from 0.8 to 30.7 mg/L. This wide range in TSS concentrations was attributed to above normal rainfall amounts recorded for the 1995 monitoring year. In 1994, TSS levels in the Catfish Creek and North Creek basins ranged from 2 to 32 mg/L and averaged 8 mg/L (CCI, 1995b). During the 1993 monitoring year TSS levels reported for the six monitoring stations ranged from <1 to 14 mg/L and averaged 7 mg/L (CCI, 1994). Total suspended solids exhibited higher levels in the Catfish Creek and North Creek basins of the Palmer Ranch for the 1992 monitoring year with concentrations ranging from <1 to 31 mg/L and averaging 5 mg/L (CCI, 1993). A similar trend was observed during the 1991 monitoring year with TSS levels ranging from <1 to 87 mg/L with an annual average of 9 mg/L for the six monitoring stations in the Catfish Creek and North Creek basins (CCI, 1992a).

Lower TSS levels with a range from <1 to 13 mg/L were reported for these two Creeks during the 1990 monitoring year than for previous years (CCI, 1991). Total suspended solid levels reported for the third and fourth monitoring years ranged from 3 to 57 and from <1 to 46 mg/L, respectively, with a yearly average of approximately 13 mg/L during each of the two monitoring years (CCI, 1988a and 1988b). During the second year of monitoring, these two streams of the Palmer Ranch exhibited a much wider range in TSS (*i.e.*, 1 to 103 mg/L) and a higher yearly average (*i.e.*, 25 mg/L) (CCI, 1986). Moreover, high TSS levels were recorded near the Prestancia construction site in Catfish Creek (CC-3), and Trunk Ditch (CC-4). These elevated TSS levels observed near Prestancia were attributed to construction activities including the excavation of Trunk Ditch.

During the first year of monitoring, TSS was reported to be much lower than observed during the past four years of the monitoring program, perhaps because of low mass transport rates associated with drought conditions or differences in sampling and analytical procedures (Palmer Venture, 1986). Overall, the surface waters of the ranch showed a TSS range of approximately 1 to 12 mg/L during the first year of monitoring, similar to levels measured during the 1993 monitoring events.

4.2.4 *Turbidity*

During the 1998 monitoring year, turbidity levels measured in Catfish Creek and North Creek ranged from 2.6 to 8.1 NTU and averaged 4.9 NTU (**Appendix Table B-6**). Similar turbidity levels were observed during 1997 (CCI, 1998). In comparison, a turbidity range of 0.8 to 36 NTU was exhibited during the previous nine years of monitoring, with positive correlations with TSS during all years (CCI, 1988a, 1988b, 1991, 1992a, 1993, 1994, 1995b, 1996, and 1997).

During the second year of the monitoring program, CCI (1986) reported high turbidities of 1.5 to 61 NTU in Catfish Creek and North Creek. More comparable turbidity levels were recorded during the first year of monitoring when less than 6 NTU were measured for all the monitoring sites in Catfish Creek (Palmer Venture, 1986). Differences between the first and second year have been attributed to a combination of the droughty conditions in the first year resulting in lower pollutant loadings, and the initiation of construction including the reconstruction of Trunk Ditch during the second year of monitoring.

Turbidity and TSS levels measured during the 1998 monitoring year were significantly correlated as has been reported for all of the previous monitoring years, except 1997. The lack of correlation between TSS and turbidity during 1997 may be explained by the low levels of both TSS and turbidity determined during the 1997 monitoring year. Additionally, the high amount of organic matter and colloidal material present in the surface water may also be responsible for the lack of correlation. High organic content in surface waters will exhibit an increased turbidity reading though the amount of filterable TSS is low. The large amount of vegetation around both Catfish and North Creeks contributes to the organic matter content of both creeks. In addition, the presence of colloids in a water sample will result in a higher turbidity level. In slow moving creeks, such as those on the Palmer Ranch property, a greater mass of colloidal species is present. Because colloids readily pass through a filter with a pore size of 0.45 μm (such as those filters used for TSS measurements), a strong correlation between TSS and turbidity is difficult to attain.

Turbidity exhibited a seasonal trend similar to, but not as pronounced as, that observed for TSS in Catfish Creek and North Creeks. The highest mean turbidity level (*i.e.*, 5.7 NTU) occurred September 1998 while the lowest mean level (*i.e.*, 4.2 NTU) was determined for the March event (**Appendix Table B-6**). This seasonal variation typically results from differences in rainfall amounts and the subsequent changes in storm water inputs to the surface waters. The overall distribution of stream turbidity levels measured during the 1998 monitoring year in Catfish Creek and North Creek is shown in **Figure 4.4B**.

The General Water Quality Criteria for all surface waters (FAC Chapter 62-302) specifies that turbidity shall not exceed 29 NTU above natural background. Based on turbidity measurements taken during previous years of monitoring, natural background turbidity levels are expected to be less than 25 NTU (mean plus one standard deviation), although higher background turbidities might occur because of natural processes, *e.g.*, organic decay and import of particulate matter via stormwater runoff. Therefore, all turbidity measurements performed during the 1998 monitoring year were in compliance with the applicable state water quality criteria.

4.3 Oxygen Demand and Related Parameters

4.3.1 *Biochemical Oxygen Demand*

Biochemical oxygen demand can be defining as: *the amount of oxygen required by bacteria while stabilizing organic matter under aerobic conditions* (Sawyer and McCarthy, 1978). The decomposable organic matter present in Catfish Creek is mostly attributed to decaying vegetation and hydrocarbon inputs (*i.e.*, automobile emission, oil leakage, *etc.*). **Figure 4.5** illustrates the distribution of BOD_5 concentrations measured in Catfish Creek and North Creek during the 1998 monitoring year. As presented in **Appendix Table B-7**, the 5-day biochemical oxygen demand (BOD_5) recorded in the two streams of the North Tract averaged 2.4 mg/L and ranged from 1.5 to 3.8 mg/L during the 1998 monitoring year.

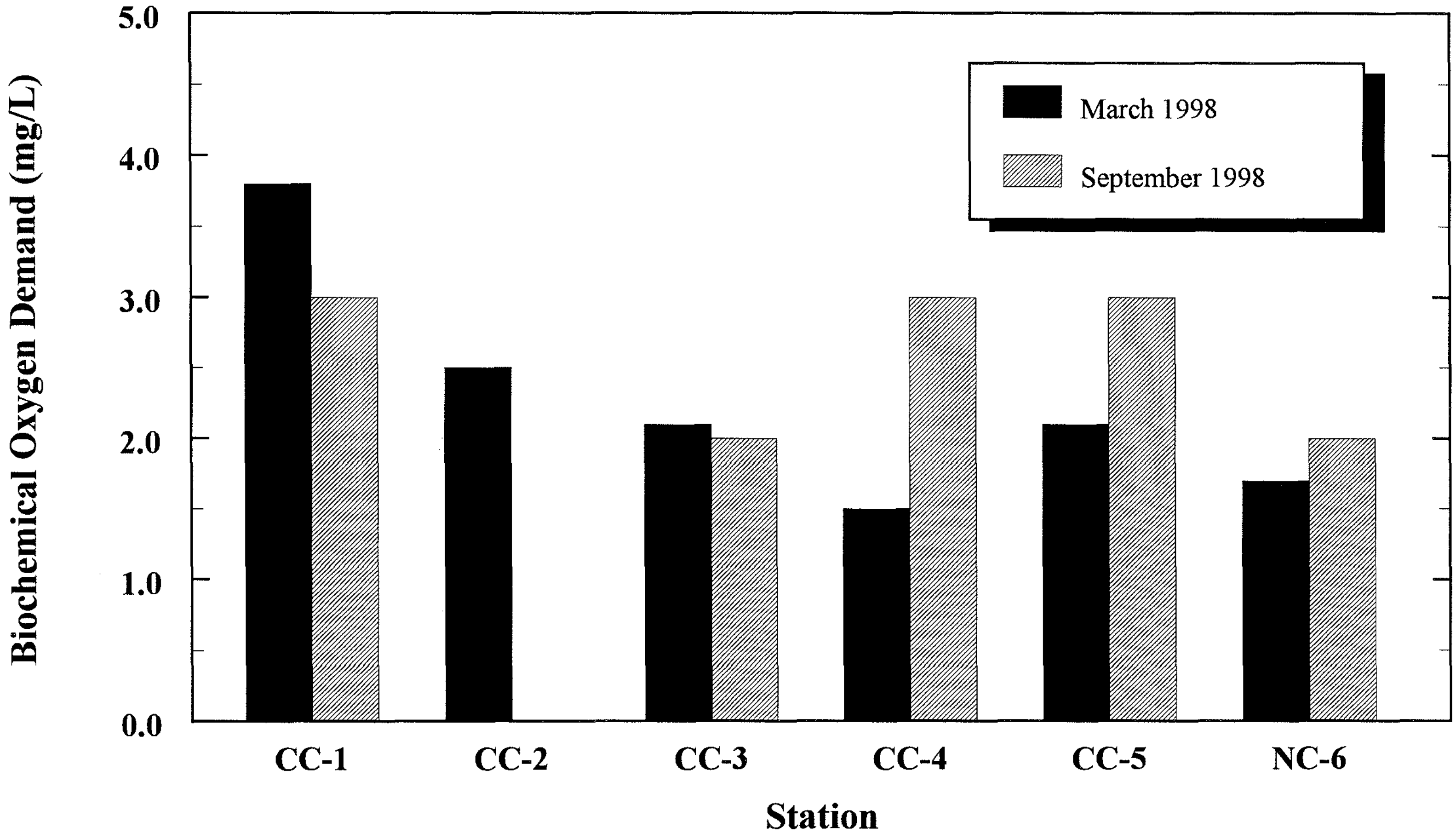


Figure 4.5 Biochemical Oxygen Demand Measured During Quarterly Monitoring Events Conducted on the Palmer Ranch from January through December 1998

Seasonally, the highest BOD_5 levels were recorded for the September event that corresponds to the end of the summer wet season when storm water runoff is high resulting in more organic material being transported to the surface waters. Additionally, a relatively high positive correlation between BOD_5 and turbidity was noted (*i.e.*, correlation coefficient (r) = 0.72), and can be attributed to decaying vegetation and other organic matter in the water column.

Spatially, biochemical oxygen demand levels in Catfish Creek averaged 2.6 mg/L with a range of 1.5 to 3.8 mg/L with no consistent trends being observed among the stations in the basin (**Appendix Table B-7**). A lower mean BOD_5 level of 1.9 NTU was observed for the North Creek sampling station.

Comparatively, BOD_5 levels measured during the 1998 monitoring year are slightly higher than those reported for the previous three years. In 1997, BOD_5 levels averaged 1.6 and ranged from 0.1 to 6.1 (CCI, 1998). Similarly, during the ninth year of monitoring, BOD_5 averaged 1.7 mg/L and had a range of 0.2 to 3.7 mg/L (CCI, 1994). Similar BOD_5 levels were observed during the 1992 monitoring year with concentrations averaging 1.8 mg/L and ranging from 0.2 to 5.3 mg/L (CCI, 1993). During the 1991 monitoring year, BOD_5 concentrations were slightly lower than those measured in 1998 and averaged 1.3 mg/L (CCI, 1992a). During the 1990 monitoring year in Catfish Creek and North Creek, an overall average BOD_5 concentration of 1.7 mg/L was observed (CCI, 1991). Higher BOD_5 concentrations were reported for the third and fourth years of monitoring when levels of BOD_5 in these streams of the Ranch averaged 3.0 and 2.6 mg/L, respectively (CCI, 1988a and 1988b). Similar levels were observed during the second year of monitoring when an average BOD_5 concentration of 4.5 mg/L was recorded for these two Creeks (CCI, 1986).

During the first year of monitoring, Palmer Venture (1986) reported a range in BOD_5 of 1.2 to 6.5 mg/L in Catfish Creek/Trunk Ditch. At the Trunk Ditch-North Creek juncture, BOD_5 was reported to range from 2.0 to 6.0 mg/L.

According to Hynes (1966), a BOD_5 of 3 mg/L suggests "fairly clean" water while a BOD_5 of 5 mg/L suggests "doubtful" quality water. In addition, a BOD_5 screening level of greater than 3.3 mg/L has been established for Florida waters to indicate potential water quality problems (FDER, 1990). Based on BOD_5 measurements made in North Creek and Catfish Creek during the 1998 monitoring year, the surface water of the North Tract generally exhibited clean conditions with 10 of the 11 measurements below the 3.3 mg/L screening level.

The General Criteria for BOD_5 in all surface waters as designated by FAC Chapter 62-302, "Rules and Regulations of the Department of Environmental Protection," as well as Sarasota County Ordinance No. 96-020, as amended, specifies that BOD_5 shall not be increased to levels that would result in violations of dissolved oxygen. Only one of the 11 BOD_5 concentrations measured in Catfish Creek and North Creek during 1998 exceeded the 3.3 mg/L screening level that the FDER (1990) considers to suggest potential water quality problems. Also during the fourteenth year of monitoring, none of the 11 BOD_5 measurements exceeded the 5 mg/L level which Hynes (1966) considered "doubtful" or between "fairly clean" and "bad" water quality.

4.3.2 *Dissolved Oxygen*

Appendix Table B-8 provides the results of dissolved oxygen measurements acquired during the fourteenth year of monitoring. Temporal and spatial distributions of dissolved oxygen concentrations measured at six monitoring stations within Catfish Creek and North Creek during the 1998 monitoring year are presented in **Figure 4.6A**. Overall, dissolved oxygen was found to average 6.0 mg/L, with a range of 2.0 to 12.9 mg/L.

Seasonally, the highest average dissolved oxygen levels were observed for the March monitoring event with concentrations averaging 7.6 mg/L. These higher dissolved oxygen levels are associated with lower water temperatures observed during this event. In contrast, dissolved oxygen concentrations for the September monitoring event averaged 4.2 mg/L in conjunction with the highest average water temperatures. Similar seasonal trends have been observed for dissolved oxygen during previous monitoring years (CCI, 1988a, 1988b, 1991, 1992a, 1993, 1994, 1995b, 1996, 1997 and 1998) and reflect the changes in the solubility of dissolved oxygen throughout the water column with changes in water temperature. Spatially, average dissolved oxygen concentrations were higher for stations within the Catfish Creek Basin with lower concentrations recorded for Station NC-6 in the North Creek Basin.

The dissolved oxygen concentrations obtained during the 1998 monitoring year for Catfish and North Creeks are generally comparable to those measured during the previous

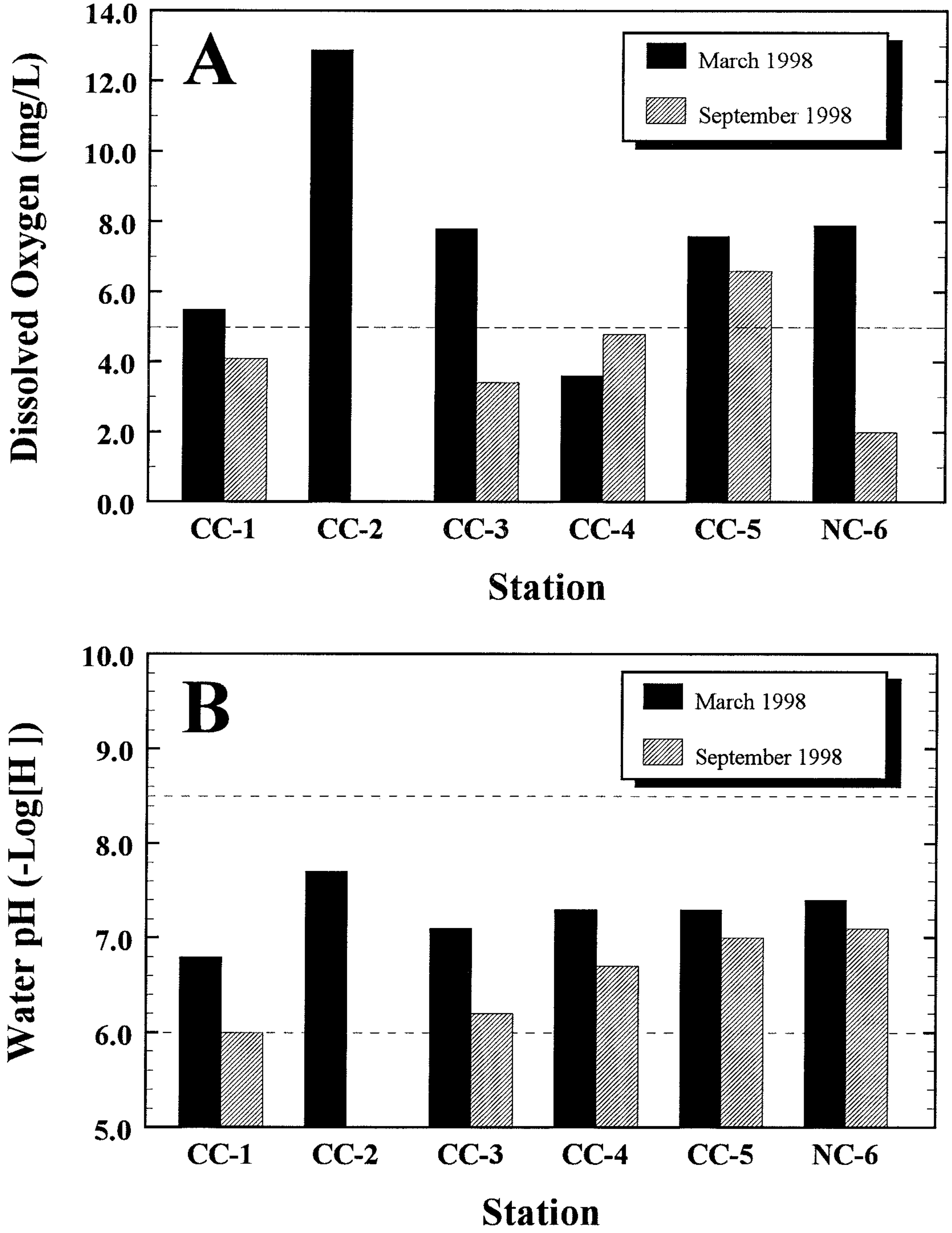


Figure 4.6 Dissolved Oxygen (A) and Water pH (B) Levels Measured During Quarterly Monitoring Events Conducted on the Palmer Ranch from January through December 1998. Dotted Lines Depict State Standards

monitoring years (CCI, 1988a, 1988b, 1991, 1992a, 1993, 1994, 1995b, 1996, 1997 and 1998) but slightly higher than the concentrations determined during the initial two years of the monitoring program (Palmer Venture, 1986; and CCI, 1986). During the third through thirteenth monitoring years, dissolved oxygen was found to average from 4.5 to 6.3 mg/L (CCI, 1988a, 1988b, 1991, 1992a, 1993, 1994, 1995b, 1996, 1997 and 1998).

An evaluation of diurnal variations in dissolved oxygen in Catfish Creek and South Creek was performed during the dry season of 1985 and the wet season of 1986. The results of the diurnal evaluation showed typical increases in dissolved oxygen during the day to maximum levels by mid-afternoon and declines during the night to minimal levels by midmorning, as well as diurnal trends characteristic of the stream community. A summary of the results of the diurnal study is provided in the report prepared by CCI (1987).

During the 1998 monitoring year, dissolved oxygen concentrations in the two streams of the North Tract sometimes occurred at levels below the 5.0 mg/L criteria specified by FAC Chapter 62-302 for predominantly freshwater. Of the 11 dissolved oxygen measurements made during 1998, five were below the 5.0 mg/L state criteria. Four of the five noncompliant dissolved oxygen measurements occurred during the September monitoring event when the solubility of oxygen in the water was low as a result of higher water temperatures.

4.3.3 *Water pH*

Results of pH monitoring in Catfish Creek and North Creek during 1998 are provided in **Appendix Table B-9** with temporal and spatial distributions shown in **Figure 4.6B**. During the 1998 monitoring year, pH levels in these two streams of the Palmer Ranch ranged from 6.0 to 7.7. Similar pH ranges were observed during the first through thirteenth monitoring years (Palmer Venture, 1986; and CCI, 1986, 1988a, 1988b, 1991, 1992a, 1993, 1994, 1995b, 1996, 1997 and 1998).

During 1998, the lowest pH levels were observed at CC-1 and CC-3 with pH levels averaging 6.4 and 6.7, respectively. The highest pH levels were recorded at Stations CC-2 and NC-6 which exhibited average pH levels of 7.7 and 7.3, respectively. These differences are attributed primarily to spatial variations in community metabolisms. Differences or changes in pH are indicative of the effects of net community metabolisms on the level of carbon dioxide and pH. During periods of net community respiration, carbon dioxide (CO_2) is produced faster than it is assimilated. When CO_2 is dissolved in water, carbonic acid (H_2CO_3) is formed in the following reaction:

$$H_2O + CO_{2(g)} \rightleftharpoons H_2CO_{3(aq)} \rightleftharpoons H^+ + HCO_3^-$$

As a result of CO_2 production during respiration, water pH is depressed due to the release of hydrogen ions (H^+) as H_2CO_3 dissociates. In contrast, carbon dioxide is consumed faster than it is produced during periods of net community photosynthesis (primary production). Thus, the reaction will shift toward the left, thereby removing CO_2 and increasing pH.

Therefore, pH typically exhibits a diel trend of increases during the day and decreases during the night. The amplitude of the cycle normally depends on the rate of production and consumption and to a lesser extent on the buffering capacity, *i.e.*, alkalinity, of the water and atmospheric exchange of carbon dioxide.

In a diurnal evaluation of Catfish Creek and South Creek, which was conducted during the dry season of 1985 and the wet season of 1986, CCI (1987) reported changes in pH characteristic of the different biological communities. During the day, Catfish Creek and South Creek exhibited changes in pH ranging up to a 1 to 2 unit increase with maximum diurnal changes observed in the lower reach of Catfish Creek (*i.e.*, CC-5) where the greatest metabolic rates were encountered.

