# ANNUAL REPORT OF THE CONTINUING SURFACE WATER QUALITY MONITORING PROGRAM IN SOUTH CREEK OF THE PALMER RANCH JANUARY - DECEMBER 1996 SARASOTA COUNTY, FLORIDA

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**IN SOUTH CREEK OF THE PALMER RANCH**
**JANUARY - DECEMBER 1996**
**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. The Palmer Ranch is located in west-central Sarasota County as shown in **Figure 1.1**. Construction of the first incremental development (Prestancia) was initiated in 1986.

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 revised during an agency review meeting in June 1985. The 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 Venture contracted CCI Environmental Services, Inc. (CCI) to implement the "Continuing Surface Water Quality Monitoring Program" during the second year of the monitoring program. CCI began monitoring on September 16, 1985, pursuant to the instructions provided by Palmer Venture. Except for 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. Following an agreement between the Sarasota County Pollution Control Division and Palmer Venture, the "Continuing Surface Water Quality Monitoring Program" 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 addition, monitoring in the South Creek Basin was suspended until one month before any development activity occurring in the basin.

As specified in Exhibit "E", the initial pre-development monitoring event, which included water quality grab sampling and *in situ* measurements collected at four (4) monitoring stations along South Creek, was performed on January 13, 1994. These results were reported by CCI Environmental Services, Inc. (1995). Subsequently, quarterly monitoring events shall be performed during the development phase at all stations downstream of the area under development. In addition, one sampling site upstream of a development area will also be monitored in order 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, the frequency of the water quality monitoring program shall be subject to change from quarterly to semiannually or to be discontinued.

The water quality conditions recorded from January through December 1996 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 years in the South Creek basin. Monitoring in the Catfish Creek and North Creek systems for 1996 was performed independent of the monitoring in South Creek, and therefore, water quality conditions observed within these basins will be presented in a separate report.

## 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, FL.).**

| | AIR TEMPERATURE | | | |
|---|---|---|---|---|
| | 1941-1970[a] | | 1931-1960[b] | |
| MONTH | °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 being 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.

## 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

**Figure 2.1 Soil Associations in 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-Basinger association: Nearly level, poorly and moderately well drained, sandy soils with weakly cemented sandy subsoil and poorly drained sandy soils throughout. |
| | 8 | Myakka-Immokalee-Basinger association: Nearly level, poorly drained, sandy soils with weakly cemented sandy subsoil and poorly drained sandy soils throughout. |
| | 26 | Imokalee-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 DESCRIPTIONS OF SOIL ASSOCIATIONS (Continued).

| Area Definition | Map Unit No. | Soil Association Description |
|---|---|---|
| Areas dominated by moderately well to poorly drained soils subject to flooding (continued) | 35 | Pomello-Paola-St. Lucie association: Nearly level to sloping, moderately well drained sandy soils with weakly cemented sandy not subsoil and excessively drained soils, sandy throughout. |
| | 36 | Imokalee-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. |

TABLE 2.2 DESCRIPTIONS OF SOIL ASSOCIATIONS (Continued).

| Area Definition | Map Unit No. | Soil Association Description |
|---|---|---|
| Areas dominated by poorly and very poorly drained soils subject to flooding (continued) | 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. |
| | 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, draughty sands. |
| | 39 | Terra Ceia association: Nearly level, very poorly drained, well-decomposed, organic soils 40-91 cm (16-36 inches) thick over loamy material. |

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 ceased 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 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 wetland fringing hammocks.

**2.4 Drainage**

The Palmer Ranch DRI is divided into six primary drainage basins that ultimately discharge into 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 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 reconstructing 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, Elodea, 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 then 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 improved pasture, idle agricultural land, 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 and pine flatwoods. Downstream of the ranch, South Creek flows through the Oscar Scherer State Recreational Area and subsequently into the tidal waters of Drymond Bay.

### 2.4.5 *Elligraw Bayou*

Elligraw Bayou is a channelized stream that flows southwesterly to Drymond 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 Drymond 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 Drymond 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 Drymond Bay.

## 2.5 Water Quality Classification

The segments of the streams traversing the North Tract of the Palmer Ranch are non-tidal freshwater systems that have been designated by the State as Class III waters pursuant to Subsection 62-302.400(1) of the Florida Administrative Code (FAC). Downstream, these streams flow into estuarine systems (Drymond Bay and Little Sarasota Bay) which are classified as 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.**

| | State of Florida | Sarasota County |
|---|---|---|
| Arsenic | Not >50 μg/L | Not >100 μg/L |
| Biochemical Oxygen Demand | Not to be increased in a manner that would depress Dissolved Oxygen levels below criteria. | Same as FAC 62-302 |
| Coliform, Fecal | Not >800/100 mL | ---- |
| Coliform, Total | Not >2,400/100 mL | 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. | +100% above background, or to max. of 500 μmhos/cm in fresh water streams. |
| Copper | Not >12.8 μg/L at a Total Hardness of 110 mg/L | Not >10 μg/L |
| Dissolved Oxygen | Not <5 mg/L | Not <4 mg/L |
| Lead | Not >3.6 μg/L at a Total Hardness of 110 mg/L | Not >10 μg/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. | ----- |
| Nitrogen, Ammonia (ionic plus non-ionic) | See Nutrients | Only applies to non-ionic Ammonia |
| Nitrogen, Nitrite | See Nutrients | ----- |
| Nitrogen, Nitrate | See Nutrients | ----- |
| Nitrogen, Total | See Nutrients | ----- |

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

| | State of Florida | Sarasota County |
|---|---|---|
| Nitrogen, Organic | See Nutrients | ----- |
| Oil and Greases | Not >5 mg/L | Not >15 mg/L |
| Phosphate, Ortho | See Nutrients | ----- |
| Phosphorus, Total | See Nutrients | ----- |
| pH | 6.0 - 8.5 | Same as FAC 62-302 |
| Solids, Total Suspended | ----- | ----- |
| Turbidity | Not >29 NTU above background | Not >25 JTU above background |
| Zinc | Not >115 μg/L at a Total Hardness of 110 mg/L | Not >10 μg/L |

## 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**.

South Creek was monitored at four (4) locations. These include one point of outflow (SC-2) and one point of inflow (SC-3), as well as in the interior of the North Tract at Stations SC-4 and SC-1. Station SC-3 is upstream of any development underway presently in the South Creek Basin. Station SC-4 is located immediately downstream of any development activity within the basin. During three of the four monitoring events, only Stations SC-1, SC-2, and SC-4 were monitored because no construction extended beyond Station SC-4. Sampling at Station SC-3 was initiated in October 1996 when construction activity moved upstream of Station SC-4.

### 3.2 Parameters and Sampling Frequency

Quarterly sampling was performed during January, April, July, and October 1996. In addition, samples were collected for analysis of the annual parameters during the October 1996 monitoring event. As specified in Exhibit "E", all four monitoring stations were to be monitored and samples collected for analysis of the annual parameters during the pre-development monitoring event (*i.e.*, January 1994). After the pre-development monitoring, only stations located downstream of an area under

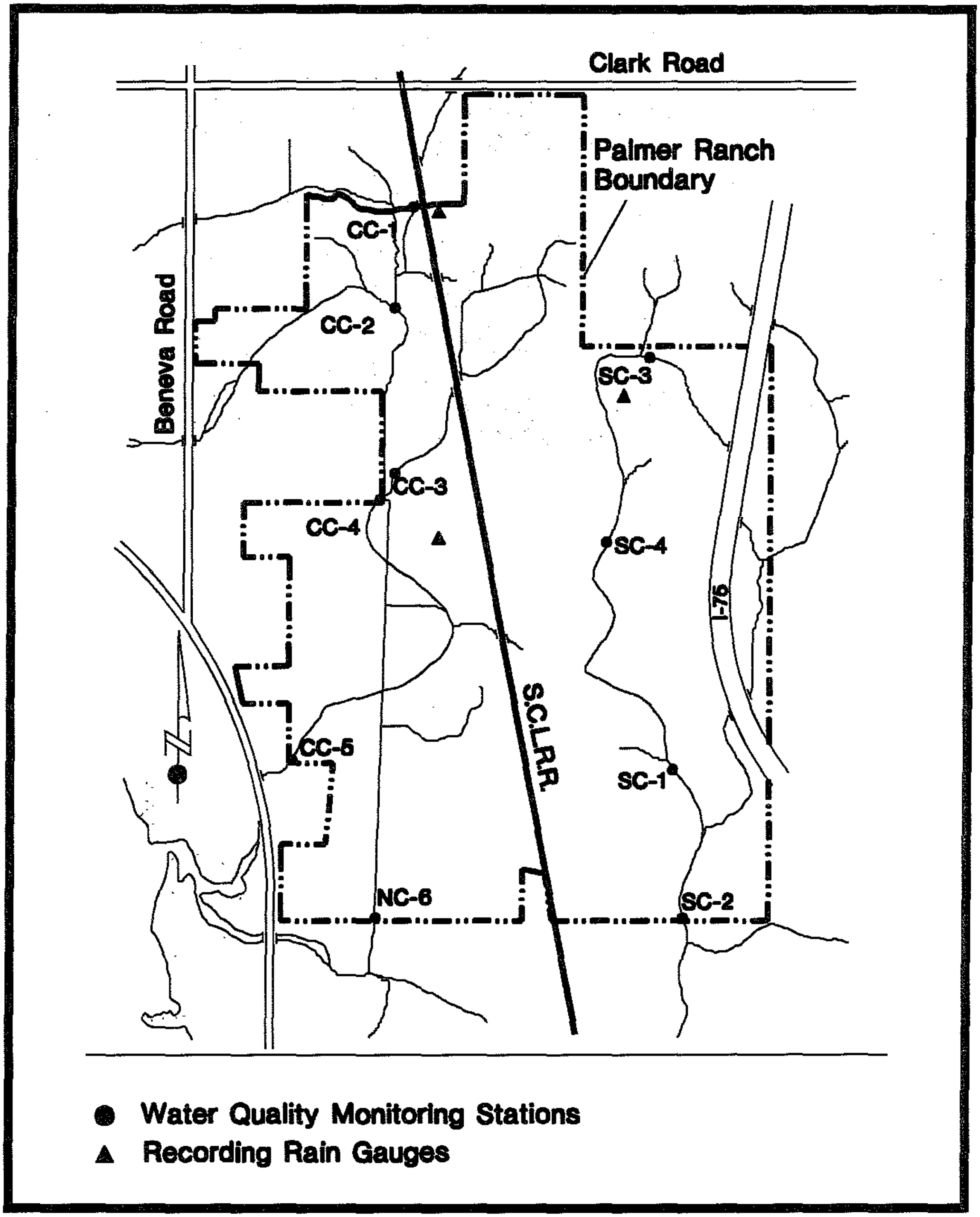


**Figure 3.1 Locations of Surface Water Monitoring Stations.**

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

| | General | Water Depth | Channel Width | |
|---|---|---|---|---|
| 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.

development were monitored. In addition, baseline water quality conditions in the basin were determined by monitoring one station located above a development area. The dates and times of all sample collections are provided in **Table 3.2**.

Surface water quality monitoring from January through December 1996 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 Endeco/YSI multi-parameter water quality meter was used for *in situ* measurements of dissolved oxygen, pH, specific conductance, and water temperature. Before 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 four quarterly events, preserved, and analyzed in the laboratory within the recommended hold times for the following parameters:

- Ammonia Nitrogen
- Nitrate Nitrogen
- Nitrite Nitrogen
- Organic Nitrogen[1]
- Total Nitrogen
- Orthophosphate
- Total Phosphorus
- Oil and Grease
- Total Suspended Solids
- Turbidity
- Biochemical Oxygen Demand
- Fecal Coliform Bacteria
- Total Coliform Bacteria

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

**TABLE 3.2 DATE AND TIME OF SAMPLING FOR THE TWELFTH ANNUAL MONITORING PERIOD OF JANUARY THROUGH DECEMBER, 1996**

| Quarter No. | Date of Sampling | Monitoring Stations | | | |
|---|---|---|---|---|---|
| | | SC-1 | SC-2 | SC-3 | SC-4 |
| 1 | 16-Jan-96 | 11:28 | 11:00 | -- | 11:50 |
| 2 | 23-Apr-96 | 11:20 | 11:00 | -- | 11:35 |
| 3 | 30-Jul-96 | 11:00 | 10:50 | -- | 11:30 |
| 4 | 16-Oct-96 | 11:15 | 10:45 | 12:00 | 11:30 |

Additional surface water grab samples were collected at each monitoring station during the October 1996 monitoring event for the laboratory analysis of the following parameters:

- Arsenic
- Copper
- Lead
- Zinc

All sampling was performed according to CCI's Comprehensive Quality Assurance Plan (CompQAP No. 87201G) on file with the Florida Department of Environmental Protection. All laboratory analyses were performed in accordance with the procedures described in the 17th edition of *Standard Methods for the Examination of Water and Wastewater* (APHA, 1989), *Methods for Chemical Analysis of Water and Wastes* (USEPA, 1983) or other FDEP/USEPA approved methodology. The method 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 the CCI's laboratory which is certified by Florida Department of Health and Rehabilitative Services for the analyses of environmental and drinking water samples. Copies of the laboratory reports of results for the 1996 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

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

| | Sample | Field | Hold | Laboratory | | Method |
|---|---|---|---|---|---|---|
| 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, Stored on Ice | 28 Days | Stored at 4 °C | 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, Stored on Ice | 28 Days | Stored at 4 °C | Gravimetric | EPA 413.1 |

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

| | Sample | Field | Hold | Laboratory | | Method |
|---|---|---|---|---|---|---|
| Dissolved Oxygen | *In situ* | ---- | ---- | ---- | Hydrolab - Membrane Electrode | APHA 4500 G |
| 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, 1989. *Standard Methods for the Examination of Water and Wastewater*, 17th 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.