As specified in the General Criteria for all surface waters (FAC Chapter 62-302) and in the Sarasota County Ordinance No. 96-020, as amended, the allowable variation in pH is 1.0 units above or below the normal pH if the pH is not lowered or elevated outside the range of 6.0 to 8.5. Additionally, if natural background is less than 6.0, the pH shall not vary below the natural background or vary more than one unit above natural background. Similarly, if natural background is above 8.5, pH shall not vary above natural background or vary more than one unit below background. During the fourteenth year of monitoring, all pH measurements in Catfish Creek and North Creek were within the allowable range of 6.0 to 8.5 (**Figure 4.6B**).

4.4 Macronutrients

4.4.1 *Total Nitrogen*

Appendix Table B-10 and **Figure 4.7** provide the results of total nitrogen measurements acquired during the 1998 monitoring year for Catfish Creek and North Creek. Overall, total nitrogen levels in Catfish Creek and North Creek ranged from 0.83 to 1.48 mg/L and averaged 1.21 mg/L during the 1998 monitoring year. In general, total nitrogen levels measured in Catfish Creek during the fourteenth monitoring year were comparable to levels measured in previous years. Slightly lower average total nitrogen concentrations of 1.00 and 0.97 mg/L was observed during the thirteenth and tenth year of monitoring (CCI, 1995b and 1998). Similar average total nitrogen concentrations (1.18 mg/L) were observed in Catfish Creek and North Creek during both the sixth and seventh monitoring years (CCI, 1991 and 1992a). Higher mean concentrations of 1.86, 1.42, 1.44, 1.36 and 1.31 mg/L observed for the second, third, fourth, eighth and ninth years of monitoring, respectively (CCI, 1986, 1988a, 1988b, 1993 and 1994).

Figure 4.8 provides the mean total nitrogen concentrations observed for the streams traversing the Palmer Ranch during the second through fourteenth monitoring years. Also included in **Figure 4.8** is the average total nitrogen concentration measured in Catfish Creek during the "Stormwater Pollutant Loading Monitoring Program" performed at the Palmer Ranch (CCI, 1992b). The mean concentrations for each component of total nitrogen (*i.e.*, ammonia, nitrate + nitrite, and organic nitrogen) are also depicted in **Figure 4.8** in order compare the relative importance of each nitrogen fraction. The average total nitrogen

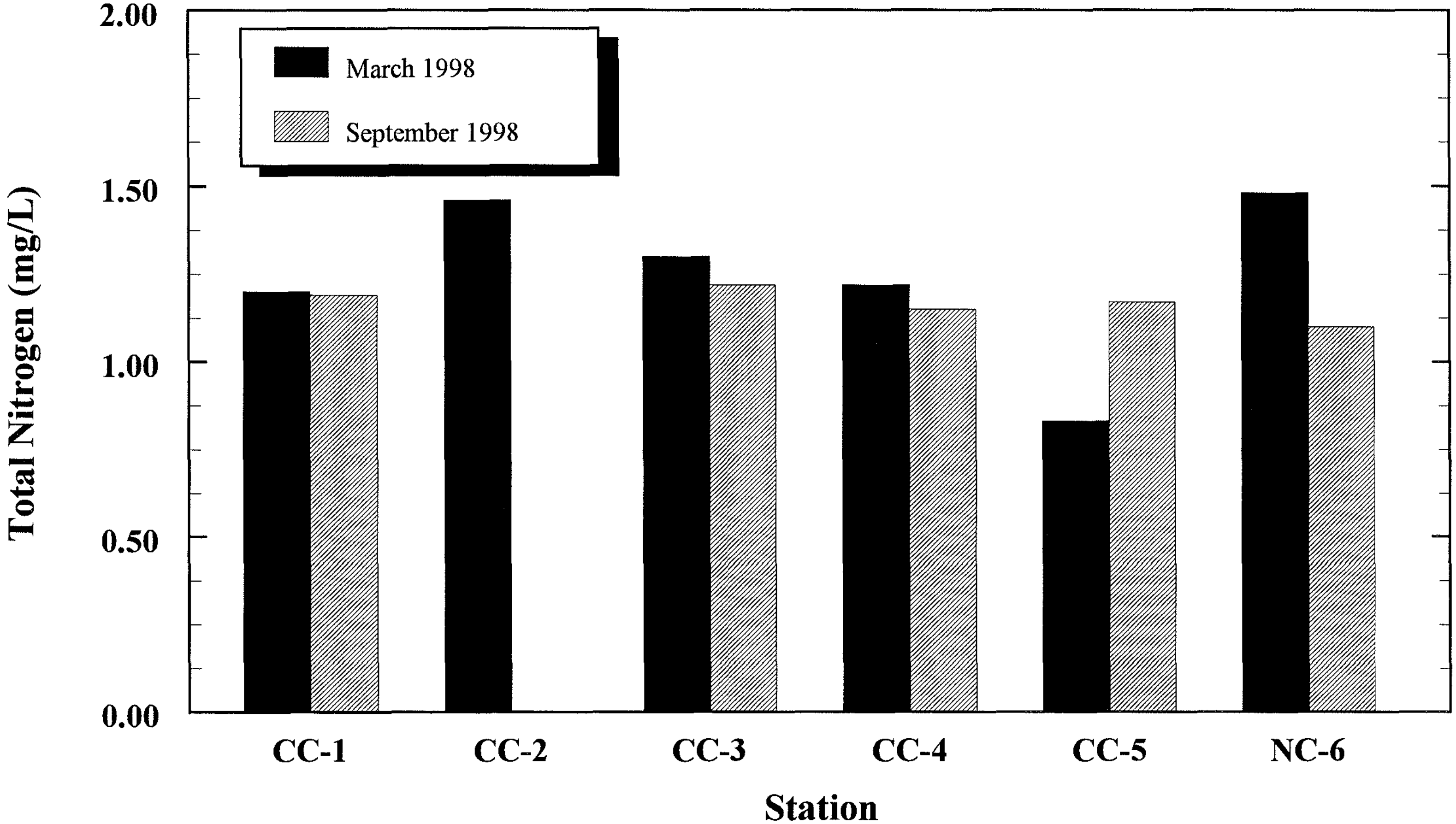


Figure 4.7 Total Nitrogen Levels Measured During Quarterly Monitoring Events Conducted on the Palmer Ranch from January through December 1998

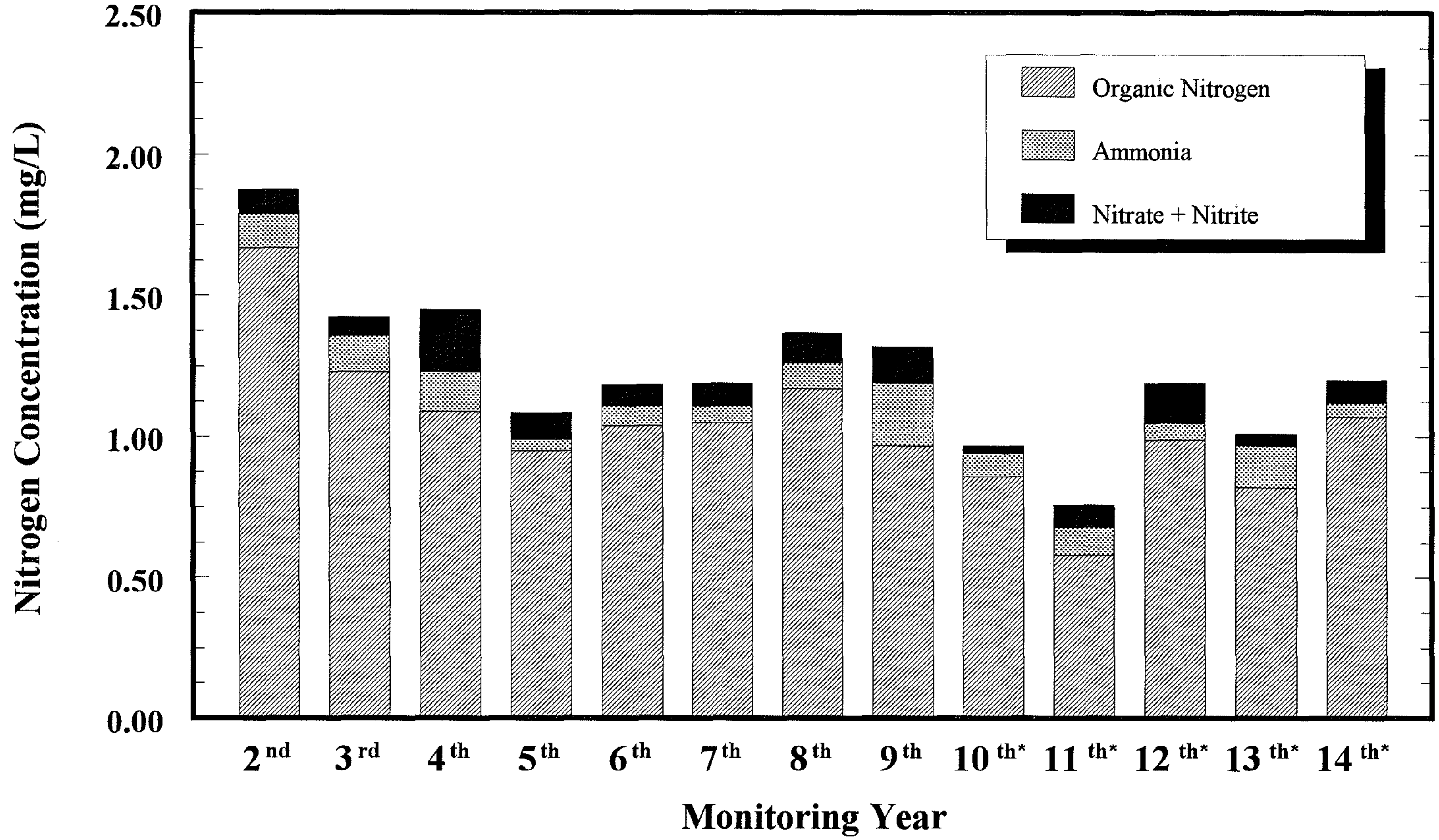


Figure 4.8 Average Nitrogen Concentrations Measured on the Palmer Ranch for the Second Through the Fourteenth Monitoring Years. *Performed Semi-annually Rather Than Quarterly.

concentrations for the six monitoring stations exhibited a general decrease over the previous five years. However, this year's results appear to represent a stabilization of total nitrogen in these two streams of the North Tract of the Palmer Ranch. Importantly, the forms of nitrogen that are readily assimilated by algae and plants (*i.e.*, nitrate + nitrite, ammonia) have generally declined, especially ammonia.

Spatial and temporal distributions of total nitrogen concentrations for the 1998 monitoring year are provided in **Figure 4.7**. Seasonally, total nitrogen concentrations were comparable during both semi-annual monitoring events with no consistent seasonal trend being observed among the monitoring stations. During 1998, the upper reaches of Catfish Creek exhibited slightly higher average total nitrogen levels than observed in the other stream segments of the Palmer Ranch. The highest average total nitrogen concentrations of 1.46 and 1.26 mg/L, in Catfish Creek were observed at Stations CC-2 and CC-3, respectively. A lower total nitrogen concentration was observed for the lower reach of Catfish Creek, averaging 1.00 mg/L at Stations CC-5. The total nitrogen levels determined in North Creek were within the range reported for the stations located in Catfish Creek.

As has been reported for all previous monitoring years, the largest fraction of total nitrogen observed during 1998 is organic nitrogen. During the fourteenth monitoring year, organic nitrogen represented approximately 88 percent of total nitrogen and averaged 1.07 mg/L. The second most abundant form of nitrogen was nitrate nitrogen that represented approximately 5.8 percent of the total nitrogen with an average concentration of 0.07 mg/L. Ammoniacal nitrogen (*i.e.*, ionized plus un-ionized ammonia) represented approximately

4.1 percent of the total nitrogen with an average level of 0.05 mg/L. As expected, the smallest fraction of total nitrogen was found to be nitrite with an average concentration of <0.01 mg/L that represented 0.8 percent of the total nitrogen concentration.

Similarly, CCI (1986, 1988a, 1988b, 1991, 1992a, 1993, 1994, 1995b, 1996, 1997 and 1998) reported generally comparable breakdowns of total nitrogen in Catfish Creek and North Creek during previous years of monitoring. The largest fraction of total nitrogen observed during the previous years of monitoring also occurred as organic nitrogen. Organic nitrogen represented from 76 to 90 percent of the total nitrogen content and averaged from 0.58 to 1.67 mg/L during these periods. The second most abundant form of nitrogen has generally been ammoniacal nitrogen that represented from 6 to 10 percent of the total with concentrations averaging 0.06 to 0.14 mg/L over the same period. However, this year as in the fourth and twelfth years, nitrate nitrogen represented a higher percent of the total nitrogen. Nitrate represented approximately 4 to 15 percent of the total nitrogen content with average nitrate levels ranging from 0.06 to 0.21 mg/L during the previous years of monitoring. As during the 1998 monitoring year, the smallest fraction of total nitrogen during previous years of monitoring was nitrite, which represented less than 1 percent of the total nitrogen present during most years of monitoring.

During the first year of monitoring, however, Palmer Venture (1986) reported a significantly different breakdown and a substantially lower total nitrogen concentration (*i.e.*, 0.8 mg/L) than for following monitoring years. During the first year, total nitrogen averaged 69 percent organic nitrogen, 8 percent ammonia nitrogen, 23 percent nitrate nitrogen, and less than 1 percent nitrite nitrogen. The lower total nitrogen during the first year versus the latter years cannot be explained based on the available information, but may be associated with the extreme droughty conditions experienced during the first monitoring year. Also, it is not completely understood why nitrate levels exceeded ammonia levels during the first year since nitrate is normally assimilated by denitrifying bacteria under conditions of depressed oxygen levels, a condition that prevailed throughout the first year.

As specified in FAC Chapter 62-302, nutrients, including total nitrogen, shall not be elevated to levels causing an imbalance in the natural flora and fauna, a condition characteristic of eutrophic or nutrient-rich streams. In this respect, there were some implications in the data acquired during the second, third, and fourth monitoring years that linked the observed total nitrogen levels to eutrophic conditions even though there appeared to be a general trend of decreasing nitrogen levels as previously discussed (CCI, 1986, 1988a, 1988b, 1991, 1992a, 1993, 1994, 1995b, 1996, 1997 and 1998). Total nitrogen results obtained during the 1998 were about the average measured during the fourteen years of the monitoring program with all 11 total nitrogen samples collected on the Palmer Ranch exhibiting concentrations below the 2.0 mg/L screening level considered by the FDEP (FDER, 1990) to be characteristic of eutrophic conditions.

4.4.2 *Nitrite*

Nitrite levels observed in Catfish Creek and North Creek during the fourteenth year of monitoring are provided in **Appendix Table B-11**. As expected, nitrite concentrations throughout these two streams traversing the North Tract were much lower than for other forms of nitrogen, and too low to be a significant nutrient source. Only one (measured at 0.01 mg/L) of the 11 samples collected during the 1998 monitoring year contained nitrite concentrations above the 0.01 or 0.05 mg/L analytical detection limit. During the previous monitoring years, nitrite concentrations measured in Catfish Creek and North Creek averaged <0.01 to 0.03 mg/L and had a range from <0.01 to 0.20 mg/L (CCI, 1987, 1988a, 1988b, 1991, 1992a, 1993, 1994, 1995b, 1997, and 1998).

As a nutrient, nitrite is considered to be covered by the general water quality standard (FAC Chapter 62-302). However, due to the observed low concentrations, nitrite was generally of little importance as a nutrient in the streams of the Palmer Ranch. For all practical purposes, nitrite is considered to meet desired standards.

4.4.3 *Nitrate*

As shown in the results provided in **Appendix Table B-12** and **Figure 4.9A**, nitrate levels observed for Catfish Creek and North Creek in the Palmer Ranch during 1998 exhibited a yearly average of 0.07 mg/L with a range of <0.01 to 0.37 mg/L. Similar nitrate concentrations were reported for the second, third, sixth, seventh, eighth, tenth, eleventh and thirteenth monitoring years. During these years average nitrate concentrations ranged from 0.04 to 0.10 mg/L (CCI, 1987, 1988a, 1991, 1992a, 1993, 1994, 1995b, 1996 and 1998). Slightly higher nitrate levels were reported for the ninth and twelfth monitoring years when nitrate averaged 0.10 and 0.13 mg/L, respectively (CCI, 1988b and 1997).

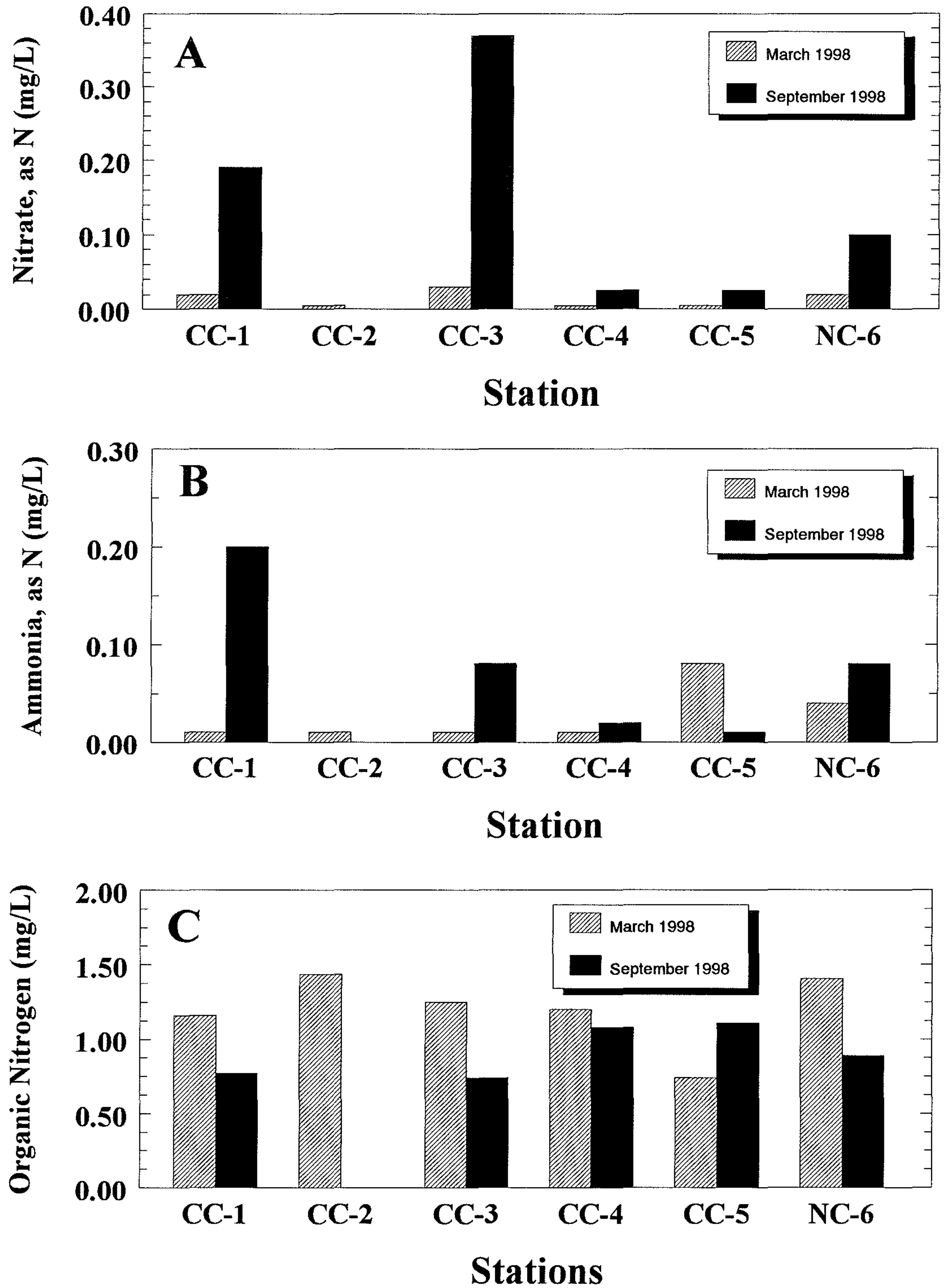


Figure 4.9 Nitrate (A), Ammonia (B), and Organic Nitrogen (C) Concentrations Measured During Quarterly Monitoring Events Conducted on the Palmer Ranch from January through December 1998

Nitrate levels were higher during the September monitoring event averaging 0.14 mg/L in Catfish and North Creeks compared to an average of 0.01 mg/L determined for the March sampling. The higher average nitrate level recorded during the September monitoring event resulted from elevated nitrate concentrations at Station CC-3 whose nitrate content was 0.37 mg/L. Nitrate concentration of 0.19 and 0.10 mg/L were recorded at Stations CC-1 and NC-6, respectively, during the September monitoring event with the concentration at the other monitoring stations being at low levels or below the analytical detection limit (**Appendix Table B-12**). During the March event, only Stations CC-1, CC-3 and NC-6 exhibited detectable levels of nitrate. Spatially, the highest average nitrate concentration of 0.20 mg/L was observed at Station CC-3. Due to the very low levels of nitrate generally found during 1998 no other spatial trends could be discerned.

As a nutrient, nitrate is designated as a parameter covered by the general water quality criteria (FAC Chapter 62-302), and is an important limiting nutrient in the streams of the Palmer Ranch. Therefore, increases in nitrate availability from anthropogenic sources would accelerate production rates of aquatic plants resulting in an imbalance in the flora and fauna that would be considered a violation of the nutrient standard. However, the nitrate concentrations determined during the 1998 monitoring year were lower than or similar to those recorded during the previous years of monitoring and are not thought to represent an important source of nitrogen in the streams of the Palmer Ranch. Therefore, nitrate is considered to meet desired criteria.

4.4.4 *Ammoniacal Nitrogen*

Appendix Table B-13 provides the results of ammoniacal nitrogen measurements (ionized plus un-ionized ammonia) recorded during the fourteenth year of monitoring. Also, spatial and temporal distributions of ammoniacal nitrogen are illustrated in **Figure 4.9B**. As described previously, ammoniacal nitrogen represented approximately 4.1 percent of the total nitrogen measured during the 1998 monitoring year. Overall, ammoniacal nitrogen exhibited an average of 0.05 mg/L with a range from <0.02 to 0.20 mg/L. Generally, ammonia concentrations measured during 1998 were within the low end of the range determined for the previous years of monitoring (Palmer Venture, 1986; and CCI, 1986, 1988a, 1991, 1992a, 1993, 1994, 1995b, 1996, 1997 and 1998).