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 twelfth year of the "Continuing Surface Water Quality Monitoring Program" (*i.e.*, January through December 1996) at Palmer Ranch, quarterly surface water quality monitoring was conducted by CCI in the South Creek Basin. Sampling was conducted on January 16, April 23, July 30, and October 16, 1996. During three of the four monitoring events, only Stations SC-1, SC-2, and SC-4 were monitored because no construction extended beyond Station SC-4. Sampling at Station SC-3 was initiated in October 1996 when construction activity moved upstream of Station SC-4.

Individual results for the four quarterly events performed during the 1996 monitoring year for the "Continuing Surface Water Quality Monitoring Program" for the South Creek Basin 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 analytical results for the samples collected during the 1996 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*

Rainfall amounts recorded in the South Creek Basin of the Palmer Ranch during the twelfth year of the "Continuing Surface Water Quality Monitoring Program" were less than normal. The rainfall amount recorded during 1996 is approximately 10 inches below than the average annual rainfall of approximately 54 inches based on a 30-year period of record (NOAA, 1982). Approximately 44 inches of precipitation were recorded (**Table 4.1**) during 1996 in comparison to 38 to 65 inches recorded during previous monitoring years (CCI, 1988a, 1988b, 1991, 1992a, 1993, 1994, and 1995).

**Figure 4.1** provides a comparison of the monthly distribution of rainfall measured in the South Creek Basin of the Palmer Ranch during the 1996 monitoring year with the monthly distribution of historical rainfall for the 30-year period of record (NOAA, 1982). Rainfall recorded during the 1996 monitoring year generally followed expected seasonal trends for this region of Florida as observed during previous monitoring years. During the 1996 monitoring year, below-normal rainfall was observed during eight months of the year (*i.e.*, February, April, June, July, August, September, and December), whereas above-normal rainfall occurred during January, March, May, and October. Near normal rainfall amounts were recorded during November (**Figure 4.1**). The highest monthly rainfall during 1996 was observed in October when 6.17 inches were recorded compared with a historical average for this month of approximately 3.18 inches.

TABLE 4.1 RAINFALL RECORDED ON THE PALMER RANCH DURING THE PERIOD OF JANUARY THROUGH DECEMBER, 1996.

| Date | Monthly Rainfall | Seasonal Rainfall[a] | Pre-event Rainfall (inches) 2 Month | 2 Week | 2 Day |
|---|---|---|---|---|---|
| January, 1996 | 3.86 | | 5.42 | 1.99 | 0.00 |
| February, 1996 | 0.65 | | | | |
| March, 1996 | 5.9 | | | | |
| Winter | | 10.41 | | | |
| April, 1996 | 1.62 | | 6.44 | 0.30 | 0.00 |
| May, 1996 | 4.36 | | | | |
| June, 1996 | 5.95 | | | | |
| Spring | | 11.93 | | | |
| July, 1996 | 3.34 | | 9.29 | 1.09 | 1.03 |
| August, 1996 | 5.79 | | | | |
| September, 1996 | 2.96 | | | | |
| Summer (wet season) | | 12.49 | | | |
| October, 1996 | 6.17 | | 9.76 | 3.8 | 0.03 |
| November, 1996 | 1.43 | | | | |
| December, 1996 | 1.50 | | | | |
| Fall (Dry Season) | | 9.10 | | | |
| Yearly Total | | 43.93 | | | |

[a] **Seasonal Rainfall (inches):**

Primary Wet Season (June - September) - 18.44
Primary Dry Season (October - January) - 12.96
Secondary Wet Season (February - March) - 6.55
Secondary Dry Season (April - May) - 5.98

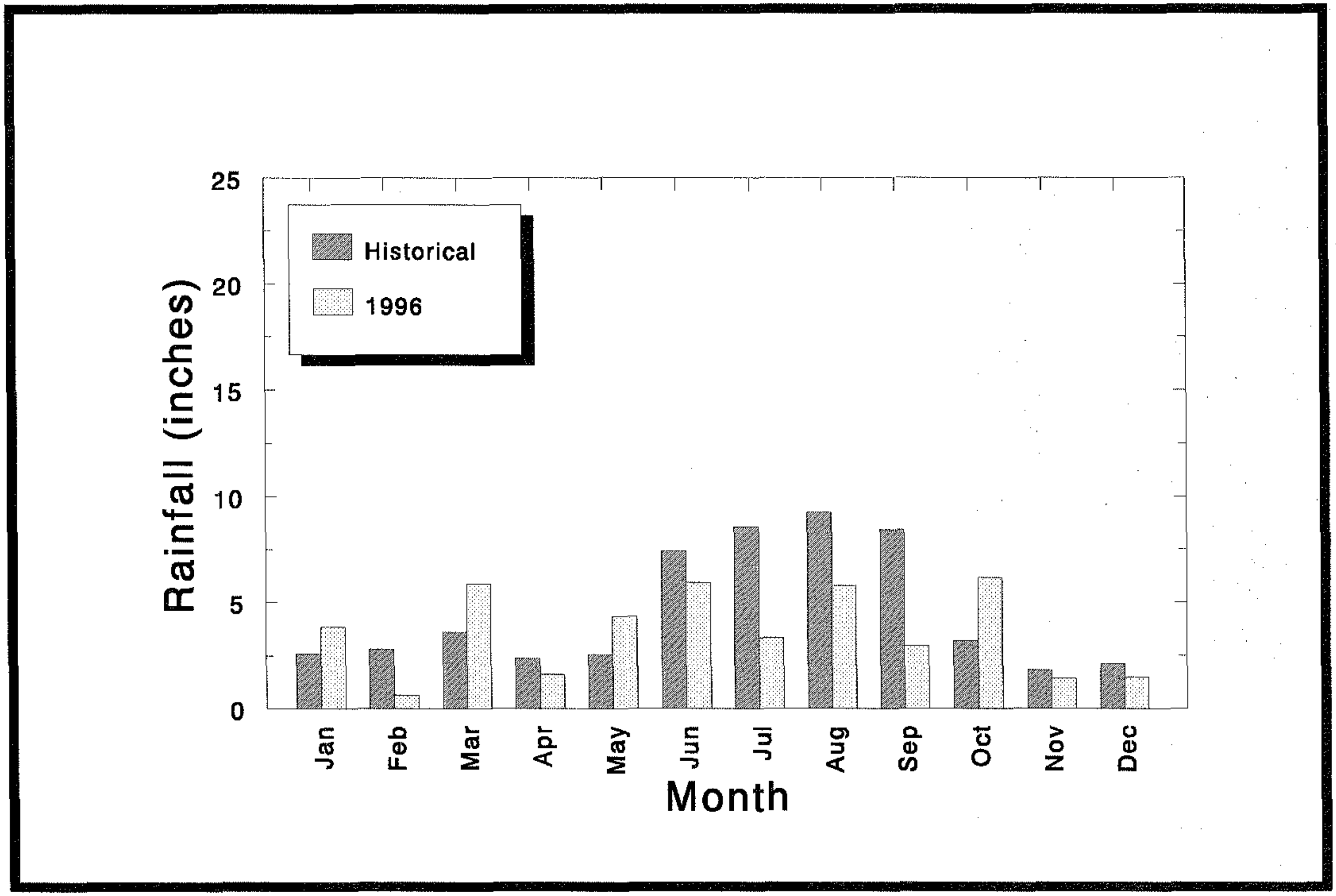


**Figure 4.1 Historic Rainfall for Sarasota County Versus Actual Rainfall Recorded on the Palmer Ranch During January Through December 1996.**

As provided in **Table 4.1**, the seasonal amounts of rainfall recorded on-site during the spring and summer quarters totaled 11.93 and 12.49 inches, respectively. Rainfall amounts recorded during the fall and winter quarters were 9.10 and 10.41 inches, respectively. In the four-month period from June through September, when the primary wet season normally occurs, 18.44 inches (or 42 percent of the total annual rainfall) was recorded on the Palmer Ranch. The total rainfall recorded during the primary wet season for 1996 was one of the lowest observed on the Palmer Ranch property during the ten-year monitoring period. Only 12.96 inches (*i.e.*, 30 percent of the annual rainfall) were recorded during the four-month period in which the primary dry season normally occurs (*i.e.*, October through January).

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, no rainfall was recorded during the 2-day antecedent period for the January and April 1996 monitoring events. Greater amounts of rainfall were recorded during the 2-week antecedent period for all events performed during the 1996 monitoring year except the April 1996 monitoring event. Rainfall amounts during the 2-week antecedent period for the four monitoring events ranged from 0.30 to 3.80 inches, with the highest antecedent amount recorded by the October 1996 monitoring event.

### 4.1.2 *Stream Stage*

Water depths measured at each station during the four quarterly sampling events performed during 1996 are tabulated in **Appendix Table B-1**. Stream stages measured during 1996 are greater than those measured during the 1991 monitoring year (*i.e.*, the last year stations in South Creek were monitored). During the 1996 monitoring year, stream stages at Stations SC-1, SC-2 and SC-4 averaged 1.1, 1.5 and 2.2 feet, respectively, compared to average stream stages of 0.9, 0.8, and 0.5 feet during 1991. Station 3 exhibited a higher stream stage during the 1991 monitoring year than measured during the 1996 monitoring year. However, the 1991 stream stage is an average of four monitoring events while only one stage measurement was performed during the 1996 monitoring year at Station 3. During the 1995 monitoring year when rainfall was 11 inches above normal, the stream stage at Stations SC-1, SC-2 and SC-4 only averaged 1.2, 1.1, and 1.3 feet, respectively. Although rainfall recorded during the 1996 monitoring year was below normal, stream stages measured in South Creek were relatively higher than for previous monitoring years. Stream stages measured at all monitoring stations in South Creek during 1996 averaged 1.5 feet with a range of 0.5 to 3.5 feet compared with average stream stages recorded during the previous monitoring years that ranged from 0.4 to 1.2 feet (CCI, 1986, 1988a, 1988b, 1990, 1991, 1992a, 1995, and 1996).

The shallowest water depth was measured at Station SC-3, which is located at upper reach of the South Creek Basin of Palmer Ranch (**Appendix Table B-1**). However, this water depth is based on a single sampling event in October 1996 when the sampling at the site was reactivated. Overall, Station SC-1 exhibited the lowest water depths during the entire 1996 monitoring year with depths averaging 1.1 feet. Station one is located at mid-reach in the South Creek Basin of Palmer Ranch, immediately downstream of the reconstructed segment. None of the four monitoring sites exhibited dry conditions during the 1996 sampling events. Seasonally, high water depths were recorded at the three monitoring stations during the October 1996 monitoring event which followed 3.80 inches of rainfall during a 2-week period before the sampling event.

### 4.1.3 *Stream Flow*

As evident in **Appendix Table B-2**, positive stream flows (*i.e.*, measurable flows) were recorded for 11 of 13 measurements (*i.e.*, 85 percent) taken during the 1996 monitoring year in the South Creek Basin. As expected, the percentage of positive flows measured during 1996 is significantly higher than the 67 and 77 percent positive flow measurements observed during the 1991 and 1994 monitoring years, respectively (CCI, 1992a; CCI, 1995). The percent positive flow measured during 1996 is lower than the 1995 monitoring year. Although below normal rainfall was recorded during the 1996 monitoring year, mean stream flows were comparable to those recorded during the previous monitoring years (CCI, 1986; CCI, 1988a; CCI, 1988b; CCI, 1990; CCI, 1991; CCI, 1992a; CCI, 1995; and CCI, 1996).

The highest stream flows were observed during the January 1996 monitoring event when stream flows averaged 1,198 GPM. Stream flows measured in January 1996 probably resulted from saturated soil conditions that prevailed during 1995 and early 1996 because of above normal rainfall amounts recorded in the South Creek Basin in 1995. Saturated soil conditions can result in an elevated groundwater table and a higher percentage of surface runoff, and therefore, increased stream flow. Thus, a 2-week antecedent rainfall amount of approximately two inches (**Table 4.1**) corresponded to the highest flow rates measured in South Creek during the 1996 monitoring year. Average flows measured during 1996 are presented in **Figure 4-2**.

During the 1996 monitoring year stream flows in the South Creek basin ranged from 0 to 2,006 GPM (**Appendix Table B-2**). Stream flows in the upper reaches ranged from 0 to 668 GPM while the lower reach exhibited flows from 0 to 2,006 GPM.

## 4.2 Physical Water Quality Parameters

### 4.2.1 *Water Temperature*

**Appendix Table B-3** presents the surface water temperature measurements collected during the 1996 monitoring year. Results suggest that the water temperature in South Creek on the Palmer Ranch ranged from 16.2 to 31.5°C during the four monitoring events. This range is similar to those recorded during previous years of monitoring (Palmer Venture, 1986; and CCI, 1986, 1988a, 1988b, 1991, 1992a, 1995, and 1996).