Seasonally, ammoniacal nitrogen concentrations in Catfish Creek and North Creek averaged 0.03 and 0.08 mg/L during the March and September sampling events, respectively. Spatially, the highest average ammoniacal nitrogen concentrations occurred in the upper reach of Catfish Creek with the ammonia concentration at Station CC-1 averaging 0.11 mg/L (**Figure 4.9B**).

Although ammoniacal nitrogen is a nutrient and therefore has the potential to influence the growth of the primary producers (plants) and their balance with the consumers (bacteria and animals), FAC Chapter 62-302 does not provide a quantitative nutrient standard for ammoniacal nitrogen. Even though ammoniacal nitrogen is a potentially important nutrient to the primary producers in the streams of the Palmer Ranch, results obtained during the monitoring program suggest that nitrate might be the preferred nitrogen source. This indication is based on trends observed during previous monitoring years as related to normal plant production and decay (CCI, 1996). Other freshwater studies (Wetzel, 1975) have also concluded that aquatic vegetation, including algae, prefer nitrate to ammonia. Although it might be less preferred than nitrate, increases in ammonia have the ability to accelerate plant production, and, in turn, influence the balance between the flora and fauna of the streams traversing the Palmer Ranch. Concentrations of ammoniacal nitrogen determined during the 1998 monitoring year were generally similar to or lower than those previously recorded during the previous years of monitoring. These levels are not thought to represent an important source of nitrogen in the streams of the Palmer Ranch. Therefore, ammonia is considered to meet desired criteria. Since the un-ionized fraction of ammoniacal nitrogen was not evaluated independently, comparisons to County and State criteria for un-ionized ammonia were not made.

4.4.5 *Organic Nitrogen*

Organic nitrogen[2] concentrations determined in Catfish Creek and North Creek within the Palmer Ranch during the 1998 monitoring year are provided in **Appendix Table B-14** and graphically depicted in **Figure 4.9C**. Overall, an average organic nitrogen concentration of 1.07 mg/L was measured in these streams of the Palmer Ranch during the 1998 monitoring year with a range from 0.74 to 1.44 mg/L. Similar organic nitrogen concentrations ranging from 0.50 to 1.89 mg/L and averaging 0.99 mg/L were observed during the 1996 monitoring year (CCI, 1997). Organic nitrogen concentrations reported for the 1993, 1994 and 1997

[2]Organic Nitrogen = Total Kjeldahl Nitrogen - Ammoniacal Nitrogen.

monitoring years had slightly lower organic nitrogen concentrations. Organic nitrogen concentrations for these three years averaged 0.97, 0.86 and 0.82 mg/L, respectfully (CCI, 1994, 1995b and 1998). A lower average organic nitrogen concentration of 0.58 mg/L and range from 0.28 to 1.09 mg/L were reported for the 1995 monitoring year (CCI, 1996). Similar average organic nitrogen concentrations (*i.e.*, 1.04 mg/L) were reported for the sixth and seventh monitoring years in Catfish and North Creeks (CCI, 1991 and 1992a). Higher average organic nitrogen concentrations of 1.10 and 1.23 mg/L were reported for the third and fourth monitoring years for stations located along Catfish and North Creeks within the Palmer Ranch, respectively (CCI, 1988a and 1988b). A much higher organic nitrogen was reported for the second year of monitoring (CCI, 1986). The organic nitrogen concentration for this monitoring year averaged 1.67 mg/L. Overall, organic nitrogen data shows a stabilizing or gradual improvement in water quality with respect to nitrogen over the past ten years. Also, channel maintenance in Trunk Ditch during the fourth monitoring year, as well as the aquatic community changes resulting from the "reconstruction" of a segment of the Catfish Creek/Trunk Ditch Basin during the second year, may have contributed to the stabilizing /declining trend in organic nitrogen.

The concentration of organic nitrogen did not follow expected seasonal trends as observed during previous monitoring years when organic nitrogen levels increased from the spring through the summer. As during the 1996 and 1997 monitoring years, higher organic nitrogen concentrations were recorded during the March 1998 monitoring event as compared to the September sampling event. Organic nitrogen levels in Catfish and North Creeks averaged

1.20 and 0.92 mg/L during the March and September 1998 monitoring events, respectively. Several factors could contribute to this observed seasonal trend: (a)the El Nino related high rainfall for the six months proceeding the March event along with the dying vegetation; and (b) below normal rainfall during the primary wet season prior to the September event.

Typically, peaks in organic nitrogen during September are apparently associated with peaks in the standing crop of aquatic vegetation and storm water loadings, since this month represents the primary wet season. During the fall and winter, the standing crop of vegetation declines in association with low production rates and the decay of plant material. In past monitoring years, organic nitrogen concentrations have exhibited a concomitant decline as the plant material was depleted by the microbial heterotrophs during this period. Additionally, storm water loading rates most likely declined in association with minimal runoff during the relatively drier months of October through May.

4.4.6 *Total Phosphorus*

During the 1998 monitoring year, total phosphorus in the Catfish Creek/Trunk Ditch Basin of the Palmer Ranch averaged 0.12 mg/L and a range of 0.03 to 0.27 mg/L (**Appendix Table B-15**). The highest total phosphorus level (0.27 mg/L) was recorded at Station CC-2 during the March monitoring event (**Figure 4.10**). The lowest mean total phosphorus concentrations were observed at Stations CC-3 and NC-6 (**Appendix Table B-15**).

Slightly higher total phosphorus distributions were observed during the 1993, 1994, 1995, 1996 and 1997 monitoring years, with concentrations averaging 0.20, 0.21, 0.18, 0.17 and

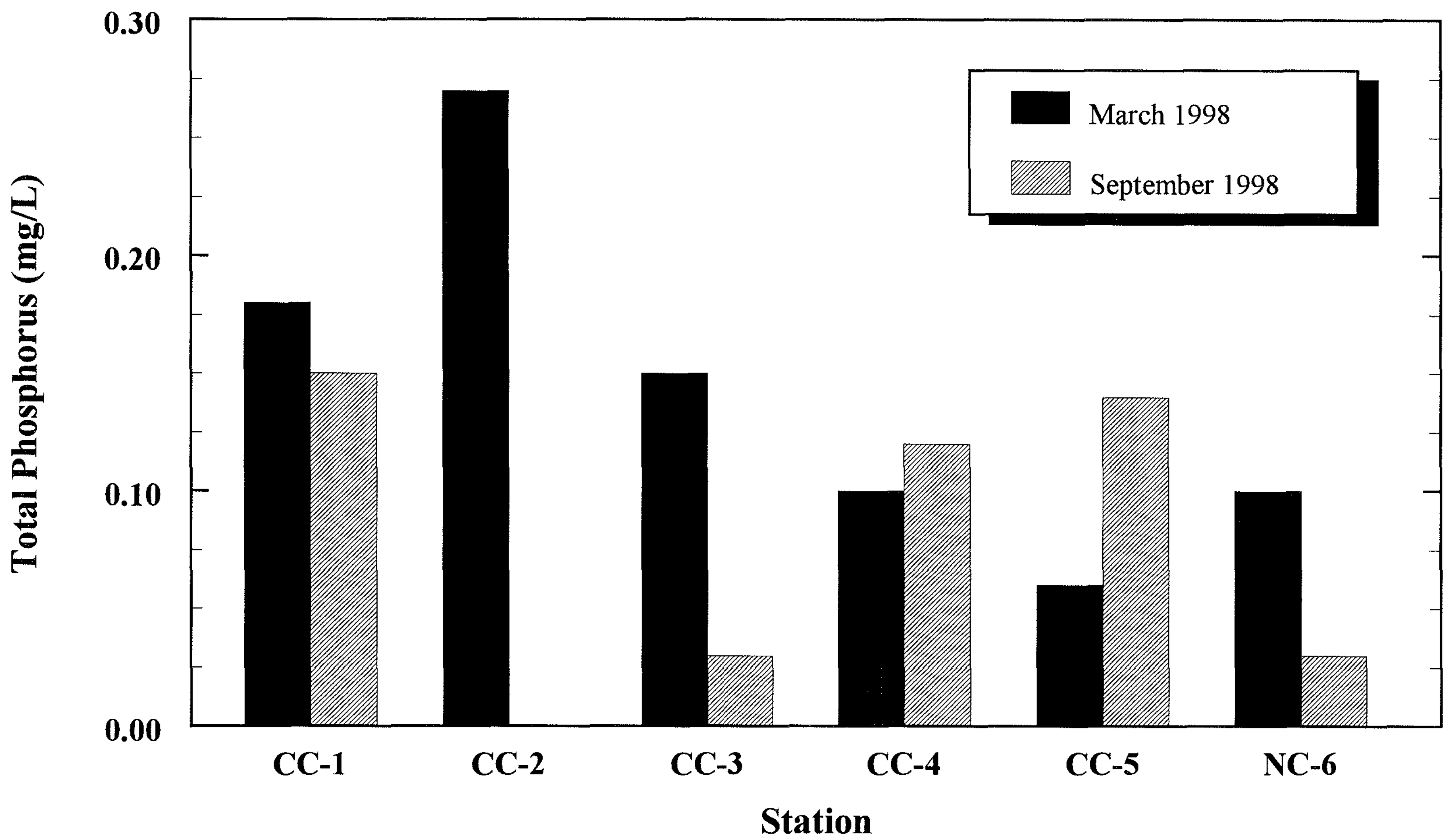


Figure 4.10 Total Phosphorus Concentrations Measured During Quarterly Monitoring Events Conducted on the Palmer Ranch from January through December 1998

0.29 mg/L, respectively (CCI, 1994, 1995b, 1996, 1997 and 1998). During the 1992 monitoring year, higher total phosphorus concentrations were observed with an average concentration of 0.38 mg/L and a range of 0.06 to 2.22 mg/L (CCI, 1993). Similar total phosphorus concentrations were observed during the sixth and seventh monitoring years with concentrations in the Catfish Creek/Trunk Ditch and North Creek Basins averaging 0.12 and 0.15 mg/L, respectively (CCI, 1991 and 1992a). During the third and fourth monitoring years, total phosphorus levels averaged 0.26 mg/L for each year (CCI, 1988a and 1988b). The highest total phosphorus levels occurred during the second monitoring year with an average of 0.46 mg/L (CCI, 1986). The source of this phosphorus was attributed to cleared lands and construction activities associated with the development of Prestancia.

Figure 4.11 provides the average phosphorus levels recorded for the second through the fourteenth years of monitoring. For comparison, the fractionation of orthophosphate and organic phosphorus levels is also provided in **Figure 4.11**. Average phosphorus concentrations in the Catfish Creek/Trunk Ditch and North Creek Basins declined during the second, third, fourth, fifth, sixth, seventh, ninth, eleventh, and twelfth years of monitoring, as illustrated in **Figure 4.11**. However, average phosphorus levels recorded for the eighth year of monitoring were higher than recorded for previous years. This observed increase in phosphorus was attributed to a high rainfall amount of 38.33 inches recorded during the primary wet season. Additionally, the average phosphorus level increased slightly during the thirteenth monitoring year. This increase is primarily due to an increase in organic phosphorus which may have resulted from the drier conditions experienced during much of

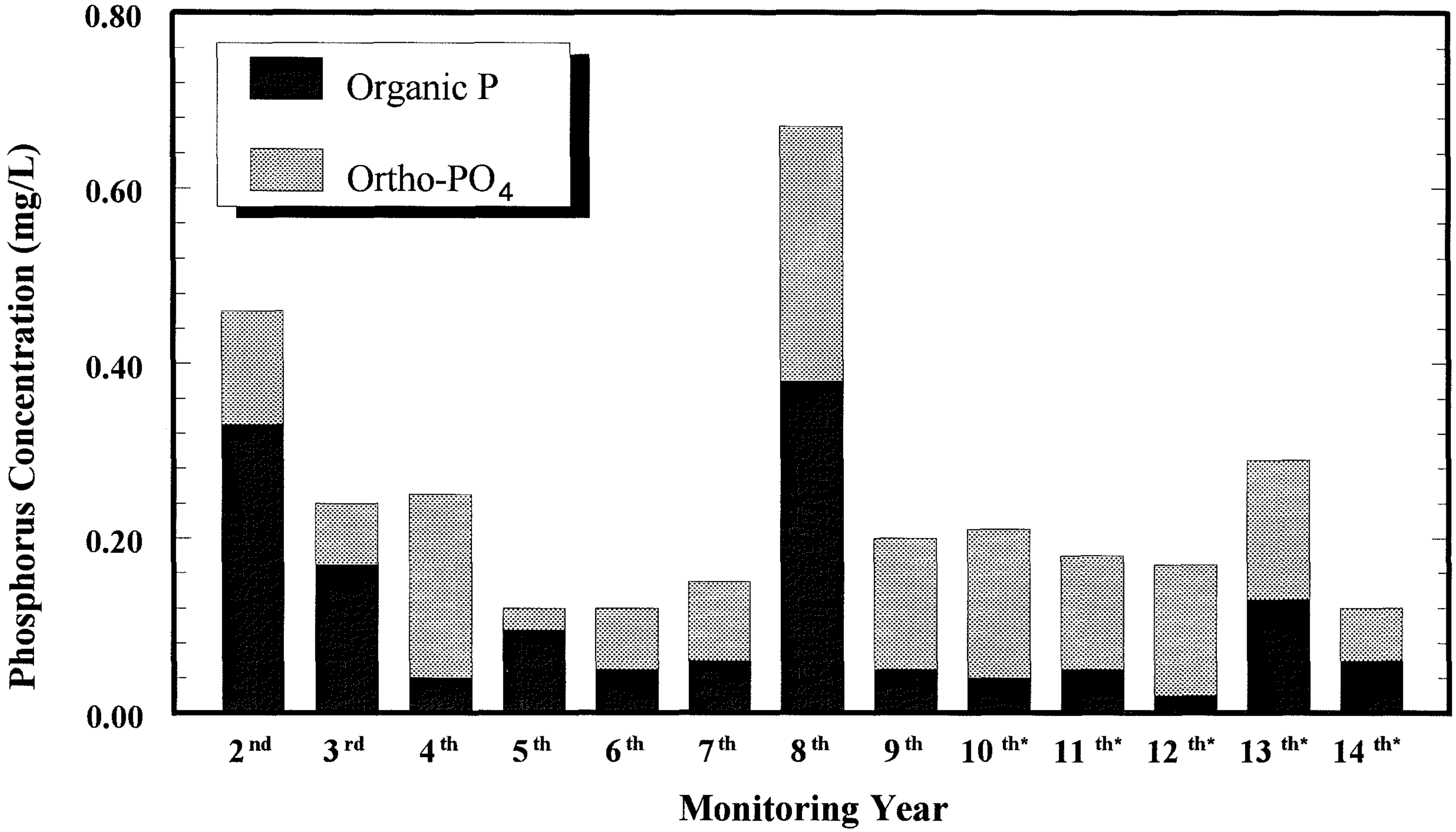


Figure 4.11 Average Phosphorus Concentrations Measured on the Palmer Ranch for the Second through the Fourteenth Monitoring Years

the year and the subsequent die-off and decay of vegetation. The total phosphorous levels observed during the fourteenth year of monitoring were near the lowest recorded to date.

As a nutrient, phosphorus is required by algae and other plants for the primary production of organic matter and, therefore, as specified in FAC Chapter 62-302, shall not be elevated to levels that will cause an imbalance in the natural flora and fauna. The results of the 1998 monitoring year indicate that none of the 11 samples collected exhibited a total phosphorus concentration that exceeded the FDEP screening level of 0.46 mg/L (FDER, 1990). The total phosphorus concentrations measured in Catfish Creek and North Creek were more often above the 0.09 mg/L level determined to be the median concentration for Florida streams (FDER, 1990).

Similar phosphorus concentrations are normally found in west-central Florida because of the widespread deposits of naturally occurring phosphate (Sheldon, 1982). Interestingly, well drillers' logs show that phosphates exist in shallow deposits on the Palmer Ranch (Patton and Associates, 1984). In the past years, a relatively high correlation was found between the total phosphorus concentrations and turbidity levels which suggests the controlling role of naturally occurring phosphate deposits on the phosphorus concentrations in the streams of the Palmer Ranch. In addition, Palmer Venture (1986) noted that the phosphate levels in the streams of the Palmer Ranch were significantly influenced by groundwater during periods when stream flow was augmented by groundwater exfiltration (*i.e.*, low flow conditions). Consequently, phosphates originating from these naturally occurring deposits within, or upstream of, the Palmer Ranch should not be considered violations even though they exhibit the potential for contributing to high rates of primary production and a concomitant imbalance in the flora and fauna.

4.4.7 *Orthophosphate*

Orthophosphate concentrations determined in the streams traversing the Palmer Ranch during the 1998 monitoring year are provided in **Appendix Table B-16**. Overall, the Catfish Creek/Trunk Ditch and North Creek Basins of the Palmer Ranch exhibited an average orthophosphate concentration of 0.06 mg/L with a range from <0.01 to 0.23 mg/L (**Figure 4.12**). As expected, orthophosphate concentrations during 1998 exhibited spacial and seasonal trends similar to those observed for total phosphorus.

Similar average orthophosphate levels were recorded for the Catfish Creek/Trunk Ditch and North Creek Basins during the 1990 and 1991 monitoring years. The annual mean orthophosphate concentrations determined during 1990 and 1991 were 0.07 and 0.09 mg/L, respectively (CCI, 1991 and 1992a). Also, an annual mean orthophosphate concentration of 0.07 mg/L and range of <0.01 to 0.15 mg/L were recorded during the third year of monitoring (CCI, 1988b). Higher orthophosphate concentrations were reported during the 1986, 1993, 1994, 1995, 1996 and 1997 monitoring years (CCI, 1986, 1994, 1995b, 1996, 1997 and 1998). Orthophosphate concentrations measured during the 1986 monitoring year averaged 0.13 mg/L and ranged from 0.04 to 0.36 mg/L (CCI, 1986). Comparable orthophosphate levels were also measured during the 1993 monitoring year when concentrations averaged 0.15 mg/L and ranged from <0.01 to 0.41 mg/L (CCI, 1994). Similar orthophosphate concentrations were observed during the 1994 monitoring year.

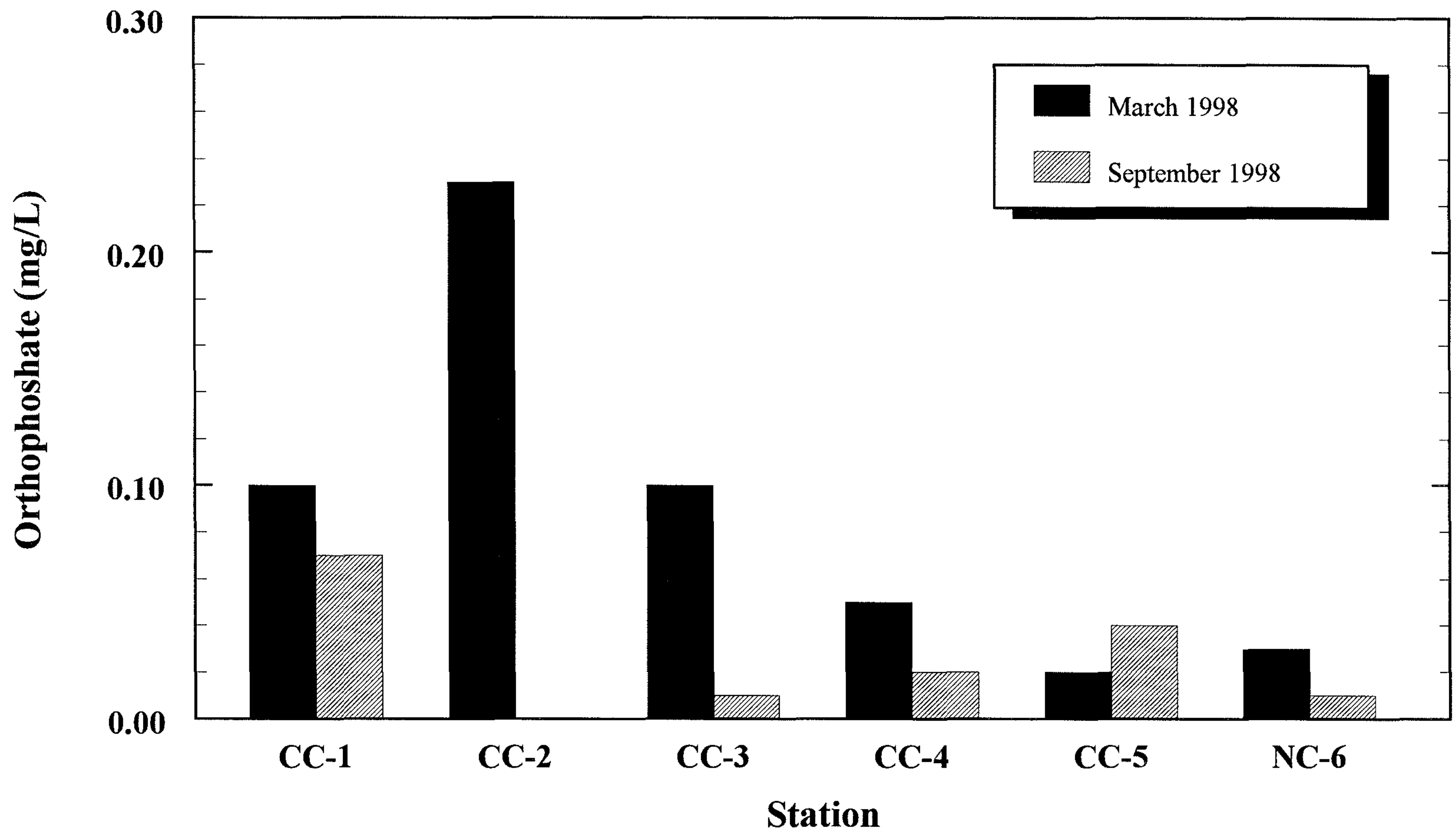


Figure 4.12 Orthophosphate Concentrations Measured During Quarterly Monitoring Events Conducted on the Palmer Ranch from January through December 1998

Overall, orthophosphate concentrations measured during the tenth monitoring year averaged 0.17 mg/L and ranged from 0.03 to 0.43 mg/L (CCI, 1995b). Average orthophosphate concentration recorded during the 1995 and 1997 monitoring years were 0.13 and 0.16 mg/L with ranges of <0.01 to 0.65 and 0.03 to 1.13 mg/L, respectively (CCI, 1996 and 1998). During the eighth monitoring year, orthophosphate concentrations averaged 0.29 mg/L and ranged from 0.01 to 2.04 mg/L (CCI, 1993).