As expected, the lowest water temperatures averaging 16.4°C were recorded in the streams of the North Tract during the winter quarterly event (*i.e.*, January 1996) with higher water temperatures recorded during the April, July and October monitoring events. The highest water temperatures averaging 30.2°C were recorded during the July 1996 (*i.e.*, summer) monitoring event. Water temperatures recorded for the April and October events averaged 24.0 and 25.0°C, respectively. Average water

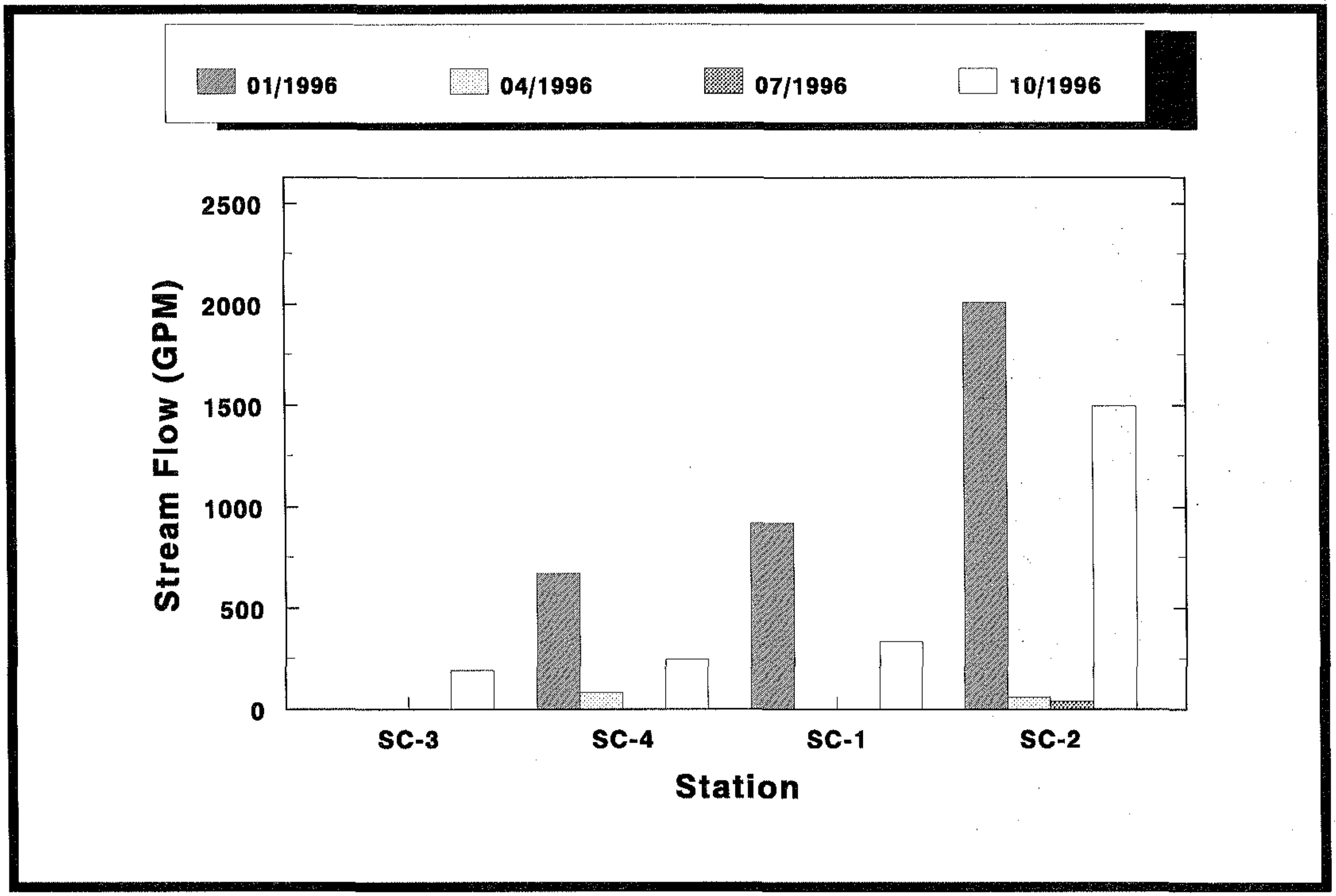


**Figure 4.2 Stream Flows Measured During Each Quarterly Sampling From January to December 1996 at the Palmer Ranch, Sarasota County.**

temperatures determined for each event in the South Creek Basin are very similar with temperature differences among stations generally being 5°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*

South Creek exhibited a range in specific conductance of 526 to 1,072 micromhos per centimeter (μmhos/cm) compared with ranges of 650 to 890, 672 to 1,363, 472 to 1,263, and 463 to 1,324 μmhos/cm during the fourth, sixth and tenth monitoring years, respectively (CCI, 1988b, 1991, 1992a, and 1995). Above normal rainfall in 1995 resulted in specific conductance levels ranging from 289 to 1,100 μmhos/cm. The higher values observed during the sixth monitoring year probably resulted from the relatively low amount of rainfall that 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 stormwater 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.

The lowest conductivities recorded during the 1996 monitoring year occurred during the October monitoring event with conductivities averaging 626 μmhos/cm. As described above, these lower conductivities most likely resulted from the cumulative effects of increased surface runoff of low conductivity stormwater during a period of high rainfall (refer to **Table 4.1**). Specific conductance levels measured at the monitoring stations in South Creek during the 1996 monitoring year are illustrated in **Figure 4.3**.

As observed during the previous years of monitoring (CCI 1988a, 1988b, 1991, 1992a, 1995, and 1996), no apparent spatial trends in conductivity were evident within the South Creek Basin of the Palmer Ranch (**Appendix Table B-4** and **Figure 4.3**). Average conductivities measured in the South Creek Basin were comparable for the mid and lower reaches at 675 and 759 μmhos/cm, respectively. However, specific conductance values measured in the lower reach of South Creek were generally higher than those measured at mid reach (**Figure 4.3**).

The State 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. None of the 13 conductivity measurements made during the 1996 monitoring year exceeded the 1,275 μmhos/cm threshold (**Figure 4.3**).

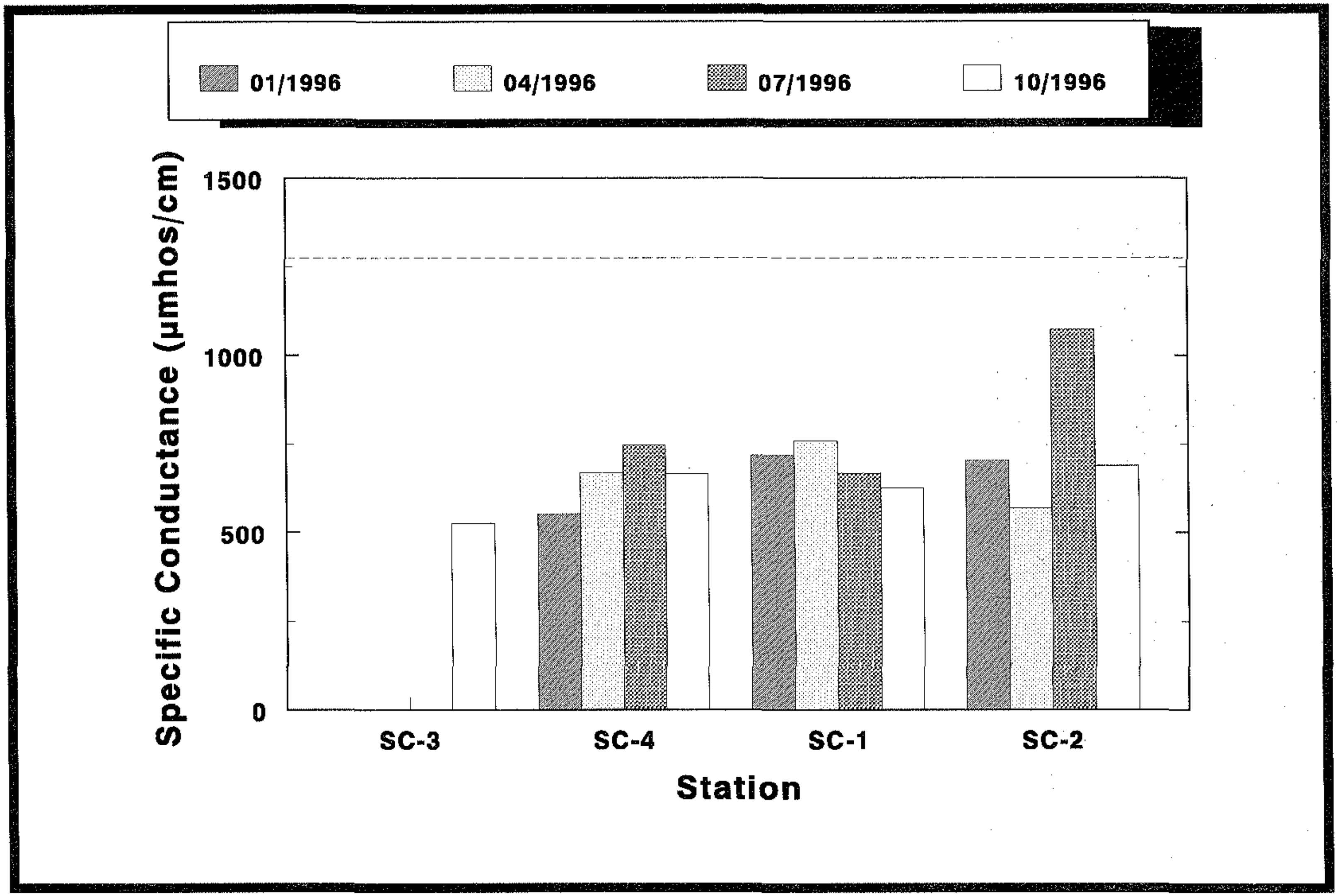


**Figure 4.3 Specific Conductance Levels Measured During Quarterly Sampling from January to December 1996 at the Palmer Ranch, Sarasota County. Dashed Line Depicts State Standard.**

The Sarasota County criterion for specific conductance (Ordinance No. 72-37) is similar to, but more stringent than, the State criteria. The County standard allows up to a 100 percent increase above background to a maximum level of 500 μmhos/cm in freshwater streams. All of the conductivity measurements made in South Creek on the Palmer Ranch during 1996 did not meet the County criteria. Ubiquitous noncompliance conductivities were also observed during the past years of monitoring (CCI 1986, 1988a, 1988b, 1991, 1992a, 1993, 1995, and 1996).

#### 4.2.3 *Total Suspended Solids*

During the 1996 monitoring year, stations along South Creek on the Palmer Ranch exhibited a range of total suspended solids (TSS) from 0.2 to 16.2 mg/L with an annual average of approximately 5.1 mg/L (**Appendix Table B-5**). **Figure 4.4A** illustrates the distribution of TSS levels during the 1996 monitoring year for South Creek. Overall, the TSS levels observed are comparable to those recorded during previous monitoring years (Palmer Venture, 1986; CCI, 1986, 1987, 1988a, 1988b, 1991, 1992a, 1995, and 1996).

The highest TSS level (16.2 mg/L) was recorded at mid reach Station SC-4 during the July 1996 monitoring event. The elevated TSS level probably resulted from higher organic matter content (*i.e.*, aquatic plants) because of stagnant water conditions at this site. Overall, TSS levels were observed to decrease downstream during this monitoring event.