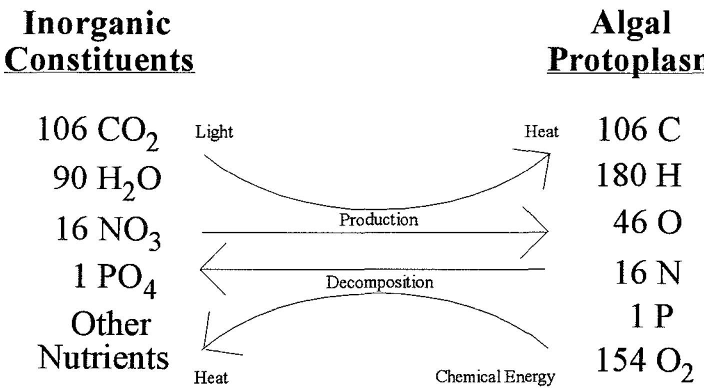
Although the phosphorus concentrations have varied considerably over the last six years, the percentage of total phosphorus consisting of orthophosphate has remained relatively constant averaging 79 percent. However, orthophosphate represented approximately 50 percent of the total phosphorus in the two streams during the 1998 monitoring period. In general, orthophosphate represented approximately 53 to 88 percent recorded for previous seven years of monitoring. As described previously, the relatively low percentage of orthophosphate observed during 1998 is thought to be related to the dry condition experienced during the second half of the monitoring year and the resulting die-off of vegetation.

Seasonally, higher orthophosphate concentrations were observed during the March monitoring event (**Figure 4.12**). This is unusual and likely reflects the high rainfall experienced prior to the March event as well as the below average rainfall observed prior to the September event. Typical seasonal trends were observed during the previous years of monitoring for the Catfish/North Creek Basins. This temporal increase in orthophosphate concentrations generally recorded at the end of the primary wet season is attributed to increased runoff during the primary wet season.

As a nutrient, orthophosphate is designated by FAC Chapter 62-302 as a general water quality parameter. This criterion specifies that the discharge of nutrients, such as orthophosphate, shall be limited to prevent an imbalance in the natural populations of aquatic flora and fauna. Although the observed levels are occasionally above the threshold considered to indicate eutrophic conditions as defined by FDEP (FDER, 1983), orthophosphate has been found to occur naturally on the North Tract. Consequently, other factors, such as nitrogen availability, are probably more growth limiting than orthophosphate. Therefore, the phosphate levels found during the 1998 monitoring year are not likely to have caused an imbalance in the aquatic flora and fauna.

4.4.8 *Nutrient Ratios*

Nitrate and phosphate are required by aquatic plants in proportions of approximately 6.8:1 on a weight basis (or 16:1 N:P on a molar basis) (Odum, 1959 and GESAMP, 1987). Nitrogen and phosphorus are assimilated in this proportion by the primary producers (rooted aquatic plants and algae) and converted into protoplasm during the process of photosynthesis. Conversely, the (unresistant or digestible) organic forms of nitrogen and phosphate are oxidized back into their biogenic salts during the process of aerobic respiration, *e.g.*, organic decomposition, heterotrophic activity. This relationship can be illustrated as:



The primary forms of these biogenic salts are nitrate and orthophosphate. However, nitrate may be substituted by some plants for other forms of nitrogen, such as ammonia. Also of importance, orthophosphate may be accumulated and stored as polyphosphates by some algae, thereby alleviating a potential future phosphate limiting condition.

Importantly, other limiting factors such as low light and low dissolved oxygen could play as important, if not more important, roles in limiting the rate of primary production and decomposition in the streams of the Palmer Ranch, respectively. For example, if the availability of inorganic nitrogen is high and the N_i:P_i ratio is low, *e.g.*, 2:1, it would indicate that some factor other than inorganic nitrogen is the real limiting factor. Even so, determinations and the use of nutrient ratios in light of other important and potentially limiting factors are helpful in evaluating the results of long-term monitoring programs when nutrient loading and its consequences are major concerns, such as for the "Continuing Surface Water Quality Monitoring Program."

Results of the fourteenth year of monitoring were used to determine the weight ratios of nitrogen to phosphorus in the streams of the Palmer Ranch (**Figures 4.13A** and **4.13B**).

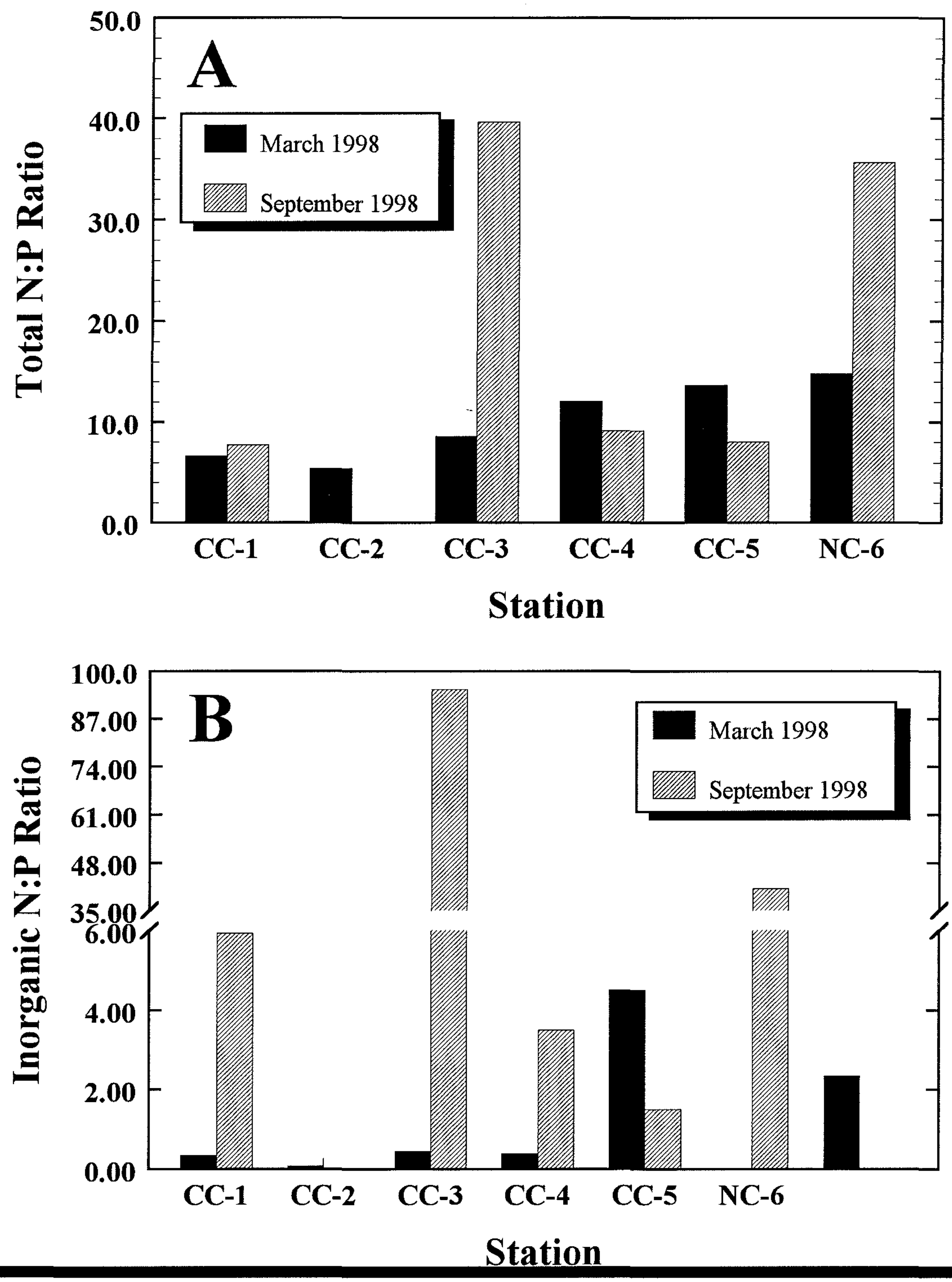


Figure 4.13 Total Nitrogen to Phosphorus Ratios (A) and Inorganic Nitrogen to Phosphorus Ratios (B) Determined from Quarterly Monitoring Data Collected on the Palmer Ranch from January to December 1998

Total nitrogen to total phosphorus ratios (N_t:P_t) are provided in **Appendix Table B-17** with ratios of inorganic nitrogen (ammonia, nitrite, and nitrate) to orthophosphate (N_i:P_i) being given in **Appendix Table B-18**.

The most meaningful ratio in assessing nutrient limiting conditions is based on the inorganic forms (biogenic salts as previously discussed) since these constituents are immediately available to the primary producers whereas even the unresistant organic forms must be chemically transformed into the inorganic forms prior to photosynthesis. The N_i:P_i ratios determined from March 1998 nutrient data are generally low and found to average approximately 1.35:1. However, a high average ratio was observed for the September event (i.e. 29.39:1) because of large ratios observed at Stations CC-3 and NC-6. The generally low N_i:P_i ratios are indicative of conditions in which fixed inorganic nitrogen would limit plant growth before orthophosphate (**Figure 4.13B**). Nutrient data collected at Station CC-3 and NC-6 during the monitoring event yielded N_i:P_i ratios of 95.0:1 and 41.0:1, respectively. These high ratio suggests surface waters at this station may be limiting with respect to phosphorus. Further, this ratio indicates that additional input of nitrogen to Station CC-3 and NC-6 may be associated with increased decomposition of organic matter in conjunction with decreased gross primary productivity.

Similarly, N_t:P_t ratios determined from 1998 nutrient data in the Catfish and North Creeks exhibited an overall average of 14.9:1 (**Appendix Table B-17**). Because this ratio is higher than 6.8:1, it would be indicative of a system out of balance with respect to nitrogen and phosphorus. Since the N_t:P_t ratio is higher than 6.8:1 it indicates a condition in which phosphorus would limit plant growth before nitrogen (**Figure 4.13A**). However, it is important to note that this average N_t:P_t ratio is skewed with respect to the September 1998 monitoring event. During this event, the N_t:P_t ratio calculated for Stations CC-3 and NC-6 were 40.5:1 and 36.5:1, respectively, suggesting that their may be additional nitrogen input in the vicinity of Stations CC-3 and NC-6 (Meybeck, 1982).

Overall, the generally low N_i:P_i ratios calculated from the 1998 data are attributed to the naturally high levels of orthophosphate, while total nitrogen is comprised of less than 12 percent inorganic nitrogen. The higher N_t:P_t ratios determined are indicative of the abundance of aquatic vegetation in the creeks and the high percentage of organic nutrients present.

4.5 Oils and Greases

As provided in **Appendix Table B-19**, the concentration of oil and grease in the streams of the Palmer Ranch ranged from <0.1 to 2.0 mg/L and averaged 1.1 mg/L during the 1998 monitoring year. One of 11 measurements made for oil and grease during 1998 was below the analytical detection limit. Additionally, all oil and grease measurements made during 1998 were below the State and County standard of ≤5 mg/L specified in FAC Chapter 62-302.

The concentrations of oils and greases reported in the streams of the Palmer Ranch during the previous years of the monitoring program (Palmer Venture, 1986; and CCI, 1986, 1988a, 1988b, 1991, 1992a, 1993, 1994, 1995b, 1996, and 1997), ranged from less than 0.1 mg/L to 17 mg/L. Most of the historic observations (231 of 238) were found to be less than the maximum allowable State criteria of 5 mg/L.

4.6 Bacteriological Parameters

4.6.1 *Total Coliform*

As indicated in **Appendix Table B-20**, the streams traversing the Palmer Ranch were found to exhibit concentrations of total coliform bacteria ranging from 20 to 200,000 colonies/100 mL with an average of 99,145 colonies/100 mL. Concentrations of total coliform bacteria exceeding the State and County water quality standards were frequently observed during the 1998 monitoring year. Of the 11 samples collected during the 1998 monitoring year, six exceeded both the State and County standards which allow up to 2,400 colonies/100 mL (**Figure 4.14A**). The highest bacteria concentrations were observed in the upper reach of the Catfish Creek/Trunk Ditch Basin (**Figure 4.14A**). During the second, third, fourth, sixth and seventh monitoring years (CCI, 1986, 1988a, 1988b, 1991, and 1992a), the total coliform concentrations in the Catfish Creek/Trunk Ditch Basin were also found to commonly exceed the State and County standards with 67, 52, 53, 43, 78 and 32 percent of the results being higher than the 2,400 colonies/100 mL criteria, respectively.

During previous years of monitoring, the highest number of total coliform bacteria colonies have generally been observed after periods of rainfall, typically during the primary wet season. However, during the 1998 monitoring year, the highest total coliform bacteria levels were observed during the March monitoring event at the end of the heavy rainfall associated with the *El Nino* weather pattern. The mean total coliform level recorded for the March

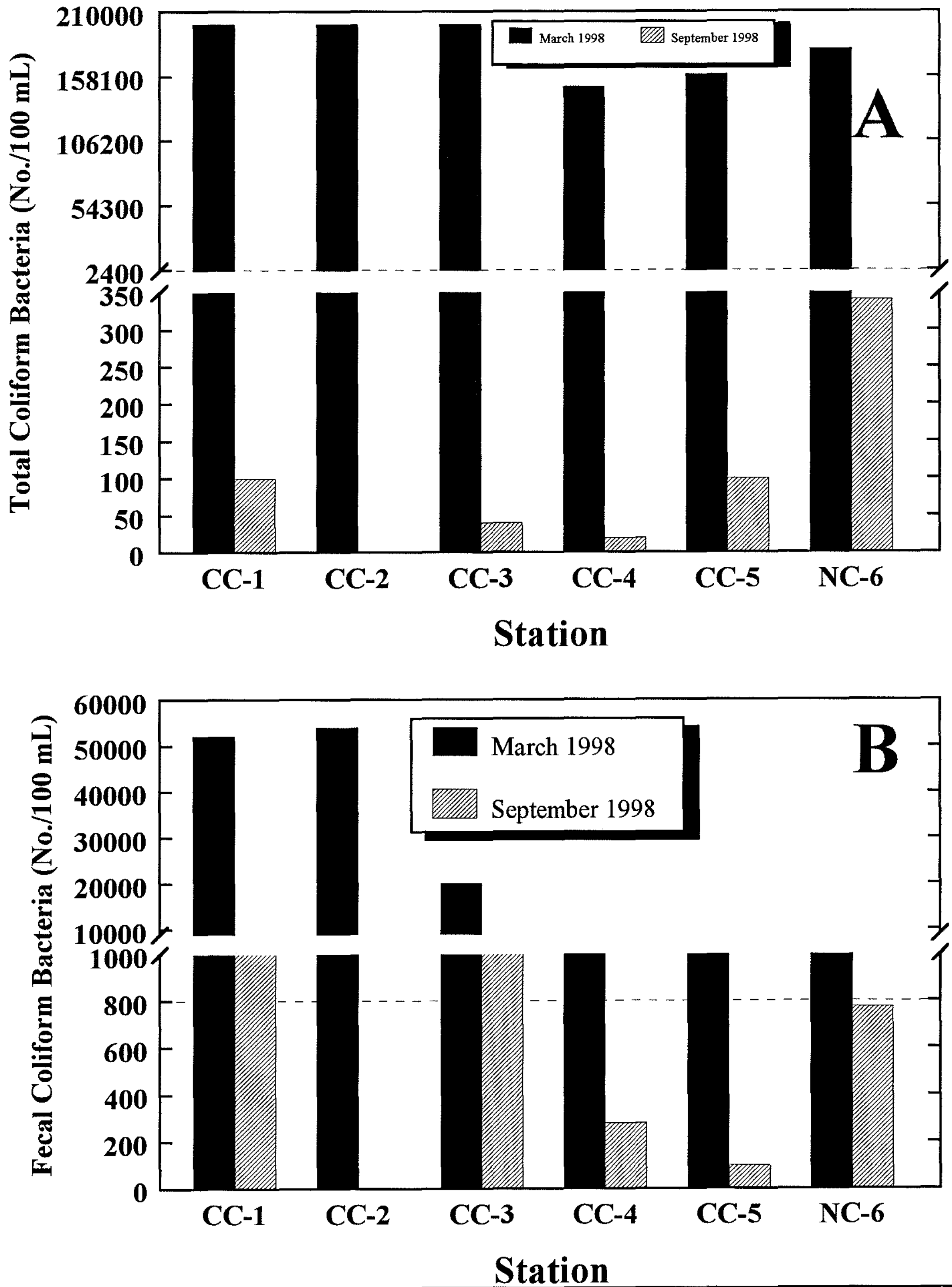


Figure 4.14 **Total Coliform Bacteria (A) and Fecal Coliform Bacteria (B) Counts Measured During Quarterly Monitoring Events Conducted on the Palmer Ranch from January through December 1998. Dashed Lines Depict State Standards.**

monitoring event in Catfish and North Creeks was 181,667 colonies/100 mL compared to an average of 120 colonies/100 mL for the September event. This temporal trend arises from the fact that the primary mode by which coliform bacteria are transported to the streams traversing the ranch is surface runoff. Consequently, seasonal trends with respect to coliform bacteria levels are commonly associated with rainfall.

As noted in previous years (CCI, 1988a, 1988b, 1991, 1992a, 1993, 1994, and 1995b), these data show that several sources of coliform bacteria exist on and upstream of the Palmer Ranch. A primary source is expected to be the naturally occurring coliform bacteria of the soils and vegetation on and upstream of the ranch. During periods of land clearing coupled with significant runoff, this source is expected to be exacerbated. Such a condition probably occurred during the second and third monitoring years in the Catfish Creek/Trunk Ditch Basin as the construction of Prestancia was initiated. Another source of coliform bacteria is represented by the warm-blooded animals inhabiting the watershed, including dogs, cats, cattle, birds, feral hogs, deer, and rodents.

4.6.2 *Fecal Coliform*

During the 1998 monitoring year, the streams of the Palmer Ranch exhibited fecal coliform densities ranged from 100 to 54,000 colonies/100 mL and averaged12,725 colonies/100 mL (**Appendix Table B-21**) as compared with a range of <10 to 6,000 colonies/100 mL during the previous five years of monitoring (CCI, 1994, 1995b, 1996, 1997 and 1998). Eight of the 11 samples (73 percent) collected during 1998 contained fecal coliform bacteria densities exceeding the 800 colonies/100 mL maximum allowed by State and County water quality criteria for Class III surface waters (**Figure 4.14B**). This is higher than results reported for the previous monitoring years, which had from 18 to 43 percent of the samples collected exceeding the 800 colonies/100 mL standard.

Spatially, the highest number of fecal coliform colonies during the 1998 monitoring year occurred in the upper reach of the Catfish Creek/Trunk Ditch Basin at Stations CC-1, CC-2 and CC-3 (**Figure 4.14B**) probably due to a greater number of warm-blooded animals in the stream communities associated with the undeveloped portion of the Palmer Ranch as well as runoff draining into the Catfish Creek/Trunk Ditch Basin from off-site. As described for total coliform bacteria, higher fecal coliform levels have typically been observed in Catfish and North Creeks during the September monitoring event (*i.e.*, end of the summer wet season). However, during the 1998 monitoring year, the highest mean fecal coliform level of 22,683 colonies/100 mL was observed during the March monitoring event (*i.e.*, end of the *El Nino* rains) compared with an average of 776 colonies/100 mL determined for the September sampling. Surface runoff associated with a higher antecedent rainfall amount for the March sampling event resulted in more bacteria being transported to both creeks.

The high fecal coliform bacteria levels observed upstream of the Palmer Ranch, indicate significant sources of fecal coliform bacteria originating upstream the ranch. Primary sources of fecal coliform bacteria are considered to be dogs, cats, birds, cattle, and other warm-blooded wild animals inhabiting the basin.

The total and fecal coliform counts for the September event are inconsistent. During this event, the fecal coliform counts were equal to or higher than the total coliform counts for all stations. This is probably an error since the fecal coliform bacteria are a component of the total coliform bacteria and, as such, should be present at lower densities. The analytical laboratory performing the analyses was contacted to confirm that the numbers were accurate. The laboratory indicated that the results provided were accurate and they did not know how the observed results could be explained. The laboratory was contacted again during May to verify the results and they reconfirmed the findings. The laboratory was then notified to contact CCI immediately if similar problems were determined so that the stations could be resampled for coliform bacteria.

4.7 Trace Elements

During 1998, samples were collected for the analyses of trace elements (*i.e.*, arsenic, copper, lead, and zinc) during the September monitoring event. The result of these analyses are provided in **Appendix Table B-22** along with the applicable State and County Standards for each element.

Arsenic concentrations during the 1998 monitoring year ranged from <1 to 7 µg/L and averaged 3 µg/L (**Appendix Table B-22**). All arsenic concentrations measured during the 1998 monitoring year were below the State standard of 50 µg/L[3]. Possible sources of arsenic

[3]Based on a total hardness of 110 mg/L.

include naturally occurring minerals and the use of arsenic-based pesticides on and upstream of the Palmer Ranch.