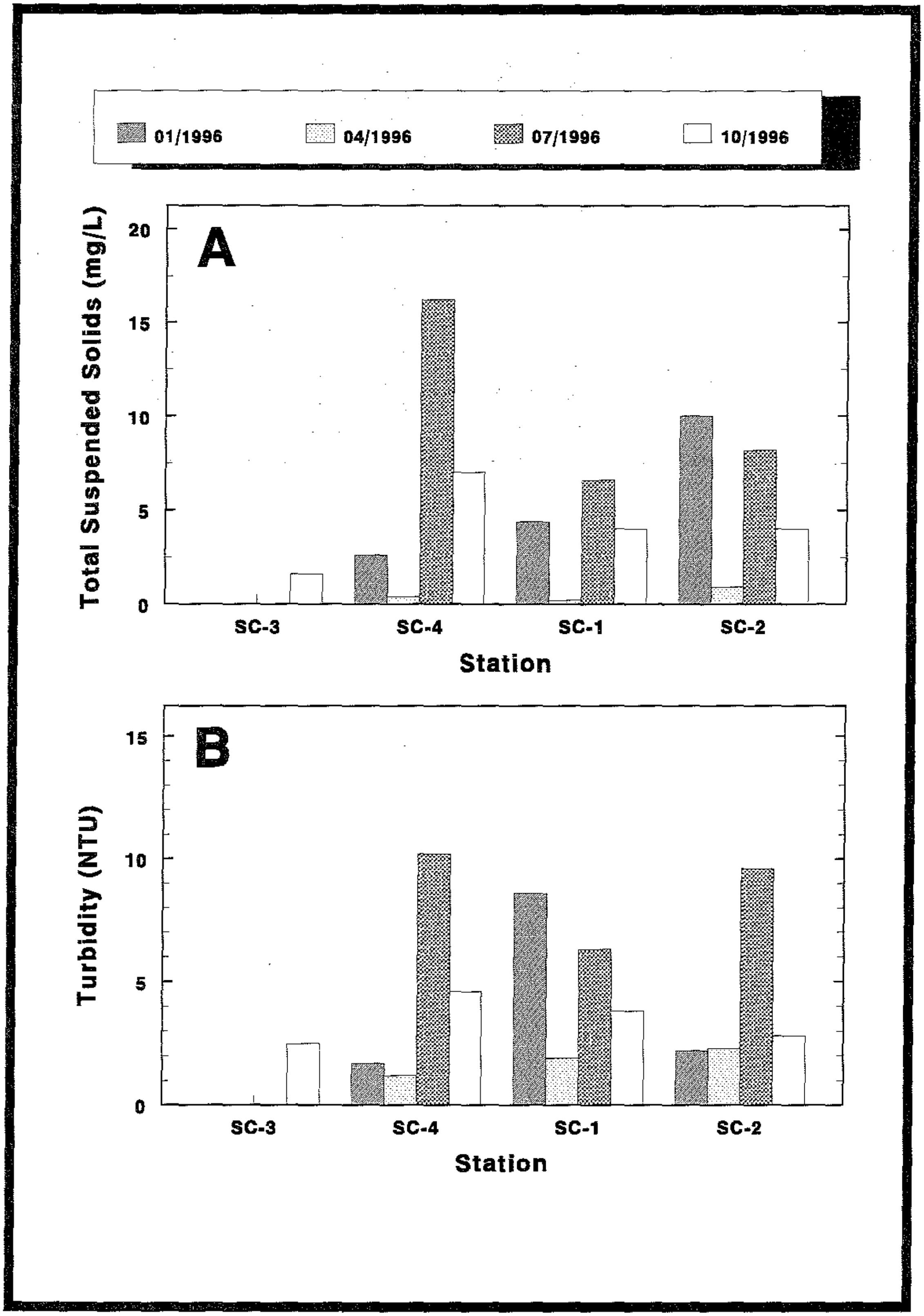


Figure 4.4 (A) Total Suspended Solids and (B) Turbidity Levels Measured During Quarterly Sampling from January to December 1996 at the Palmer Ranch, Sarasota County.

The lowest TSS level was recorded at Station SC-1 (*i.e.*, mid reach) during the April 1996 event. Overall, lower TSS concentrations were observed at all monitoring stations in the South Creek Basin during this event in response to lower rainfall amounts.

During 1995, TSS levels averaged 10 mg/L and ranged from 2.4 to 27.4 mg/L (CCI, 1996). Total suspended solids in the South Creek Basin of the Palmer Ranch ranged from <1 to 39 mg/L and averaged 9 mg/L for the 1994 monitoring year (CCI, 1995). Similar TSS levels were reported for the South Creek Basin during the sixth and seventh monitoring years (CCI, 1991 and 1992a). However, greater TSS levels ranging from <1 to 54 mg/L were observed during the third and fourth monitoring years with annual averages of 8.7 and 12.9 mg/L, respectively (CCI, 1988a and 1988b). During both years relatively high rainfall amounts were recorded. Much lower TSS levels were reported for South Creek during the fifth monitoring year. Total suspended solids averaged 6.7 mg/L and ranged from 2 to 11 mg/L during this monitoring year (CCI, 1990) because of abnormally dry conditions that resulted in less runoff entering the South Creek system and lower TSS levels.

During the first year of monitoring, TSS was reported to be the lowest than observed during any other year 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 fifth monitoring year.

### 4.2.4 *Turbidity*

During the twelfth year of the monitoring program, turbidity levels measured in South Creek ranged from 1.2 to 10.2 NTU with an overall average of 4.4 NTU (**Appendix Table B-6**). Comparable turbidity levels were measured during the 1995 monitoring year. Turbidity levels ranged from 1.7 to 11.8 NTU during this monitoring year (CCI, 1996). In comparison, similar turbidity ranges of 1.2 to 18 NTU, 0.6 to 10.5 NTU, and 0.9 to 15.2 NTU were exhibited during the third, sixth and seventh monitoring years, respectively (CCI, 1988a, 1991, and 1992a). During the first year of monitoring, much lower turbidities (*i.e.*, less than 6 NTU) were reported (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.

As in previous years, turbidity levels measured in South Creek during the 1996 monitoring year were correlated (*i.e.*, correlation coefficient (r) = 0.71) with TSS. Overall, a stronger correlation (r = 0.82) was determined between turbidity and TSS for all monitoring years. The lower correlation coefficient between TSS and turbidity determined for the 1996 monitoring year probably reflects variations in the amount of organic matter and colloidal material present in the surface water. High organic content in surface waters will exhibit an increased turbidity reading even though the amount of filterable TSS is low. The large amount of native vegetation around South Creek contributes to the organic matter content of creek water. Also, 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 may be present. Because colloids readily pass through a filter with a pore size of 0.45 $\mu$m (*i.e.*, such as on filters used for TSS measurements), a stronger correlation between TSS and turbidity is difficult to attain.

Turbidity exhibited the same seasonal trends observed for TSS in South Creek. The highest mean turbidity level (*i.e.*, 8.7 NTU) occurred during the summer sampling event (July 1996) while the lowest turbidity level (*i.e.*, 1.8 NTU) was determined for the April event (**Appendix Table B-6**). During the January and October events, average turbidities in South Creek were 4.2 and 3.4 NTU, respectively. The overall distribution of stream turbidity levels measured during the 1996 monitoring year in South 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 1996 monitoring year met the applicable state water quality criteria.

Sarasota County Ordinance (No. 72-37) allows a maximum increase of 25 Jackson units above background. Analysis of turbidity samples, however, was performed in accordance with FAC Chapter 62-302 criteria that is based on the Nephelometric procedure. Therefore, a comparison of the turbidity results to the County criteria cannot be made.

## 4.3 Oxygen Demand and Related Parameters

### 4.3.1 *Biochemical Oxygen Demand*

As presented in **Appendix Table B-7**, the 5-day biochemical oxygen demand ($BOD_5$) recorded in the South Creek Basin during the 1996 monitoring year averaged 2.7 mg/L and ranged from 0.9 to 10.8 mg/L. **Figure 4.5** illustrates the distribution of $BOD_5$ concentrations measured in South Creek during the 1996 monitoring year. Seasonally, the highest mean $BOD_5$ levels were determined during the July 1996 sampling event. Higher $BOD_5$ levels were recorded for the July event that coincides with the peak growing season for aquatic vegetation. Spatially, the highest $BOD_5$ levels were measured in samples collected at Station SC-4. Overall, slightly lower $BOD_5$ levels were observed at SC-2 than the two upstream stations (**Figure 4.5**).