Concentrations of total copper measured in the Catfish Creek and North Creek basins during the 1998 monitoring period averaged 20 μg/L and ranged from <20 to 30 μg/L (**Appendix Table B-22**). Unfortunately, the analytical laboratory did not analyze the copper to detection limits which would allow a determination of compliance with the State and County standard of 12.8 μg/L[4]. However, concentrations in excess of the detection limits and standards were observed at Stations CC-3, CC-4 and NC-6. Possible sources of copper in the surface waters of the Palmer Ranch include the use of copper containing herbicides, fertilizers, algicides, and pesticides.

Total lead concentrations measured in the streams of the Palmer Ranch during 1998 averaged 1 μg/L and ranged from <1 to 2 μg/L (**Appendix Table B-22**). Therefore, all of the measured lead concentrations were in compliance with both the State and County standard of 3.6 μg/L[5]. Possible anthropogenic sources of lead in the surface waters of the Palmer Ranch included automobile emissions roads and parking areas, and runoff from light industrial land uses located upstream of the Palmer Ranch property.

The concentration of zinc determined for the six monitoring stations during 1998 averaged 19 μg/L and ranged from 14 to 26 μg/L.. Therefore, none of the five zinc concentrations

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[4]*Ibid.*

[5]*Ibid.*

determined during the 1998 monitoring events exceeded the State and County standard of 115 µg/L[6]. Possible sources of zinc include the use of zinc containing fertilizers and runoff from roads on and upstream of the Palmer Ranch.

[6] *Ibid.*

5.0 SUMMARY

During the fourteenth year of the "Continuing Surface Water Quality Monitoring Program", sampling was performed at six stations located in the Catfish Creek/Trunk Ditch Basin of the Palmer Ranch from January through December 1998. In 1994, the sampling frequency was changed from quarterly to semi-annual and approved by the Sarasota County Pollution Control Division. Semi-annual monitoring events were performed during March and September 1998. Water quality monitoring has been performed at approximately the same six locations in the Catfish Creek/Trunk Ditch Basin during the previous thirteen years. However, monitoring was performed bimonthly during the first year and subsequently changed to a quarterly frequency at the beginning of the second year of monitoring. The results of the first thirteen years of monitoring may be reviewed in the annual reports prepared by Palmer Venture (1986) and CCI (1986, 1988a, 1988b, 1990, 1991, 1992a, 1993, 1994, 1995b, 1996, 1997 and 1998). In addition, results from the "Stormwater Pollutant Loading Monitoring Program" for Palmer Ranch performed from August 1988 to April 1990 can be reviewed in a final report prepared by CCI (1992b).

The continuing Surface Water Quality Monitoring Program conducted for the Palmer Ranch streams entailed measurements of specific conductance, water temperature, suspended solids, turbidity, dissolved oxygen, pH, biochemical oxygen demand, macronutrients, oils and greases, and bacteriological quality during each semi-annual sampling event. In addition, samples for the determination of trace elements were collected at five sites (one was dry) on the Palmer Ranch during the annual sampling event performed in September 1998. These results obtained during the 1998 monitoring year are summarized in **Table 5.1**. A complete tabulation of results by parameter is provided in **Appendix B**.

The 1998 monitoring year exhibited a total annual rainfall amount below historical normal levels with a total of approximately 48 inches of precipitation occurring on the Palmer Ranch. The historical annual average amount of rainfall for the region based on a 30-year record is 54.8 inches per year (NOAA, 1982). Rainfall during previous monitoring years on the Palmer Ranch ranged from 33 to 65 inches. The rainfall during the 1998 monitoring year occurred in a somewhat abnormal pattern. The cumulative rainfall from January through March 1998 was almost 22 inches and substantially more than normal. Then below average rainfall occurred for every month, except November, during the remainder of the year.

The specific conductance measured in the Catfish Creek/Trunk Ditch Basin in 1998 ranged from 366 to 1,157 μmhos/cm, as compared with a range of 421 to 1,625 μmhos/cm reported for previous monitoring years. Seasonally, lower conductivities were recorded during the March monitoring event. These lower conductivities most likely resulted from the cumulative effects of increased surface runoff of low conductivity storm water resulting from the *El Nino* weather pattern.

Total suspended solids in the Catfish Creek/Trunk Ditch Basin averaged 6.5 mg/L and ranged from 1.0 to 15.0 mg/L during the 1998 monitoring year. Seasonally, a slightly higher mean TSS level (*i.e.*, 8.8 mg/L) was observed during the September 1998 monitoring event probably resulting from higher rainfall and subsequent surface water runoff. The March

TABLE 5.1. SUMMARY OF RESULTS FOR THE PALMER RANCH WATER QUALITY MONITORING PROGRAM FOR THE PERIOD FROM JANUARY THROUGH DECEMBER, 1998

Parameter	CC-1 Mean	CC-2 Mean	CC-3 Mean	CC-4 Mean	CC-5 Mean	Catfish Creek Basin				Applicable Criteria[a]
						Mean	N	Min	Max	
PHYSICAL PARAMETERS										
Depth (ft)	1.5	0.3	0.5	0.8	0.6	0.7	10	0.0	2.6	------
Flow (GPM)	1420.45	109.96	540.80	1424.94	3682.40	1435.71	10	0.00	7082.06	------
Temperature (C)	24.1	23.9	24.4	27.0	27.4	25.5	9	21.1	30.9	------
Conductivity (µmhos/cm)[b]	501	762	828	605	706	671	9	366	1157	+50%,1275
Total Suspended Solids (mg/L)	10.0	1.0	4.2	6.7	10.3	7.0	9	1.0	15.0	------
Turbidity (NTU)[c]	7.1	3.1	5.3	5.7	4.6	5.4	9	3.1	8.1	+29
OXYGEN DEMAND AND RELATED PARAMETERS										
Biochemical Oxygen Demand, 5-day (mg/L)	3.4	2.5	2.1	2.3	2.6	2.6	9	1.5	3.8	------
Dissolved Oxygen (mg/L)	4.8	12.9	5.6	4.2	7.2	6.3	9	3.4	12.9	≥5.0
pH (-log[H+])	6.4	7.7	6.7	7.0	7.2	6.9	9	6.0	7.7	6.0 - 8.5
MACRONUTRIENTS										
Nitrite Nitrogen (mg/L)	0.02	<0.01	0.02	0.02	0.02	0.01	9	<0.01	0.03	------
Nitrate Nitrogen (mg/L)	0.11	<0.01	0.20	0.02	0.02	0.08	9	<0.01	0.37	------
Ammonia Nitrogen (mg/L)	0.11	<0.02	0.05	0.02	0.05	0.05	9	<0.02	0.20	------[d]
Organic Nitrogen (mg/L)	0.97	1.44	1.00	1.14	0.93	1.05	9	0.74	1.44	------
Total Nitrogen (mg/L)	1.19	1.46	1.26	1.19	1.00	1.19	9	0.83	1.46	------
Orthophosphate (mg/L)	0.09	0.23	0.05	0.04	0.03	0.07	9	<0.01	0.23	------
Total Phosphorus (mg/L)	0.17	0.27	0.09	0.11	0.10	0.13	9	0.03	0.27	------
ORGANIC CONSTITUENTS										
Oil and Grease (mg/L)	1.5	0.6	1.0	0.8	1.3	1.1	9	<0.1	2.0	≤ 5
MICROBIOLOGICAL (COUNT/100 ML)										
Total Coliform Bacteria	100,050	200,000	100,020	75,010	80,050	101,140	9	20	200,000	≤2,400
Fecal Coliform Bacteria	26,560	54,000	10,900	640	4,050	15,367	9	100	54,000	≤800

TABLE 5.1. (CONTINUED)

Parameter	NC-6 Mean	All Stations Mean	N	Min	Max	Applicable Criteria[a]
PHYSICAL PARAMETERS						
Depth (ft)	1.0	0.7	12	0.0	26	------
Flow (GPM)	1460.84	1439.90	12	0.00	7082.06	------
Temperature (C)	25.0	25.4	11	21.1	30.9	------
Conductivity (µmhos/cm)[b]	627	663	11	366	1,157	+50%
Total Suspended Solids (mg/L)	4.0	6.5	11	1.0	15.0	------
Turbidity (NTU)[c]	2.8	4.9	11	2.6	8.1	+29
OXYGEN DEMAND AND RELATED PARAMETERS						
Biochemical Oxygen Demand, 5-day (mg/L)	1.9	2.4	11	1.5	3.8	------
Dissolved Oxygen (mg/L)	5.0	6.0	11	2.0	12.9	≥5.0
pH (-log[H+])	7.3	7.0	11	6.0	7.7	6.0 - 8.5
Macronutrients						
Nitrite Nitrogen (mg/L)	0.02	0.01	11	<0.01	0.03	------
Nitrate Nitrogen (mg/L)	0.06	0.07	11	<0.01	0.37	------
Ammonia Nitrogen (mg/L)	0.06	0.05	11	<0.02	0.20	------[d]
Organic Nitrogen (mg/L)	1.15	1.07	11	0.74	1.44	------
Total Nitrogen (mg/L)	1.29	1.21	11	0.83	1.48	------
Orthophosphate (mg/L)	0.02	0.06	11	<0.01	0.23	------
Total Phosphorus (mg/L)	0.07	0.12	11	0.03	0.27	------
ORGANIC CONSTITUENTS						
Oil and Grease	1.6	1.1	11	<0.1	2.0	≤5
MICROBIOLOGICAL (count/100 mL)						
Total Coliform Bacteria	90,170	99,145	11	20	200,000	≤2,400
Fecal Coliform Bacteria	840	12,725	11	100	54,000	≤800

[a] State and County Criteria.
[b] State Criteria allows 50% increase above background to 1275 µmhos/cm.
[c] State Criteria allows a maximum increase of 29 NTU above background.
[d] State Criteria allows a maximum of 0.02 mg/L unionized ammonia.

event exhibited a mean TSS level of 4.6 mg/L. The relatively small seasonal variation in TSS concentrations recorded during the 1998 monitoring year may be attributable to a well-established littoral zone along much of Catfish Creek and the storm water management systems in place on the west side of the Palmer Ranch and the dry conditions experienced during much of the year. In general the TSS levels measured during 1998 were slightly higher than those measured in 1996 and 1997, but comparable to those reported for earlier monitoring years. The low TSS levels can be attributed to the widening and deepening of Catfish Creek/Trunk Ditch to decrease stream velocity and flood height. By reducing velocity of the stream, TSS levels are also lowered.

Turbidity levels measured in Catfish and North Creeks during 1998 averaged 4.9 with a range from 2.6 to 8.1 NTU. Turbidity levels followed the same seasonal trends as TSS with higher levels being observed for the September event. As in previous years, turbidity and TSS levels measured during 1998 were found to be positively correlated.

Five-day biochemical oxygen demand was found to average 2.4 mg/L for the two streams of the North Tract. The BOD_5 levels measured in the Catfish Creek/Trunk Ditch and North Creek Basins during 1998 were comparable to those measured during the 1993, 1994, 1995, 1996 and 1997 monitoring years. Levels of BOD_5 observed during the second, third, and fourth monitoring years were greater than in 1998. As observed during prior monitoring years, a positive correlation was found between BOD_5 and TSS (*i.e.*, $r = 0.77$) indicating the contribution of decaying vegetation and other organic matter to TSS levels in the water column.

Dissolved oxygen levels were found to average 6.0 mg/L with a range from 2.0 to 12.9 mg/L. The results obtained for dissolved oxygen concentrations during the 1998 monitoring year for Catfish and North Creeks are generally comparable to those reported during the third through thirteenth monitoring years. Of the 11 dissolved oxygen measurements made during 1998, five were below the $\geq$5.0 mg/L State and County standard.

The steady decline of nutrients observed during the previous monitoring years in the surface waters of the Palmer Ranch stabilized in 1998. Nutrient concentrations during the 1998 monitoring year rarely exceeded the threshold levels characteristic of eutrophic conditions. During the fourteenth year of monitoring, Catfish and North Creeks exhibited annual average total nitrogen and total phosphorus concentrations of 1.21 and 0.12 mg/L, respectively. In general, the average total nitrogen concentration for the 1998 monitoring year was slightly higher than observed within the Catfish Creek and North Creek basins for the 1997 monitoring year and comparable to the levels observed during 1994, 1995 and 1996. Total Phosphorus concentrations determined during 1998 were among the lowest recorded for the monitoring period.

Inorganic nitrogen and phosphorus fractions that are required by plants during the process of photosynthesis were also found to be readily available. Inorganic nitrogen represented 12 percent of the total nitrogen content while orthophosphate comprised 50 percent of the total phosphorus concentration measured during 1998. During prior years of monitoring, inorganic phosphorus comprised 53 to 77 percent of the total phosphorus and the inorganic nitrogen fraction constituted 10 to 23 percent of the total nitrogen content.

The average composition of the total nitrogen present during 1998 is approximately 88 percent organic nitrogen, 4 percent ammonia, 6 percent nitrate nitrogen, and less than 1 percent nitrite nitrogen. Total phosphorus present in Catfish and North Creeks during 1998 is comprised of approximately 50 percent orthophosphate with the remaining 50 percent being organic phosphorus.

Although the availability of inorganic nitrogen was substantial, the low N_i:P_i ratio implies that inorganic nitrogen should become limiting to primary producers in the streams on the Palmer Ranch before orthophosphate. Ratios of inorganic nitrogen to inorganic phosphorus (*i.e.*, orthophosphate) were generally found to be below 2.0:1 (by weight), as compared with algal protoplasm that has a ratio of 6.8:1 (by weight). Interestingly, the average ratio of total nitrogen to total phosphorus determined from 1998 nutrient concentrations was 14.9:1 indicative of a more balanced system slightly limited with respect to phosphorus. The ratios of inorganic nitrogen to inorganic phosphorus averaged 1:1 to 4.6:1 during the previous years of monitoring.

Potential sources of nutrients to Catfish Creek upstream of the Palmer Ranch are surface runoff originating in the commercial-industrial strip development along Clark Road and from the country club and development located in the western part of the Catfish Creek/Trunk Ditch Basin. Within the ranch, potential sources of nutrients include Prestancia (golf course and residential development) and active pastures. Additionally, rainfall and surficial phosphate deposits represent two ubiquitous sources of phosphate and fixed nitrogen throughout the ranch.

During the fourteenth year of monitoring, all oils and greases concentrations measured for stations located in Catfish Creek and North Creek were below the State standard of ≤5.0 mg/L. Potential sources of oils and greases into the Catfish and North Creeks include runoff from the golf course, roads, and natural vegetation. During previous years of monitoring in the Catfish and North Creeks, oils and greases ranged from <0.2 to 1.6 mg/L with only seven of the 238 observations (*i.e.*, approximately 3 percent) exceeding the State standard, and only one measurement exceeding the 15 mg/L County standard.

The bacteriological quality of the streams on the Palmer Ranch was found to be higher than that observed during previous monitoring years. Total coliform and fecal coliform levels in excess of the applicable standards were sometimes observed during 1998. Of the 11 total coliform analyses, six measurements exceeded the maximum allowable limit of 2,400 colonies/100 mL for total coliform bacteria. Eight of the 11 fecal coliform counts were found to exceed the maximum allowable limit of 800 colonies/100 mL. During the previous monitoring years, 32 of 215 total coliform bacteria measurements (or approximately 15 percent) exceeded the 2,400 colonies/100 mL as specified in the State standard. In addition, approximately 12 percent of the fecal coliform bacteria measurements in the streams of the North Tract exceeded the 800 colonies/100 mL State standard. The primary sources of coliform bacteria within the Palmer Ranch are expected to include warm-blooded animals as well as naturally occurring soil bacteria.

During storm events that frequently occur in the early spring through late summer, it is likely that more fecal and non-fecal coliform bacteria are transported by surface runoff to the streams of the Palmer Ranch than at other times of the year. However, during drier periods of the year, it is likely that birds, cattle, and other warm-blooded animals, which are sources of fecal coliform bacteria, are attracted to the streams to water and feed, thereby resulting in an increase in fecal coliform counts.

Annual samples for the analyses of trace elements (*i.e.*, arsenic, copper, lead, and zinc) were collected during the September 1998 sampling event. Concentrations of zinc measured in all samples collected during the September 1998 monitoring event averaged 19 µg/L and ranged from 14 to 26 µg/L. The levels of zinc in the two streams of the North Tract of Palmer Ranch were determined to be in compliance of both State and County standards during the 1998 monitoring year. Arsenic concentrations averaged 3 µg/L and ranged from <1 to 7 µg/L for the September 1998 monitoring event. Water samples collected in Catfish and North Creeks had copper concentrations ranging from <20 to 30 µg/L and averaging 20 µg/L. Lead concentrations averaged 1 µg/L and ranged from <1 to 2 µg/L for the September 1998 monitoring event. Therefore, the concentrations of arsenic and lead in all samples were below both the State and County standards. Three of the copper concentrations exceeded the State and County standard.

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APPENDIX A
Exhibit "E"

Exhibit "E" to the Amended and Restated
Master Development Order for the Palmer Ranch
Development of Regional Impact

(An Exhibit Containing Surface
Water Monitoring Program and
Consisting of Pages E-1 through E-5)

SURFACE WATER MONITORING PROGRAM

Locations

Water quality measurements and grab samples shall be performed in Catfish Creek, North Creek and South Creek. Sampling and measurements shall be made at a total of 10 monitoring stations (refer to FIGURE 5). Five stations are located in Catfish Creek (CC-1, CC-2, CC-3, CC-4 and CC-5); one station is located in North Creek (NC-6); and four stations are located in South Creek (SC-1, SC-2, SC-3 and SC-4)

Procedures

Monitoring shall be accomplished within a two-day period. At the time of grab sampling, simultaneous in situ measurements of dissolved oxygen, pH, temperature and specific conductance shall be made and flow rates shall be determined using velocity-area measurements. Additionally, water depths and pre- and post-event weather conditions shall be recorded. All sample collections and in situ measurements shall be made at approximate mid-depth and mid-stream at each of the ten stations.

Frequency

Due to the wealth of baseline monitoring data which currently exists, baseline monitoring of all South Creek sites shall be suspended until one month before development begins. One month prior to the commencement of sampling the Palmer Ranch will notify the Sarasota County Pollution Control Division the dates of sampling and stations to be sampled. At the time of sampling, water quality grab samples will be collected and in situ

SURFACE WATER MONITORING PROGRAM

Locations

Water quality measurements and grab samples shall be performed in Catfish Creek, North Creek and South Creek. Sampling and measurements shall be made at a total of 10 monitoring stations (refer to FIGURE 5). Five stations are located in Catfish Creek (CC-1, CC-2, CC-3, CC-4 and CC-5); one station is located in North Creek (NC-6); and four stations are located in South Creek (SC-1, SC-2, SC-3 and SC-4)

Procedures

Monitoring shall be accomplished within a two-day period. At the time of grab sampling, simultaneous in situ measurements of dissolved oxygen, pH, temperature and specific conductance shall be made and flow rates shall be determined using velocity-area measurements. Additionally, water depths and pre- and post-event weather conditions shall be recorded. All sample collections and in situ measurements shall be made at approximate mid-depth and mid-stream at each of the ten stations.

Frequency

Due to the wealth of baseline monitoring data which currently exists, baseline monitoring of all South Creek sites shall be suspended until one month before development begins. One month prior to the commencement of sampling the Palmer Ranch will notify the Sarasota County Pollution Control Division the dates of sampling and stations to be sampled. At the time of sampling, water quality grab samples will be collected and in situ measurements made at all monitoring stations along South Creek. Following this initial monitoring event, all subsequent monitoring shall be performed on a quarterly basis during the development phase. During development, all stations located downstream of an area under development shall be monitored. In addition, one sampling site upstream of a development area shall be maintained for baseline determination. Once an area is substantially developed as agreed to by the Sarasota County Pollution Control Division and Palmer Ranch, a modification of the monitoring program shall be subject to discussion at any time to change the frequency of water quality monitoring from quarterly to semi-annual or to discontinue the monitoring.

Monitoring of Catfish and North Creeks shall continue on a quarterly basis for a maximum of two years or until substantial development takes place. Once substantial development or a two-year period occurs as agreed to by the Sarasota County Pollution Control Division and Palmer Ranch, monitoring frequency for sites located in Catfish and North Creeks shall be subject to change from quarterly to a semi-annual depending on the monitoring results obtained up to that time. Semi-annual sampling, for both basins, shall be performed during a dry and wet season allowing for monitoring of low and high flow conditions.

Parameters

All water quality grab samples shall be analyzed for the following parameters:

- o Biochemical Oxygen Demand, 5-day
- o Nitrite
- o Ortho-phosphate
- o Total Suspended Solids
- o Ammonia Nitrogen
- o Fecal Coliform
- o pH
- o Conductivity
- o Total Kjeldahl Nitrogen
- o Nitrate
- o Total Nitrogen
- o Total Phosphorus
- o Turbidity
- o Oils and Greases
- o Total Coliform
- o Dissolved Oxygen

Additionally, analysis shall be done for the following parameters on an annual basis (the first analysis done for South Creek sites will be in conjunction with the initial monitoring event):

- o Copper
- o Arsenic
- o Lead
- o Zinc

No pesticide or mercury, chromium, cadmium and nickel analysis shall be performed because results obtained from the Palmer Ranch Continuous Water Quality Monitoring Program during April 1985 through June 1990 on sites along Catfish Creek indicate that these parameters have consistently been below detection limits and/or state and county standards. Therefore, it may be more important to monitor those parameters which have exhibited higher concentrations than those set by the state.

Methods

All laboratory analyses and in situ measurements shall be performed in accordance with procedures described in the 17th edition of Standard Methods (APHA, 1989) or the Methods for Chemical Analysis of water and Wastes (USEPA, 1993). Methods used for in situ measurements, sample collection, sample preservation and storage and sample analysis are provided in Table A. As changes in technology advance, the methods used in laboratory analysis may be modified to reflect these state-of-the-art procedures. The surface water monitoring program for Catfish Creek, North Creek and South Creek shall be performed on a continuous basis.

Additional Studies

In considering the water quality of lakes on the Palmer Ranch, the Aquatic Center of the University of Florida has expressed interest in conducting limnological research on the Palmer Ranch. One of the objectives of the research would be to develop state-of-the-art strategies in the control of hydrilla and water hyacinth that can be applied on a nation-wide basis.

Since the borrow pit lake in Parcel C has an overabundance of hydrilla, this area has been selected for research. The borrow pit lake was conditioned in the MDO to undergo limnological study as a result of a previous commitment by the Palmer Ranch. Its characters are similar to other borrow pit lakes located on the Palmer Ranch, as well as other borrow pit lakes in Sarasota County. Management of the lake will comply with the newly adopted earth-moving ordinance (Ordinance No. 89-112) which became effective March 13, 1990. This ordinance has provisions to deal with borrow pit lakes uniformly throughout the County. This lake will be used for stormwater management purposes which will be enhanced by the creation of a littoral shelf. The creation of a littoral shelf would promote improved water quality as desirable vegetation would utilize nutrients and lower BOD and TSS levels. Additionally, the Palmer Ranch has made application for a permit from the Florida Game and Fresh Water Fish Commission for the introduction of Triploid Grass Carp. These measures, along with other biological or chemical controls that may be implemented as part of the University of Florida research project for control of hydrilla and lake rehabilitation, would indicate that a further limnological study is unwarranted. Consequently, it is recommended that the future limnological study of the borrow pit as conditioned in the MDO be deleted.

Further, the MDO required the monitoring of an off-site dairy farm to determine the source and significance of water quality problems contributed to surface water. As a result of the water quality data collected from Station SC-7, which is the site used to monitor this off-site contribution, pollutants have significantly decreased. This is no doubt a result of the elimination of the dairy farm which has been converted to residential development (Serenoa). Therefore, it is recommended that monitoring of the site be terminated.

Reporting

A data report shall be submitted to the Sarasota County Pollution Control Division following each sampling event. The report will include: (1) a map of the monitoring stations; (2) narrative and/or tabulation of methods used in collecting, handling, storing and analyzing all samples; (3) a tabulation of all measurement and results of analyses; and (4) the signature(s) of the individual(s) responsible for the authenticity, precision and accuracy of t he data presented. Brief summaries of the responsibility an credentials of the project team members shall be included. In addition, an annual report of the interpretation of the data shall be prepared following each year of monitoring. The annual report will include hydrological information derived from in situ measurements as well as interpretation of the chemical parameters measured over the year. Also included in the annual report shall be tabular representations of all the data collected over the previous year for all of the sites and graphical representation of some of the chemical trends discovered over the year of monitoring.

APPENDIX B
Water Quality Data

Appendix Table B-1
Continuing Surface Water Quality Monitoring Program
Stream Stage (ft)[a]
January - December, 1998

Sampling Date	Catfish Creek/Trunk Ditch							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	NC-6	Mean	STD	Min	Max	N
March 9, 1998	0.3	0.5	0.8	0.6	0.8	0.6	0.8	0.6	0.2	0.3	0.8	6
September 2, 1998	2.6	0.0	0.3	0.9	0.3	0.8	0.1	0.7	1.0	0.0	2.6	6
Mean	1.5	0.3	0.5	0.8	0.6		0.5					
Minimum	0.3	0.0	0.3	0.6	0.3		0.1					
Maximum	2.6	0.5	0.8	0.9	0.8		0.8					
Std. Deviation	1.6	0.4	0.4	0.2	0.4		0.5					
N	2	2	2	2	2		2					

Stations	Mean	STD	Min	Max	N
CC-1, CC-2 (upper reach)	0.9	1.2	0.0	2.6	4.0
CC-3, CC-4 (mid reach)	0.6	0.3	0.3	0.9	4.0
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	0.7	0.7	0.0	2.6	10.0
All six stations	0.7	0.7	0.0	2.6	12.0

[a] Stream Stage measured at sampling site for each station. 0.00 = Station dry.
STD - Standard deviation
N - Number of observations

Appendix Table B-2
Continuing Surface Water Quality Monitoring Program
Stream Flow (gpm)
January - December, 1998

Sampling Date	Catfish Creek/Trunk Ditch							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	NC-6	Mean	STD	Min	Max	N
March 9, 1998	2840.9	219.9	1081.6	2499.8	7082.1	2744.9	2674.8	2733.2	2367.5	219.9	7082.1	6
September 2, 1998	0.0	0.0	0.0	350.1	282.7	126.6	246.8	146.6	164.0	0.0	350.1	6
Mean	1420.5	110.0	540.8	1424.9	3682.4		1460.8					
Minimum	0.0	0.0	0.0	350.1	282.7		246.8					
Maximum	2840.9	219.9	1081.6	2499.8	7082.1		2674.8					
Std. Deviation	2008.8	155.5	764.8	1520.1	4807.8		1716.9					
N	2	2	2	2	2		2					

Stations	Mean	STD	Min	Max	N
CC-1, CC-2 (upper reach)	765.2	1387.7	0.0	2840.9	4.0
CC-3, CC-4 (mid reach)	982.9	1107.2	0.0	2499.8	4.0
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	1435.7	2243.1	0.0	7082.1	10.0
All six stations	1439.9	2094.0	0.0	7082.1	12.0

STD - Standard deviation
N - Number of observations

Appendix Table B-3
Continuing Surface Water Quality Monitoring Program
Water Temperature (°C)
January - December, 1998

Sampling Date	Catfish Creek/Trunk Ditch							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	NC-6	Mean	STD	Min	Max	N
March 9, 1998	21.1	23.9	21.9	23.6	23.9	22.9	22.7	22.9	1.2	21.1	23.9	6
September 2, 1998	27.0		26.9	30.3	30.9	28.8	27.3	28.5	2.0	26.9	30.9	5
Mean	24.1	23.9	24.4	27.0	27.4		25.0					
Minimum	21.1	23.9	21.9	23.6	23.9		22.7					
Maximum	27.0	23.9	26.9	30.3	30.9		27.3					
Std. Deviation	4.2		3.5	4.7	4.9		3.3					
N	2	1	2	2	2		2					

Stations	Mean	STD	Min	Max	N
CC-1, CC-2 (upper reach)	24.0	3.0	21.1	27.0	3
CC-3, CC-4 (mid reach)	25.7	3.7	21.9	30.3	4
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	25.5	3.5	21.1	30.9	9
All six stations	25.4	3.3	21.1	30.9	11

STD - Standard deviation
N - Number of observations

Appendix Table B-4
Continuing Surface Water Quality Monitoring Program
Specific Conductance (µmhos/cm)[a]
January - December, 1998

Sampling Date	Catfish Creek/Trunk Ditch							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	NC-6	Mean	STD	Min	Max	N
March 9, 1998	366	762	499	512	619	552	432	532	141	366	762	6
September 2, 1998	635		1,157	698	793	821	822	821	202	635	1,157	5
Mean	501	762	828	605	706		627					
Minimum	366	762	499	512	619		432					
Maximum	635	762	1,157	698	793		822					
Std. Deviation	190		465	132	123		276					
N	2	1	2	2	2		2					

Stations	Mean	STD	Min	Max	N
CC-1, CC-2 (upper reach)	588	202	366	762	3
CC-3, CC-4 (mid reach)	717	307	499	1,157	4
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	671	227	366	1,157	9
All six stations	663	222	366	1,157	11

[a] Applicable State surface water quality criteria: Maximum allowable increase of 50% above background or to 1,275 umhos/cm which ever is greater.
STD - Standard deviation
N - Number of observations

Appendix Table B-5
Continuing Surface Water Quality Monitoring Program
Total Suspended Solids (mg/L)
January - December, 1998

Sampling Date	Catfish Creek/Trunk Ditch							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	NC-6	Mean	STD	Min	Max	N
March 9, 1998	11.0	1.0	3.4	2.4	5.5	4.7	4.0	4.6	3.5	1.0	11.0	6
September 2, 1998	9.0		5.0	11.0	15.0	10.0	4.0	8.8	4.5	4.0	15.0	5
Mean	10.0	1.0	4.2	6.7	10.3		4.0					
Minimum	9.0	1.0	3.4	2.4	5.5		4.0					
Maximum	11.0	1.0	5.0	11.0	15.0		4.0					
Std. Deviation	1.4		1.1	6.1	6.7		0.0					
N	2	1	2	2	2		2					
Stations	Mean	STD	Min	Max	N							
CC-1, CC-2 (upper reach)	7.0	5.3	1.0	11.0	3							
CC-3, CC-4 (mid reach)	5.5	3.9	2.4	11.0	4							
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	7.0	4.7	1.0	15.0	9							
All six stations	6.5	4.4	1.0	15.0	11							

STD - Standard deviation
N - Number of observations

Appendix Table B-6
Continuing Surface Water Quality Monitoring Program
Turbidity (NTU)[a]
January - December, 1998

Sampling Date	Catfish Creek/Trunk Ditch							All Stations					
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	NC-6	Mean	STD	Min	Max	N
March 9, 1998	7.8	3.1	4.0	3.3	4.6	4.6	2.6	4.2	1.9	2.6	7.8	6
September 2, 1998	6.3		6.5	8.1	4.5	6.4	2.9	5.7	2.0	2.9	8.1	5
Mean	7.1	3.1	5.3	5.7	4.6		2.8					
Minimum	6.3	3.1	4.0	3.3	4.5		2.6					
Maximum	7.8	3.1	6.5	8.1	4.6		2.9					
Std. Deviation	1.1		1.8	3.4	0.1		0.2					
N	2	1	2	2	2		2					
Stations	Mean	STD	Min	Max	N							
CC-1, CC-2 (upper reach)	5.7	2.4	3.1	7.8	3							
CC-3, CC-4 (mid reach)	5.5	2.2	3.3	8.1	4							
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	5.4	1.9	3.1	8.1	9							
All six stations	4.9	2.0	2.6	8.1	11							

[a] Applicable State surface water quality criteria: Maximum allowable increase of 29 NTU above background
STD - Standard deviation
N - Number of observations

Appendix Table B-7
Continuing Surface Water Quality Monitoring Program
5-Day Biochemical Oxygen Demand (mg/L)
January - December, 1998

Sampling Date	Catfish Creek/Trunk Ditch							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	NC-6	Mean	STD	Min	Max	N
March 9, 1998	3.8	2.5	2.1	1.5	2.1	2.4	1.7	2.3	0.8	1.5	3.8	6
September 2, 1998	3.0		2.0	3.0	3.0	2.8	2.0	2.6	0.5	2.0	3.0	5
Mean	3.4	2.5	2.1	2.3	2.6		1.9					
Minimum	3.0	2.5	2.0	1.5	2.1		1.7					
Maximum	3.8	2.5	2.1	3.0	3.0		2.0					
Std. Deviation	0.6		0.1	1.1	0.6		0.2					
N	2	1	2	2	2		2					

Stations	Mean	STD	Min	Max	N
CC-1, CC-2 (upper reach)	3.1	0.7	2.5	3.8	3
CC-3, CC-4 (mid reach)	2.2	0.6	1.5	3.0	4
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	2.6	0.7	1.5	3.8	9
All six stations	2.4	0.7	1.5	3.8	11

STD - Standard deviation
N - Number of observations

Appendix Table B-8
Continuing Surface Water Quality Monitoring Program
Dissolved Oxygen (mg/L)[a]
January - December, 1998

Sampling Date	Catfish Creek/Trunk Ditch							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	NC-6	Mean	STD	Min	Max	N
March 9, 1998	5.5	12.9	7.8	3.6	7.7	7.5	7.9	7.6	3.1	3.6	12.9	6
September 2, 1998	4.1		3.4	4.8	6.6	4.7	2.0	4.2	1.7	2.0	6.6	5
Mean	4.8	12.9	5.6	4.2	7.2		5.0					
Minimum	4.1	12.9	3.4	3.6	6.6		2.0					
Maximum	5.5	12.9	7.8	4.8	7.7		7.9					
Std. Deviation	1.0		3.1	0.8	0.8		4.2					
N	2	1	2	2	2		2					

Stations	Mean	STD	Min	Max	N
CC-1, CC-2 (upper reach)	7.5	4.7	4.1	12.9	3
CC-3, CC-4 (mid reach)	4.9	2.0	3.4	7.8	4
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	6.3	3.0	3.4	12.9	9
All six stations	6.0	3.0	2.0	12.9	11

[a] Applicable State surface water quality criteria: Minimum allowable concentration of 5.0 mg/L
STD - Standard deviation
N - Number of observations

Appendix Table B-9
Continuing Surface Water Quality Monitoring Program
Water pH (-Log[H+])[a]
January - December, 1998

Sampling Date	Catfish Creek/Trunk Ditch							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	NC-6	Mean	STD	Min	Max	N
March 9, 1998	6.8	7.7	7.1	7.3	7.3	7.2	7.4	7.3	0.3	6.8	7.7	6
September 2, 1998	6.0		6.2	6.7	7.0	6.5	7.1	6.6	0.5	6.0	7.1	5
Mean	6.4	7.7	6.7	7.0	7.2		7.3					
Minimum	6.0	7.7	6.2	6.7	7.0		7.1					
Maximum	6.8	7.7	7.1	7.3	7.3		7.4					
Std. Deviation	0.6		0.6	0.4	0.2		0.2					
N	2	1	2	2	2		2					

Stations	Mean	STD	Min	Max	N
CC-1, CC-2 (upper reach)	6.8	0.9	6.0	7.7	3
CC-3, CC-4 (mid reach)	6.8	0.5	6.2	7.3	4
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	6.9	0.5	6.0	7.7	9
All six stations	7.0	0.5	6.0	7.7	11

[a] Applicable State surface water quality criteria: Allowable range of 6.0 to 8.5
STD - Standard deviation
N - Number of observations

Appendix Table B-10
Continuing Surface Water Quality Monitoring Program
Total Nitrogen (mg/L)
January - December, 1998

Sampling Date	Catfish Creek/Trunk Ditch							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	NC-6	Mean	STD	Min	Max	N
March 9, 1998	1.20	1.46	1.30	1.22	0.83	1.20	1.48	1.25	0.24	0.83	1.48	6
September 2, 1998	1.19		1.22	1.15	1.17	1.18	1.10	1.16	0.04	1.10	1.22	5
Mean	1.19	1.46	1.26	1.19	1.00		1.29					
Minimum	1.19	1.46	1.22	1.15	0.83		1.10					
Maximum	1.20	1.46	1.30	1.22	1.17		1.48					
Std. Deviation	0.01		0.06	0.05	0.24		0.27					
N	2	1	2	2	2		2					

Stations	Mean	STD	Min	Max	N
CC-1, CC-2 (upper reach)	1.28	0.16	1.19	1.46	3
CC-3, CC-4 (mid reach)	1.22	0.06	1.15	1.30	4
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	1.19	0.16	0.83	1.46	9
All six stations	1.21	0.18	0.83	1.48	11

STD - Standard deviation
N - Number of observations

Appendix Table B-11
Continuing Surface Water Quality Monitoring Program
Nitrite Nitrogen (mg/L)
January - December, 1998

Sampling Date	Catfish Creek/Trunk Ditch							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	NC-6	Mean	STD	Min	Max	N
March 9, 1998	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.00	<0.01	0.01	6
September 2, 1998	<0.03		<0.05	<0.05	<0.05	<0.05	<0.05	<0.03	0.00	<0.0	<0.05	5
Mean	<0.02	<0.01	<0.02	<0.02	<0.02		0.02					
Minimum	<0.01	<0.01	<0.01	<0.01	<0.01		0.01					
Maximum	<0.05	<0.01	<0.05	<0.05	<0.05		<0.05					
Std. Deviation	0.01		<0.01	<0.01	0.01		0.01					
N	2	1	2	2	2		2					

Stations	Mean	STD	Min	Max	N
CC-1, CC-2 (upper reach)	<0.01	0.01	<0.01	<0.05	3
CC-3, CC-4 (mid reach)	<0.02	0.01	<0.01	<0.05	4
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	<0.01	0.01	<0.01	<0.05	9
All six stations	0.01	0.01	<0.01	<0.05	11

STD - Standard deviation
N - Number of observations

Appendix Table B-12
Continuing Surface Water Quality Monitoring Program
Nitrate Nitrogen (mg/L)
January - December, 1998

Sampling Date	Catfish Creek/Trunk Ditch							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	NC-6	Mean	STD	Min	Max	N
March 9, 1998	0.02	<0.01	0.03	<0.01	<0.01	0.01	0.02	0.01	0.01	<0.01	0.03	6
September 2, 1998	0.19		0.37	<0.05	<0.05	0.15	0.10	0.14	0.14	<0.05	0.37	5
Mean	0.11	<0.01	0.20	<0.02	<0.02		0.06					
Minimum	0.02	<0.01	0.03	<0.01	<0.01		0.02					
Maximum	0.19	<0.01	0.37	<0.05	<0.05		0.10					
Std. Deviation	0.12		0.24	0.01	0.01		0.06					
N	2	1	2	2	2		2					

Stations	Mean	STD	Min	Max	N
CC-1, CC-2 (upper reach)	0.07	0.10	<0.01	0.19	3
CC-3, CC-4 (mid reach)	0.11	0.18	<0.01	0.37	4
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	0.08	0.13	<0.01	0.37	9
All six stations	0.07	0.11	<0.01	0.37	11

STD - Standard deviation
N - Number of observations

Appendix Table B-13
Continuing Surface Water Quality Monitoring Program
Ammoniacal Nitrogen (mg/L)
January - December, 1998

Sampling Date	Catfish Creek/Trunk Ditch							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	NC-6	Mean	STD	Min	Max	N
March 9, 1998	<0.02	<0.02	<0.02	<0.02	0.08	0.02	0.04	0.03	0.03	<0.02	0.08	6
September 2, 1998	0.20		0.08	0.02	0.01	0.08	0.08	0.08	0.08	0.01	0.20	5
Mean	0.11	<0.02	0.05	0.02	0.05		0.06					
Minimum	<0.02	<0.02	0.01	<0.02	0.01		0.04					
Maximum	0.20	<0.02	0.08	0.02	0.08		0.08					
Std. Deviation	0.13		0.05	0.01	0.05		0.03					
N	2	1	2	2	2		2					

Stations	Mean	STD	Min	Max	N
CC-1, CC-2 (upper reach)	0.07	0.11	<0.02	0.20	3
CC-3, CC-4 (mid reach)	0.03	0.03	<0.02	0.08	4
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	0.05	0.06	<0.02	0.20	9
All six stations	0.05	0.06	<0.02	0.20	11

STD - Standard deviation
N - Number of observations

Appendix Table B-14
Continuing Surface Water Quality Monitoring Program
Organic Nitrogen (mg/L)[a]
January - December, 1998

Sampling Date	Catfish Creek/Trunk Ditch							All Stations					
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	NC-6	Mean	STD	Min	Max	N
March 9, 1998	1.16	1.44	1.25	1.20	0.74	1.16	1.41	1.20	0.25	0.74	1.44	6
September 2, 1998	0.77		0.74	1.08	1.11	0.93	0.89	0.92	0.17	0.74	1.11	5
Mean	0.97	1.44	1.00	1.14	0.93		1.15					
Minimum	0.77	1.44	0.74	1.08	0.74		0.89					
Maximum	1.16	1.44	1.25	1.20	1.11		1.41					
Std. Deviation	0.28		0.36	0.08	0.26		0.37					
N	2	1	2	2	2		2					

Stations	Mean	STD	Min	Max	N
CC-1, CC-2 (upper reach)	1.12	0.34	0.77	1.44	3
CC-3, CC-4 (mid reach)	1.07	0.23	0.74	1.25	4
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	1.05	0.25	0.74	1.44	9
All six stations	1.07	0.26	0.74	1.44	11

[a] Organic Nitrogen = Total Nitrogen - Ammoniacal Nitrogen
STD - Standard deviation
N - Number of observations

Appendix Table B-15
Continuing Surface Water Quality Monitoring Program
Total Phosphorus (mg/L)
January - December, 1998

Sampling Date	Catfish Creek/Trunk Ditch							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	NC-6	Mean	STD	Min	Max	N
March 9, 1998	0.18	0.27	0.15	0.10	0.06	0.15	0.10	0.14	0.08	0.06	0.27	6
September 2, 1998	0.15		0.03	0.12	0.14	0.11	0.03	0.09	0.06	0.03	0.15	5
Mean	0.17	0.27	0.09	0.11	0.10		0.07					
Minimum	0.15	0.27	0.03	0.10	0.06		0.03					
Maximum	0.18	0.27	0.15	0.12	0.14		0.10					
Std. Deviation	0.02		0.08	0.01	0.06		0.05					
N	2	1	2	2	2		2					

Stations	Mean	STD	Min	Max	N
CC-1, CC-2 (upper reach)	0.20	0.06	0.15	0.27	3
CC-3, CC-4 (mid reach)	0.10	0.05	0.03	0.15	4
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	0.13	0.07	0.03	0.27	9
All six stations	0.12	0.07	0.03	0.27	11

STD - Standard deviation
N - Number of observations

Appendix Table B-16
Continuing Surface Water Quality Monitoring Program
Orthophosphate (mg/L)
January - December 1998

Sampling Date	Catfish Creek/Trunk Ditch							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	NC-6	Mean	STD	Min	Max	N
March 9, 1998	0.10	0.23	0.10	0.05	0.02	0.10	0.03	0.09	0.08	0.02	0.23	6
September 2, 1998	0.07		<0.01	0.02	0.04	0.03	<0.01	0.03	0.03	<0.01	0.07	5
Mean	0.09	0.23	0.05	0.04	0.03		0.02					
Minimum	0.07	0.23	<0.01	0.02	0.02		<0.01					
Maximum	0.10	0.23	0.10	0.05	0.04		0.03					
Std. Deviation	0.02		0.07	0.02	0.01		0.02					
N	2	1	2	2	2		2					

Stations	Mean	STD	Min	Max	N
CC-1, CC-2 (upper reach)	0.13	0.09	0.07	0.23	3
CC-3, CC-4 (mid reach)	0.04	0.04	<0.01	0.10	4
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	0.07	0.07	<0.01	0.23	9
All six stations	0.06	0.07	<0.01	0.23	11

STD - Standard deviation
N - Number of observations

Appendix Table B-17
Continuing Surface Water Quality Monitoring Program
Total Nitrogen to Total Phosphorus Ratios
January - December, 1998

Sampling Date	Catfish Creek/Trunk Ditch							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	NC-6	Mean	STD	Min	Max	N
March 9, 1998	6.64	5.41	8.63	12.20	13.83	9.34	14.80	10.25	3.91	5.41	14.80	6
September 2, 1998	7.90		40.50	9.58	8.36	16.59	36.50	20.57	16.44	7.90	40.50	5
Mean	7.27	5.41	24.57	10.89	11.10		25.65					
Minimum	6.64	5.41	8.63	9.58	8.36		14.80					
Maximum	7.90	5.41	40.50	12.20	13.83		36.50					
Std. Deviation	0.89		22.53	1.85	3.87		15.34					
N	2	1	2	2	2		2					

Stations	Mean	STD	Min	Max	N
CC-1, CC-2 (upper reach)	6.65	1.25	5.41	7.90	3
CC-3, CC-4 (mid reach)	17.73	15.26	8.63	40.50	4
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	12.56	10.80	5.41	40.50	9
All six stations	14.94	12.03	5.41	40.50	11

STD - Standard deviation
N - Number of observations

Appendix Table B-18
Continuing Surface Water Quality Monitoring Program
Inorganic Nitrogen to Inorganic Phosphorus Ratios
January - December, 1998

Sampling Date	Catfish Creek/Trunk Ditch							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	NC-6	Mean	STD	Min	Max	N
March 9, 1998	0.35	0.09	0.45	0.40	4.50	1.16	2.33	1.35	1.74	0.09	4.50	6
September 2, 1998	5.93		95.00	3.50	1.50	26.48	41.00	29.39	40.12	1.50	95.00	5
Mean	3.14	0.09	47.73	1.95	3.00		21.67					
Minimum	0.35	0.09	0.45	0.40	1.50		2.33					
Maximum	5.93	0.09	95.00	3.50	4.50		41.00					
Std. Deviation	3.94		66.86	2.19	2.12		27.34					
N	2	1	2	2	2		2					

Stations	Mean	STD	Min	Max	N
CC-1, CC-2 (upper reach)	2.12	3.30	0.09	5.93	3
CC-3, CC-4 (mid reach)	24.84	46.80	0.40	95.00	4
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	12.41	31.04	0.09	95.00	9
All six stations	14.10	29.32	0.09	95.00	11

STD - Standard deviation
N - Number of observations

Appendix Table B-19
Continuing Surface Water Quality Monitoring Program
Oil and Grease (mg/L)[a]
January - December, 1998

Sampling Date	Catfish Creek/Trunk Ditch							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	NC-6	Mean	STD	Min	Max	N
March 9, 1998	1.0	0.6	0.4	<0.1	0.1	0.4	1.2	0.6	0.5	<0.1	1.2	6
September 2, 1998	2.0		1.5	1.6	1.9	1.8	1.9	1.8	0.2	1.5	2.0	5
Mean	1.5	0.6	1.0	0.8	1.0		1.6					
Minimum	1.0	0.6	0.4	<0.1	0.1		1.2					
Maximum	2.0	0.6	1.5	1.6	1.9		1.9					
Std. Deviation	0.7		0.8	1.1	1.3		0.5					
N	2	1	2	2	2		2					

Stations	Mean	STD	Min	Max	N
CC-1, CC-2 (upper reach)	1.2	0.7	0.6	2.0	3
CC-3, CC-4 (mid reach)	0.9	0.8	<0.1	1.6	4
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	1.0	0.8	<0.1	2.0	9
All six stations	1.1	0.7	<0.1	2.0	11

[a] Applicable State surface water quality criteria: Maximum allowable concentration of 5.0 mg/L
STD - Standard deviation
N - Number of observations

Appendix Table B-20
Continuing Surface Water Quality Monitoring Program
Total Coliform Bacteria (colonies/100 mL)
January - December, 1998

Sampling Date	Catfish Creek/Trunk Ditch							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	NC-6	Mean	STD	Min	Max	N
March 9, 1998	200,000	200,000	200,000	150,000	160,000	182,000	180,000	181,667	22,286	150,000	200,000	6
September 2, 1998	100		40	20	100	65	340	120	128	20	340	5
Mean	100,050	200,000	100,020	75,010	80,050		90,170					
Minimum	100	200,000	40	20	100		340					
Maximum	200,000	200,000	200,000	150,000	160,000		180,000					
Std. Deviation	141,351		141,393	106,052	113,066		127,039					
N	2	1	2	2	2		2					

Stations	Mean	STD	Min	Max	N
CC-1, CC-2 (upper reach)	133,367	115,412	100	200,000	3
CC-3, CC-4 (mid reach)	87,515	103,061	20	200,000	4
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	101,140	97,491	20	200,000	9
All six stations	99,145	96,110	20	200,000	11

a Applicable State surface water quality criteria: Maximum allowable density of 2,400 colonies/100mL
STD - Standard deviation
N - Number of observations

Appendix Table B-21
Continuing Surface Water Quality Monitoring Program
Fecal Coliform Bacteria (colonies/100 mL)[a]
January - December, 1998

Sampling Date	Catfish Creek/Trunk Ditch							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	NC-6	Mean	STD	Min	Max	N
March 9, 1998	52,000	54,000	20,000	1,000	8,000	27,000	1,100	22,683	24,491	1,000	54,000	6
September 2, 1998	1,120		1,800	280	100	825	580	776	691	100	1,800	5
Mean	26,560	54,000	10,900	640	4,050		840					
Minimum	1,120	54,000	1,800	280	100		580					
Maximum	52,000	54,000	20,000	1,000	8,000		1,100					
Std. Deviation	35,978		12,869	509	5,586		368					
N	2	1	2	2	2		2					

Stations	Mean	STD	Min	Max	N
CC-1, CC-2 (upper reach)	35,707	29,970	1,120	54,000	3
CC-3, CC-4 (mid reach)	5,770	9,507	280	20,000	4
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	15,367	22,261	100	54,000	9
All six stations	12,725	20,760	100	54,000	11

[a] Applicable State surface water quality criteria: Maximum allowable density of 800 colonies/100mL
STD - Standard deviation
N - Number of observations

Appendix Table B-22
Continuing Surface Water Quality Monitoring Program
Trace Metals (µg/L)[a]
January - December, 1998

Parameters	Catfish Creek/Trunk Ditch							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	NC-6	Mean	STD	Min	Max	N
Arsenic	0.002		<0.001	0.004	0.007	0.004	0.001	0.003	0.003	<0.001	0.007	5
Copper	<0.02		0.03	0.03	<0.02	0.02	0.03	0.02	0.01	<0.02	0.03	5
Lead	0.002		0.002	0.001	<0.001	0.002	<0.001	0.001	0.001	0.001	0.002	5
Zinc	0.026		0.021	0.014	0.017	0.020	0.017	0.019	0.005	0.014	0.026	5

[a]Applicable State surface water quality criteria: Maximum allowable concentrations of 50 µg/L for arsenic, 12.8 µg/L for copper, 3.6 µg/L for lead, and 115 ug/L for zinc.
STD - Standard deviation
N - Number of observations

APPENDIX C

Semi-annual Data Tables

Table 1. Summary of Water Quality Data Collected in the South Creek Basin of Palmer Ranch on March 9, 1998, Sarasota County, Florida

Parameters	Stations				Water Quality Standards	
	CC-1	CC-2	CC-3	CC-4	County	State
Time	10:20	10:40	11:00	11:15	-----	-----
Stream flow (cfs)	6.33	0.49	2.41	0.22	-----	-----
Water depth (feet)	0.3	0.5	0.8	0.6	-----	-----
Temperature (°C)	21.1	23.9	21.8	25.9	-----	-----
pH (-log[H^+])	6.8	7.6	7.0	7.0	6.0 - 8.5	6.0 - 8.5
Dissolved oxygen (mg/L)	5.5	12.9	7.8	3.6*	5.0	4.0
Specific conductivity (μmhos/cm)	366	762*	499	1,107*	1,275	500
Total coliform bacteria (No./100 mL)	200,000*	200,000*	200,000*	150,000*	2,400	2,400
Fecal coliform bacteria (No./100 mL)	52,000*	54,000*	20,000*	1,000*	800	800
Nitrite nitrogen (mg/L)	<0.01	<0.01	<0.01	<0.01	-----	-----
Nitrate nitrogen (mg/L)	0.02	<0.01	0.03	<0.01	-----	-----
Ammonia nitrogen (mg/L)	<0.02	<0.02	<0.02	<0.02	-----	-----
Total Kjeldahl nitrogen (mg/L)	1.17	1.45	1.26	1.21	-----	-----
Organic nitrogen (mg/L)	1.17	1.45	1.26	1.21	-----	-----
Total nitrogen (mg/L)	1.19	1.45	1.29	1.21	-----	-----
Orthophosphate (mg/L)	0.10	0.23	0.10	0.05	-----	-----
Total phosphorus (mg/L)	0.18	0.27	0.15	0.10	-----	-----
Total suspended solids (mg/L)	11.0	1.0	3.4	2.4	-----	-----
Turbidity (NTU)	7.8	3.1	4.0	3.3	+29 NTU	+25 JTU
Oil and grease (mg/L)	1.0	0.6	0.4	<0.1	5	15
Biochemical oxygen demand (mg/L)	3.8	2.5	2.1	1.5	-----	-----

* Non-compliance with water quality standards specified by FAC 62-302 and\or Sarasota County Ordinance 72-37 for Class III fresh waters.

Table 1. Summary of Water Quality Data Collected in the South Creek Basin of Palmer Ranch on March 9, 1998, Sarasota County, Florida (Continued)

Parameters	Stations		Water Quality Standards	
	CC-5	NC-6	County	State
Time	11:30	11:50	-----	-----
Stream flow (cfs)	1.60	0.67	-----	-----
Water depth (feet)	0.8	0.8	-----	-----
Temperature (°C)	30.2	25.8	-----	-----
pH (-log[H^+])	7.6	7.0	6.0 - 8.5	6.0 - 8.5
Dissolved oxygen (mg/L)	7.6	2.6*	5.0	4.0
Specific conductivity (µmhos/cm)	691*	740*	1,275	500
Total coliform bacteria (No./100 mL)	160,000*	180,000*	2,400	2,400
Fecal coliform bacteria (No./100 mL)	8,000*	1,100*	800	800
Nitrite nitrogen (mg/L)	<0.01	0.01	-----	-----
Nitrate nitrogen (mg/L)	<0.01	0.02	-----	-----
Ammonia nitrogen (mg/L)	0.08	0.04	-----	-----
Total Kjeldahl nitrogen (mg/L)	0.82	1.45	-----	-----
Organic nitrogen (mg/L)	0.74	1.41	-----	-----
Total nitrogen (mg/L)	0.82	1.48	-----	-----
Orthophosphate (mg/L)	0.02	0.03	-----	-----
Total phosphorus (mg/L)	0.06	0.10	-----	-----
Total suspended solids (mg/L)	5.5	4.0	-----	-----
Turbidity (NTU)	4.6	2.6	+29 NTU	+25 JTU
Oil and grease (mg/L)	0.7	1.2	5	15
Biochemical oxygen demand (mg/L)	2.1	1.7	-----	-----

* Non-compliance with water quality standards specified by FAC 62-302 and\or Sarasota County Ordinance 72-37 for Class III fresh waters.

Table 1. Summary of Water Quality Data Collected in the Catfish and North Creek Basin of Palmer Ranch on September 2, 1998, Sarasota County, Florida

Parameters	Stations				Water Quality Standards	
	CC-1	CC-2	CC-3	CC-4	County	State
Time	10:40	DRY	11:20	11:30	-----	-----
Stream flow (cfs)	0.0		0.0	0.78	-----	-----
Water depth (feet)	2.6		0.25	0.9	-----	-----
Temperature (°C)	27.0		26.9	30.3	-----	-----
pH ($-\log[H^+]$)	6.0		6.2	6.7	6.0 - 8.5	6.0 - 8.5
Dissolved oxygen (mg/L)	4.1*		3.4*	4.8*	4.0	5.0
Specific conductivity (μmhos/cm)	635*		1157*	698*	500	1,275
Total coliform bacteria (No./100 mL)	100		40	20	2,400	2,400
Fecal coliform bacteria (No./100 mL)	1120*		1800*	280	800	800
Nitrite nitrogen (mg/L)	<0.05		<0.05	<0.05	-----	-----
Nitrate nitrogen (mg/L)	0.19		0.37	<0.05	-----	-----
Ammonia nitrogen (mg/L)	0.20		0.08	0.02	-----	-----
Total Kjeldahl nitrogen (mg/L)	0.97		0.82	1.10	-----	-----
Organic nitrogen (mg/L)	1.17		0.90	1.12	-----	-----
Total nitrogen (mg/L)	1.16		1.19	1.10	-----	-----
Orthophosphate (mg/L)	0.07		<0.01	0.02	-----	-----
Total phosphorus (mg/L)	0.15		0.03	0.12	-----	-----
Total suspended solids (mg/L)	9.0		5.0	11	-----	-----
Turbidity (NTU)	6.3		6.5	8.1	+25 JTU	+29 NTU
Oil and grease (mg/L)	2.0		1.5	1.6	15	5
Biochemical oxygen demand (mg/L)	3.0		2.0	3.0	-----	-----
Arsenic as As (mg/L)	0.002		<0.001	0.004	<.1	<.05
Copper as Cu (mg/L)	<0.02		0.03*	0.03*	<.01	<.0128[a]
Lead as Pb (mg/L)	0.002		0.002	0.001	<.01	<.0036[a]
Zinc as Zn (mg/L)	0.026*		0.021*	0.014*	<.01	<.115[a]

*Non-compliance with water quality standards specified by FAC 62-302 and\or Sarasota County Ordinance 72-37 for Class III fresh waters.

[a] Calculated based upon a total hardness of 110 mg/L.

Table 1. Summary of Water Quality Data Collected in the Catfish and North Creek Basin of Palmer Ranch on September 2, 1998, Sarasota County, Florida (Continued)

Parameters	Stations		Water Quality Standards	
	CC-5	NC-6	County	State
Time	12:05	12:20	-----	-----
Stream flow (cfs)	0.63	0.55	-----	-----
Water depth (feet)	0.3	1.2	-----	-----
Temperature (°C)	30.9	27.3	-----	-----
pH ($-\log[H^+]$)	7.0	7.1	6.0 - 8.5	6.0-8.5
Dissolved oxygen (mg/L)	6.6	2.0	4.0	5.0
Specific conductivity (µmhos/cm)	793*	822*	500	1,275
Total coliform bacteria (No./100 mL)	100	340	2,400	2,400
Fecal coliform bacteria (No./100 mL)	100	580	800	800
Nitrite nitrogen (mg/L)	<0.05	<0.05	-----	-----
Nitrate nitrogen (mg/L)	<0.05	0.10	-----	-----
Ammonia nitrogen (mg/L)	0.01	0.08	-----	-----
Total Kjeldahl nitrogen (mg/L)	1.12	0.97	-----	-----
Organic nitrogen (mg/L)	1.13	1.05	-----	-----
Total nitrogen (mg/L)	1.12	1.07	-----	-----
Orthophosphate (mg/L)	0.04	<0.01	-----	-----
Total phosphorus (mg/L)	0.14	0.03	-----	-----
Total suspended solids (mg/L)	15.0	4.0	-----	-----
Turbidity (NTU)	4.5	2.9	+25 JTU	+29 NTU
Oil and grease (mg/L)	1.9	1.9	15	5
Biochemical oxygen demand (mg/L)	3.0	2.0	-----	-----
Arsenic AS As (mg/L)	0.007	0.001	<.1	<.05
Copper AS Cu (mg/L)	<0.02	0.03*	<.01	<.0128[a]
Lead AS Pb (mg/L)	<0.001	<0.001	<.01	<.0036[a]
Zinc AS Zn (mg/L)	0.017*	0.017*	<.01	<.115[a]

*Non-compliance with water quality standards specified by FAC 62-302 and\or Sarasota County Ordinance 72-37 for Class III fresh waters.

[a] Calculated based upon a total hardness of 110 mg/L

APPENDIX D
Monitoring Team

WILLIAM W. HAMILTON PRINCIPAL

FIELDS OF COMPETENCE

Environmental Assessment and Permitting; Project Management; Natural Systems Identification and Mapping; Habitat Mitigation Design; Wildlife Ecology and Wildlife Habitat Management Plans.

EXPERIENCE SUMMARY

William W. Hamilton has over twenty-nine years of varied, practical environmental consulting experience. He has gained this experience by direct technical participation and/or management of a wide variety of environmental impact assessment and permitting projects. His more recent work has included design and management of ecological investigations to serve as a basis for environmental resource permitting, wetland resource permitting and listed species management plans. Additionally, Mr. Hamilton has frequently served to coordinate permit application processing on behalf of an Applicant and/or their design professionals. He has also designed numerous wetland mitigative plans related to permitting. He has served as an expert witness on environmental matters in U.S. District Court, State of Florida Administrative Proceedings and numerous local government proceedings.

Mr. Hamilton's experience record also includes participation in several professional associations and related activities. He has served as a faculty member of the Florida Chamber's Environmental Permitting Summer School and is a past General Chairman of the Florida Association for Water Quality Control. He has also served as Chairman of the Technical Advisory Committee to the Board of County Commissioners for the identification and acquisition of conservation/passive recreation lands in Manatee County and was appointed to state-wide CARL advisory panel for identification and ranking of environmentally significant lands.

EDUCATION

University of North Carolina
Charlotte, North Carolina
B.S. - Biology in 1970

WILLIAM W. HAMILTON PRINCIPAL

EMPLOYMENT HISTORY

1972 - Present	CCI Environmental Services, Inc. (f.k.a. Conservation Consultants, Inc.)
1970 - 1972	Consultant to Conservation Consultants, Inc.

KEY PROJECTS

AVALON ASSOCIATES: Project Manager for ecological/environmental elements of the joint Environmental Resource Permit (ERP) application for the Avalon Park development. Prepared the on-site mitigation plan and served as the applicant's representative to coordinate with the U.S. Army Corps of Engineers for application review (1,850 acres). Orange County, Florida.

OSCEOLA DEVELOPMENT PROJECT L.P.: Project Manager for ecological/environmental elements of the joint ERP/Wetland Resource Permit for the 3.4 sq. ft. World Expo Center at Osceola Trace. Prepared the on-site mitigation plan. Osceola Trace, 768 acres, Osceola County, Florida.

MILLER SELLEN CONNER & WALSH, INC: Project Manager for environmental constraints analysis of 30,000 acre tract. Responsible for site studies and literature reviews to identify protected and/or regulated habitats, and presence or likely occurrence of endangered/threatened species. Assisted in alternative land use evaluations and formulation of a conceptual development plan for the 30,000 acre site. Clay County, Florida.

PALMER VENTURE: Project Manager for Eastside Environmental Systems Analysis. Supervised site assessments of vegetation communities and threatened/ endangered species occurrence. Prepared impact prediction/mitigation report. Assisted in development of master drainage plan for purposes of maintaining wetland hydroperiod. 2200± acres, Palmer Ranch, Sarasota County, Florida.

KEY PROJECTS (CONTINUED)

DEL NORTH ASSOCIATES: Project Manager for design of Red-cockaded woodpecker monitoring plan to identify preferred habitat and foraging range. Prepared with others a report documenting extent of significant habitat. Prepared management plan identifying habitat preserve and maintenance procedures. Negotiated plan approval by Florida Game and Fresh Water Fish Commission. 1135 acre Del Vera Development, Lee County, Florida.

FLAG DEVELOPMENT COMPANY, INC.: Project Manager for preparation of on-site management plan for Florida Scrub jay, Gopher tortoise and Florida sandhill crane, including identification of minimum area required for habitat preservation and long-term maintenance and monitoring programs. Negotiated plan approval by Florida Game and Fresh Water Fish Commission. 1800 acre New River Planned Development, Pasco County, Florida.

FLAG AVALON ASSOCIATES, LTD.: Project Manager responsible for preparation of vegetation, wetland and threatened/endangered species components of a Development of Regional Impact/Application of Development Approval for the 5,575 acre Avalon Park Development. Supervised all ecological field surveys and assisted in site design to minimize impacts to the Econ River which bisects the site. Also was primary author of a wildlife management plan to protect Red-cockaded woodpecker colonies, Florida scrub jay and Gopher tortoise on-site. Negotiated plan approval with the Florida Game and Fresh Water Fish Commission. Avalon Park, Orange County, Florida.

PALMER VENTURE: Sr. Project Advisor for a Study of Wetland Characteristics and Hydroperiod Simulation. Responsible for study design and report preparation. Program involved literature assessment of wetland hydroperiod and field appraisals of vegetative characterization of wetlands, wetland topography, soil borings and extended water level measurements in wetlands and in adjacent shallow wells. A mathematical model to simulate annual hydroperiod was constructed and validated with on-site data and literature. 5000 acres, Palmer Ranch, Sarasota County, Florida.

KEY PROJECTS (CONTINUED)

SEMINOLE FARMS TRUST: Project Manager for habitat mapping and wetland assessment of two adjacent tracts totalling about 128 acres. Advised the client and counsel on regulatory requirements and exemptions for agricultural improvements to allow increased cattle carrying capacity on the tracts. City of Sanford, Florida.

VOLUSIA COUNTY GOVERNMENT: Sr. Environmental Consultant. Reviewed habitat mapping and field inspected on-site wetlands. Advised project planning consultants on site use alternatives and "permitability". Provided a deposition regarding same in condemnation proceedings related to a County Solid Waste Transfer Facility. 60± acre site. Volusia County, Florida.

S.W. JOHNSON DEVELOPMENT, INC.: Project Manager for environmental components of surface water management and wetland resource permitting. Assisted in project layout to minimize adverse impacts on wetlands and developed approach to integrate preserved wetlands into the surface water management plan for hydroperiod maintenance. Assisted the Project Engineer in the preparation and processing of local, state and federal permits including wetland mitigation approval. 300 acre Deer Creek Subdivision, Sarasota County, Florida.

SOUTH BREVARD WATER AUTHORITY: Environmental Project Manager serving to coordinate and review preparation of habitat mapping and performance of wildlife surveys on a proposed regional wellfield site. Prepared wetland and wildlife impact analysis associated with various groundwater level drawdown scenarios. Provided expert testimony during Administrative Proceedings related to water use permitting. 22,000 acre Bull Creek site. Osceola County, Florida.

SCHROEDER-MANATEE, INC.: Project Manager for ecological site assessments of a 1,500± acre site proposed as a major employment center. Reviewed habitat mapping and wildlife surveys as a basis for assisting on alternative site design evaluations. Coordinated staff preparation of responses to DRI Application questions concerning water quality, wetlands and wildlife. Prepared a wildlife habitat management plan and negotiated acceptance of same by the Florida Game and Freshwater Fish Commission. Provided expert testimony at local and regional government proceedings concerning project approval. University Place Development of Regional Impact, Sarasota County, Florida.

KEY PROJECTS (CONTINUED)

SMITH & GILLESPIE ENGINEERS: Project Manager for a one-year baseline study of the six mile tidal segment of the Braden River below the Evers Reservoir dam. Responsibilities included field sampling design and general supervision of habitat mapping, bathymetric mapping, seasonal benthic community analyses, tidal amplitude monitoring and monthly water quality/salinity monitoring. Also reviewed and edited CCI staff reports of findings. Braden River, Manatee County, Florida.

W. F. BISHOP & ASSOCIATES: Project Environmental Consultant for design of a 1.5 acre tidal pond, mangrove swamp and salt marsh restoration program. The Barclay, Little Sarasota Bay, Sarasota County, Florida.

MANATEE GATEWAY: Environmental Project Manager for Design and Permitting of 80-acre Boat Basin, Navigation Channel and Tidal Circulation Channel. Manatee Gateway Development on the Manatee River, Palmetto, Florida.

LANSBROOK DEVELOPMENT CORP.: Environmental Project Manager for design and Permitting Coordinator to acquire Federal, State and County permits for three docks (59 total slips), nature boardwalks and two boat ramps on Lake Tarpon (OFW), Pinellas County, Florida.

BAY VENTURE CORP.: Environmental Project Manager for stormwater system design assistance/wetland mitigation and Coordinator for dredge/fill and stormwater permitting. Five hundred acre Prestancia Development and TPC Golf Course, Sarasota County, Florida.

U.S. HOME CORP.: Project Manager to develop habitat enhancement and management plan for Florida scrub jay. Supervised design of field study methodology to define range of scrub jay pair found nesting in uncharacteristic habitat, i.e., a slash pine on a wetland fringe. Negotiated approval of a habitat enhancement and management plan with the U.S. Fish & Wildlife Service. Stoneybrook Golf and Country Club, Sarasota County, Florida.

GARY M. SERVISS Senior Environmental Scientist

FIELDS OF COMPETENCE

Environmental Impact Assessment/Prediction, Biological Monitoring, Wetland Evaluations, Water Quality Assessment, Marine Biology, Environmental Permitting, Natural Systems Restoration and Mitigation, Wildlife Surveys and Management Plans, Project Management.

EXPERIENCE SUMMARY

Mr. Gary Serviss has over seventeen years of technical and project management experience in environmental assessments and permitting. He has extensive experience in wetlands evaluation/ classification, mitigation design, water quality assessment, wildlife evaluations, and habitat mapping. He has designed and coordinated numerous environmental investigations to serve as a basis for environmental permit applications and Development of Regional Impact Applications. He has served as an expert witness on environmental constraints, bald eagles and wetland impacts related to dredge and fill activities. Prior to joining CCI, Mr. Serviss served over four years with the Natural Resources Department of Sarasota County, Florida where he was responsible for dredge and fill application assessment and biological monitoring programs. He also evaluated development proposals for environmental impacts and acted as the County's coordinator for artificial reef siting and construction. His experience record also includes serving as an Environmental Specialist with the Florida Department of Environmental Protection where he was responsible for wetland resource and stormwater management enforcement in an eight-county area. Mr. Serviss has been certified by the U. S. Army Corps of Engineers as a Wetland Delineator.

As Vice President and Director of CCI's Technical Services Division, Mr. Serviss is responsible for the management and supervision of CCI's Professional Services Group. He manages projects involving qualitative and quantitative vegetation and wildlife assessments, wildlife management plan preparation, water quality monitoring and assessment, natural systems restoration and mitigation, and environmental permitting. Mr. Serviss is a member of the Sarasota Bay National Estuary Program's Artificial Habitat Enhancement Task Force, the local Sea Grant Marine Advisory Committee, and is Chairman of the Sarasota County Artificial Reef Committee.

EDUCATION

Florida Institute of Technology
Melbourne, Florida
M.S. - Biological Sciences in 1982

Florida Institute of Technology
Melbourne, Florida
B.S. - Marine Biology in 1979

GARY M. SERVISS SENIOR ENVIRONMENTAL SCIENTIST

EMPLOYMENT HISTORY

1988 - Present
CCI Environmental Services, Inc.
(f.k.a. Conservation Consultants, Inc.)
Senior Environmental Scientist

1984 - 1988
Sarasota County, Florida
Natural Resources Department, Coastal Zone Division
Marine Biologist

1982 - 1984
Florida Department of Environmental Protection
Environmental Specialist

KEY PROJECTS

SCHROEDER-MANATEE RANCH, INC.: Project Manager to implement a preliminary site assessment of a 2,300 acre Development of Regional Impact. Assessment involved individual wetland inventory for jurisdiction and mitigation potential and an Endangered and Threatened species survey. Assisted in the development and refinement of the land plan. Coordinated detailed habitat mapping, gopher tortoise and other wildlife surveys. Prepared responses to DRI questions and sufficiency questions. University Lakes, Manatee County, Florida.

LITTLE SARASOTA BAY STUDY: Project Scientist to coordinate the Biological, Hydrological and Water Quality assessment of Little Sarasota Bay. Analyzed the biological data (including seagrass, macroalgae, benthic infauna, fish fauna and phytoplankton) and co-authored the "Ecological Status of Little Sarasota Bay with reference to Midnight Pass" report. Also coordinated the biological assessment of the permit to dredge Midnight Pass. Involved the delineation of marine habitats, benthic infauna monitoring, fish fauna monitoring and sediment analysis. Sarasota County, Florida.

SCHROEDER-MANATEE RANCH, INC.: Project Scientist for implementation of a site assessment of 1,500 acres. Assessment included mapping of habitats by APOXSEE nomenclature; individual inventory of each wetland for size, function, habitat value, mitigation potential and agency jurisdiction; and an Endangered and Threatened species survey. Developed environmental methodology for wetlands and protected species and obtained County approval. Coordinated the field surveys of wetlands and wildlife and prepared DRI responses and sufficiency responses. Prepared wildlife management plan for submission to FGFWFC. University Place Development of Regional Impact, Sarasota County, Florida.

KEY PROJECTS (CONTINUED)

SAM RODGERS PROPERTIES, INC.: Project Manager to coordinate the habitat mapping, wetland and SHW/NP delineation, and protected species surveys (for bald eagle, red-cockaded woodpeckers, gopher tortoise and scrub jays) for this 968 acre site. Assisted in obtaining Sarasota County, ACOE and SWFWMD approval of the golf course and initial phases of development. Designed mitigation areas and supervised the construction and mulch transfer process. Prepared a Gopher tortoise and Scrub jay management plan and obtained FGFWFC and USFWS approval. Also prepared and coordinated approval of a Level II Earthmoving Permit through Sarasota County. Pelican Pointe, Sarasota County, Florida.

MATTHEWS, HUTTON AND EASTMORE: Project manager to attend a deposition of a bald expert relative to a condemnation hearing for a county park acquisition. Conducted a field survey of the site in question, reviewed the project history, bald eagle articles and assisted in establishing hearing strategies. Expert testimony was presented relative to bald eagle constraints, native habitats and potential impacts to Lemon Bay. Sarasota County, Florida.

PALMER VENTURE: Project Manager to coordinate the establishment of SHWL within approximately 100 wetlands. Assisted in the preparation and processing of wetland resource permits, including mitigation area and monitoring program design, through FDEP and ACOE for a 2,200 acre project. Also assisted in the preparation and processing of a Conceptual Surface Water Management permit through SWFWMD for the project. East Side, Palmer Ranch, Sarasota County, Florida.

WEST COAST REGIONAL WATER SUPPLY AUTHORITY: Project Manager to coordinate this three-year project to monitor the ecological condition of the wellfield and surrounding areas to detect possible ecological effects attributable to wellfield pumpage. Water level and wildlife information were collected monthly at 27 sites. Qualitative vegetative information is collected bi-annually from the 27 sites. Quantitative data on species composition and percent cover is collected bi-annually for herbaceous and shrub vegetation and annually for trees at six sites. Infrared aerial photography is analyzed twice a year for land use and hydrologic changes. Progress reports are submitted bi-annually and a comprehensive report is provided annually. A methodology manual was prepared. South Central Hillsborough Regional Wellfield, Hillsborough County, Florida.

KEY PROJECTS (CONTINUED)

FLORIDA POWER CORPORATION: Project manager for the design and implementation of a zooplankton entrainment study at the Anclote Power Plant. A pilot study was performed to finalize station locations, define sampling depths and time, establish sample transfer procedures, and determine sample analysis and latent mortality processes. The primary study involved the collection of 40 samples from each of three stations over a three-month period. Initial, latent and overall mortality was determined for key species, data was statistically analyzed and a technical report of results was prepared. Pasco County, Florida.

CYPRESS LAKES VENTURE: Project Manager to conduct field surveys to flag wetland limits and to mark the seasonal high water and normal pool elevations within the wetlands. Obtained agency verifications of wetland jurisdiction and assisted in the permit application preparation and processing. Approval was obtained from the Florida Game and Fresh Water Fish Commission of a recipient site to relocate gopher tortoises and eleven tortoises were relocated. Polk County, Florida.

RESOURCE ASSESSMENT, INC.: Project Scientist in the preparation and processing of a Development of Regional Impact application for this 466 acre project. Also assisted in the preparation and processing of a permit for the project through the ACOE and a Conceptual Environmental Resource Permit through SFWMD. Permitting involved impacts to 9.87 acres of wetland, mitigation plan preparation, restoration plans for the hydroperiod of preserved wetlands and a preservation plan for a protected plant (Hand Adder's tongue fern) Wellington Commons, Palm Beach County, Florida.

ABBEY MANAGEMENT COMPANY: Project Scientist involved in the habitat mapping, wetland delineation and protected species survey on a 1,269 acre site. Coordinated the quantitative survey for Lee County Listed Species on the 691 acre portion of the site proposed for development. Prepared responses for the Environmental Impact Assessment portion of the rezone application including the Protected Species Survey report. Estero River Bay, Lee County, Florida.

PRESENTATIONS

Instructor for United States Department of Agriculture, Soil Conservation Service, Technical Training Course on Wetland Restoration and Enhancement. Topic: Restoring Wetland Vegetation. February 1994.

Lecture providing continuing education on "Overview of Wetlands Permitting and the Consultant's Role in the Process" presented to Manatee County School Teachers - June 1991.

KEY PROJECTS (CONTINUED)

PALMER RANCH DEVELOPMENT, LTD. Conducted semi-annual water quality monitoring and sampling at 6 stations within Catfish Creek and North Creek. Prepared semi-annual data reports discussing water quality analyses and an annual interpretive report. Sarasota County, Florida.

PALMER RANCH DEVELOPMENT, LTD. Conducted quarterly water quality monitoring and sampling at 4 stations within South Creek (Eastside). Prepared quarterly reports discussing water quality analyses and an annual interpretive report. Sarasota County, Florida.

CREEKWOOD DEVELOPMENT, LTD. Conducted semi-annual water quality monitoring program. Performed *in-situ* measurements and collected samples for laboratory analysis from five surface water and four groundwater sites. Prepared quarterly data reports and an annual summary report. Manatee County, Florida.

COOPER CREEK SQUARE. Conducted quarterly monitoring at three sites. Monitoring parameters included nutrients, physical parameters, bacteria, *in-situ* parameters, trace metals and flow. Following each monitoring event, a report of results was prepared for submittal to Manatee County. Also prepared an annual interpretative report following the completion of each year of monitoring. Monitoring was performed to satisfy DRI Development Order Condition.

PUBLICATIONS

Sauers, S. and G. Serviss. 1985. Ecological Status of Little Sarasota Bay with reference to Midnight Pass. County of Sarasota, Florida. 92 pp.

Alevizon, W., R. Richardson, P. Pitts, and G. Serviss. 1985. Coral Zonations and Patterns of Community Structure in Bahamian Reef Fishes. Bull. Mar. Sci. 36(2): 304-318.

ROBERT B. MASON ENVIRONMENTAL CHEMIST

FIELDS OF COMPETENCE

Chemical and Microbial Analysis of Environmental and Drinking Water Samples in Accordance with EPA and FDEP Approved Methodologies; Water Quality Sample Collection; QA/QC Requirements.

EXPERIENCE SUMMARY

Mr. Mason has seven years experience in environmental chemistry. His experience includes wet chemistry analysis for minerals and nutrients, metals analysis by atomic absorption and ICP, gas chromatographic experience (both purge and trap and extraction techniques), and bacteriological identification.

Prior to joining CCI, Mr. Mason served as Director of the Central Laboratory for the Manatee County Department of Public Works. In this capacity, he functioned to serve both Wastewater and Solid Waste divisions. He was responsible for sample analyses, sample collection scheduling, media and equipment purchasing, and as quality control officer he was responsible for implementation of all quality control procedures and documentation. Additionally, he was the designated Safety Officer. In this capacity, he organized and conducted employee safety programs, inventoried and ordered all safety equipment required for wastewater treatment plants and operators, and advised Clients of their responsibilities for compliance to the SARA Title III Law.

At CCI, Mr. Mason serves as Laboratory Supervisor and Chemist. He is responsible for the daily operation of the laboratory including; sample analyses and reporting, sample tracking, equipment maintenance, and quality control/quality assurance procedures. He also performs microbiology identification of drinking water samples.

EDUCATION

Seton Hall University
M.S. - Chemistry in 1971

Delaware Valley College
B.S. - Chemistry in 1965

ROBERT B. MASON ENVIRONMENTAL CHEMIST

EMPLOYMENT HISTORY

1994 - Present	CCI Environmental Services, Inc. (*f.k.a.*, Conservation Consultants, Inc.) Environmental Chemist, Laboratory Supervisor
1988 - 1994	Manatee County Department of Public Works Laboratory Director
1969 - 1986	SANDOZ Pharmaceutical Co. Research Chemist, Safety Officer

KEY PROJECTS

PASADENA YACHT AND COUNTRY CLUB: Project Chemist responsible for the analysis of water and sediment samples collected during the implementation of agency approved workscopes for water and sediment quality and hydrographic monitoring in Boca Ciega Bay for the Pasadena Yacht and Country Club Marina. Monitoring is performed to comply with FDER Permit requirements. Gulfport, Pinellas County, Florida.

CITY OF BRADENTON WWTP: Project Chemist responsible for the analysis of water samples collected during the implementation of agency approved workscopes for water quality and hydrographic monitoring in the Manatee River required for Florida Department of Environmental Protection (FDEP) permit compliance. Manatee County, Florida.

PURSLEY COMMUNITIES, INC.: Project Manager for the implementation of Surface Water Quality monitoring program as specified by the Development Order during construction of the River Club Development. Manatee County, Florida.

EVERS RESERVOIR: Project Chemist for the analysis of surface water quality samples collected in the Evers Reservoir as part of the post-construction monitoring program as specified by Permit Conditions. Manatee County, Florida.

BRADEN RIVER: Project Chemist for the analysis of surface water quality samples collected in the Braden River as specified by the SFWMD Permit Conditions for the Evers Reservoir. Manatee County, Florida.

KEY PROJECTS (CONTINUED)

POWER CORPORATION: Project Chemist responsible for the analysis of water quality samples collected during implementation of agency approved workscopes for various water resource assessments specified by the DRI Development Order during construction of the Tara Development. Responsible for data collection and preparation of reports of results. Manatee County, Florida.

SOS ASSOCIATES, LTD.: Project Chemist responsible for the analysis of water quality samples collected during implementation of agency approved workscopes for various surface water resource assessments and monitoring programs specified by the DRI Development Order during construction of the Cooper Creek Square Development. Bradenton, Florida.

WILMA SOUTHEAST: Project Chemist responsible for the analysis of water quality samples collected during implementation of agency approved workscopes for various surface and groundwater quality and hydrographic monitoring programs required by the DRI Development Order during construction of the Creekwood Development. Bradenton, Florida.

HONEYCOMB COMPANY OF AMERICA: Project Chemist for the analysis of water quality samples of the industrial effluent entering the county sewer system. Bradenton, Florida.

APPLIED OPTICS: Project Manager for the implementation of a water quality monitoring program for the industrial effluent entering the county sewer system. Bradenton, Florida.

CITY OF GULFPORT: Project Chemist responsible for the analysis of water and sediment samples collected during a monitoring program conducted for a municipal marina applying for a dredge and fill permit. Other responsibilities include data management and report of results. Gulfport, Pinellas County, Florida.

ARTHUR W. PERKINS ENVIRONMENTAL SCIENTIST

FIELDS OF COMPETENCE

Wetland Mitigation Monitoring, Threatened and Endangered Fauna Surveys, Water Quality Monitoring and Sampling, Environmental Compliance Monitoring.

EXPERIENCE SUMMARY

Mr. Arthur Perkins has conducted qualitative and quantitative vegetation monitoring, threatened and endangered species surveys, and water quality monitoring and sampling programs. He has assisted with habitat mapping and classification using the Florida Department of Transportation Land Use Cover and Forms Classification System and the Florida Department of Community Affairs Land Use and Cover Classification System. Additionally, he has assisted with wetland jurisdictional delineations and hydroperiod determinations.

EDUCATION

McMurry University
Abilene, Texas
B.S. - Biology in 1994

Texas A&M University - Corpus Christi
Corpus Christy, Texas
Graduate Studies in Wetland Ecology & Environmental Science

EMPLOYMENT HISTORY

1998 - Present
CCI Environmental Services, Inc.
Environmental Scientist

1995 - 1996
Flour Bluff Independent School District
Substitute Teacher

1986 - 1990
United States Air Force
Avionics Technician

KEY PROJECTS

LENNAR HOMES: Project Scientist to ensure environmental compliance at The Hamptons, a large residential construction site. Services included observations of wetland mulch transfer and daily erosion control measures inspections. Sarasota County, Florida.

FLORIDA POWER CORP.: Conducted Scrub Jay survey and habitat mapping of two 300 acre tracts associated with the Debary Power Plant. Quantitative scrub jay surveys involved transects through suitable habitat while playing scrub jay vocalizations. Volusia County, Florida.

POWER CORP.: Assisted with the jurisdictional wetland delineations on a 600 acre site. Separate FDEP & ACOE wetland lines were delineated. Manatee County, Florida.

NEW RIVER DEVELOPMENT CO.: Assisted with habitat mapping and wetland delineation on this 1,000 acre site. Performed water quality monitoring and hydroperiod monitoring. Pasco County, Florida.

LANSBROOK DEVELOPMENT CORP.: Conducted bald eagle nest surveys in potential habitat. Monitored bald eagle behavior relative to adjacent construction activities. Pinellas County, Florida.

SMITH & GILLESPIE ENGINEERS, INC.: Conducted quarterly water quality monitoring and sampling at 12 stations within the Evers Reservoir and Tidal Braden River. Prepared quarterly reports discussing water quality analyses and an annual interpretive report. Manatee County, Florida.

MANATEE COUNTY: Assisted with habitat mapping survey at the Headwaters of Duette Park, a 2100± acre site. Manatee County, Florida.

FORSBURG CONSTRUCTION COMPANY: Conducted gopher tortoise survey on approximately two miles of roadway. Excavated tortoise burrows and relocated the gopher tortoise. Sarasota County, FL.

KEY PROJECTS (CONTINUED)

SARASOTA INTERSTATE BUSINESS CORP.: Conducted four pre-construction water quality monitoring events. Performed *in-situ* measurements and collected samples for laboratory analysis from three surface water and two groundwater sites. Data reports of results were prepared. Sarasota County, Florida.

CITY OF BRADENTON: Conducted quarterly water quality monitoring associated with the City's Wastewater Treatment Plant effluent. Three sites were sampled within the Manatee River and at the Outfall. Quarterly data reports of results and an annual interpretive report were prepared. Manatee County, Florida.

PINELLAS COUNTY PUBLIC WORKS DEPARTMENT: Conducted monthly status monitoring events of planted lake littoral zones and mitigation areas for multiple roadway projects. Qualitative and quantitative monitoring of mitigation areas was also conducted. Results were summarized in technical reports. Pinellas County, Florida.

SOUTH CENTRAL HILLSBOROUGH REGIONAL WELLFIELD: Performed monthly surface water and groundwater level monitoring at 14 sites adjacent to the wellfield. Assisted in qualitative and quantitative vegetation surveys. Hillsborough County, Florida.

PALMER RANCH DEVELOPMENT, LTD. Conducted semi-annual water quality monitoring and sampling at 6 stations within Catfish Creek and North Creek. Prepared semi-annual data reports discussing water quality analyses and an annual interpretive report. Sarasota County, Florida.

PALMER RANCH DEVELOPMENT, LTD. Conducted quarterly water quality monitoring and sampling at 4 stations within South Creek (Eastside). Prepared quarterly reports discussing water quality analyses and an annual interpretive report. Sarasota County, Florida.

KEY PROJECTS (CONTINUED)

CREEKWOOD DEVELOPMENT, LTD. Conducted semi-annual water quality monitoring program. Performed *in-situ* measurements and collected samples for laboratory analysis from five surface water and four groundwater sites. Prepared quarterly data reports and an annual summary report. Manatee County, Florida.

COOPER CREEK SQUARE. Conducted quarterly monitoring at three sites. Monitoring parameters included nutrients, physical parameters, bacteria, *in-situ* parameters, trace metals and flow. Following each monitoring event, a report of results was prepared for submittal to Manatee County. Also prepared an annual interpretative report following the completion of each year of monitoring. Monitoring was performed to satisfy DRI Development Order Condition.