Lower flow conditions within the upper portion of the creek may have also contributed to the accumulation of detritus, especially at mid reach stations. Additionally, a positive correlation between $BOD_5$ and TSS was noted which suggests

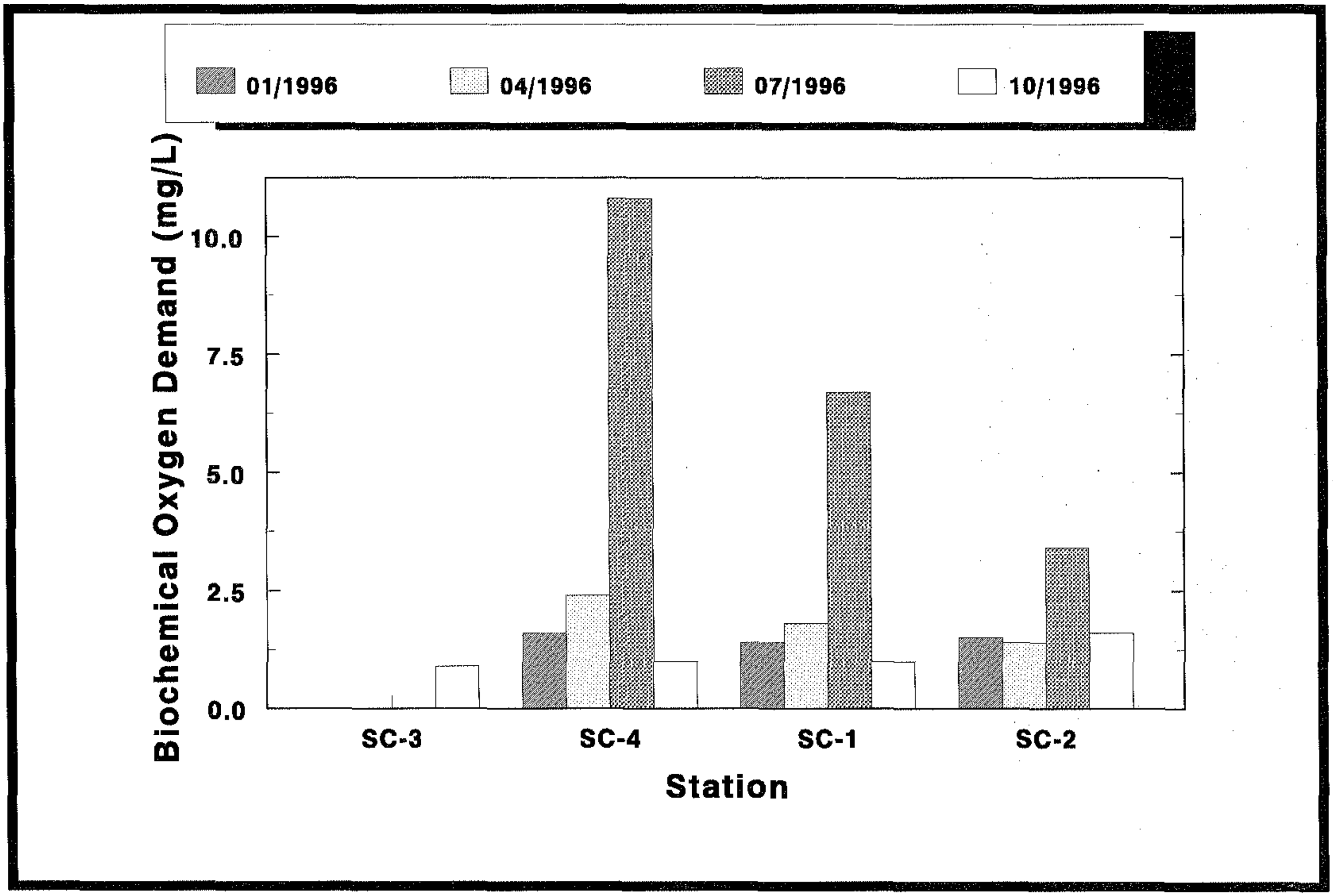


**Figure 4.5** Biochemical Oxygen Demand Measured During Quarterly Sampling from January to December 1996 at the Palmer Ranch, Sarasota County.

the contribution of decaying vegetation and other organic matter in the water column to TSS levels.

During the 1995 monitoring year, $BOD_5$ levels in South Creek averaged 2.4 mg/L and ranged from 1.6 to 6.3 mg/L (CCI, 1996). Similar levels were observed during the 1994 monitoring year with $BOD_5$ levels averaging 2.2 mg/L and ranging from 0.4 to 7.2 mg/L (CCI, 1995). Lower biochemical oxygen demand concentrations were observed during the 1991 monitoring year with an average of 1.8 mg/L and a range of 0.3 to 4.3 mg/L (CCI, 1992a). Biochemical oxygen demand concentrations comparable to those observed during the 1995 monitoring year were recorded in South Creek for the third, fourth and sixth monitoring years when $BOD_5$ concentrations ranged from 0.4 to 9.9 mg/L (CCI, 1988a, 1988b and 1991). During the second year of monitoring, a higher average $BOD_5$ concentration of 4.6 mg/L was recorded in the creek (CCI, 1986).

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). South Creek generally exhibited fairly clean water with only three of the 13 measurements performed in 1996 being over the 3.3 mg/L screening level. The $BOD_5$ concentrations measured during the July 1996 monitoring event exceeded the screening level at all three monitoring stations (**Figure 4.5**). Because of low flow conditions exhibited for this monitoring event, a build-up of detritus probably occurred resulting in elevated $BOD_5$ concentration throughout the creek. In addition, the July monitoring event coincides with the peak of the aquatic vegetation growing season that also can contribute to the overall organic content of the stream. As discussed previously, TSS and turbidity levels were also observed to follow the same seasonal trend as $BOD_5$.

Biochemical oxygen demand can be defined 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 South Creek is mostly attributed to decaying vegetation with a minor contribution hydrocarbon input (*i.e.*, automobile emission, oil leakage, *etc.*) resulting from runoff from Interstate-75.

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. 72-37, specifies that $BOD_5$ shall not be increased to levels that would result in violations of dissolved oxygen. Biochemical oxygen demand concentrations recorded in South Creek of the Palmer Ranch during the July 1996 monitoring event exceeded the 3.3 mg/L screening level suggesting potential water problems. Also during the twelfth year of monitoring, only the $BOD_5$ measurements made at SC-1 and SC-4 during the July event were greater the 5 mg/L level which Hynes (1966) considered to be "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 1996 monitoring year in South Creek. Temporal and spatial distributions of dissolved oxygen concentrations measured at four monitoring stations within South Creek during the 1996 monitoring year are presented in **Figure 4.6A**. Overall, dissolved oxygen was found to average 6.6 mg/L and range from 1.3 to 11.1 mg/L. The highest dissolved oxygen concentration (11.1 mg/L) was recorded at Station SC-1 during the July event. The high dissolved oxygen concentration measured at this site probably resulted from a large standing crop of algal matter. This conclusion is supported by relatively high $BOD_5$, TSS, and turbidity levels also recorded for this site during the July monitoring event (**Figures 4.4 and 4.5**). The lowest average dissolved oxygen level (*i.e.*, 1.3 mg/L) was recorded in the mid-reach of South Creek (at Station SC-4).

Seasonally, the highest average dissolved oxygen levels were observed for the January 1996 monitoring events with the lowest levels occurring during the July event in conjunction with the higher average water temperatures and relatively higher $BOD_5$ levels. Similar seasonal trends have been observed during previous monitoring years (CCI, 1988a, 1988b, 1991, 1992a, 1993, and 1996) and reflect the changes in the solubility of dissolved oxygen in the water column with changes in water temperature.

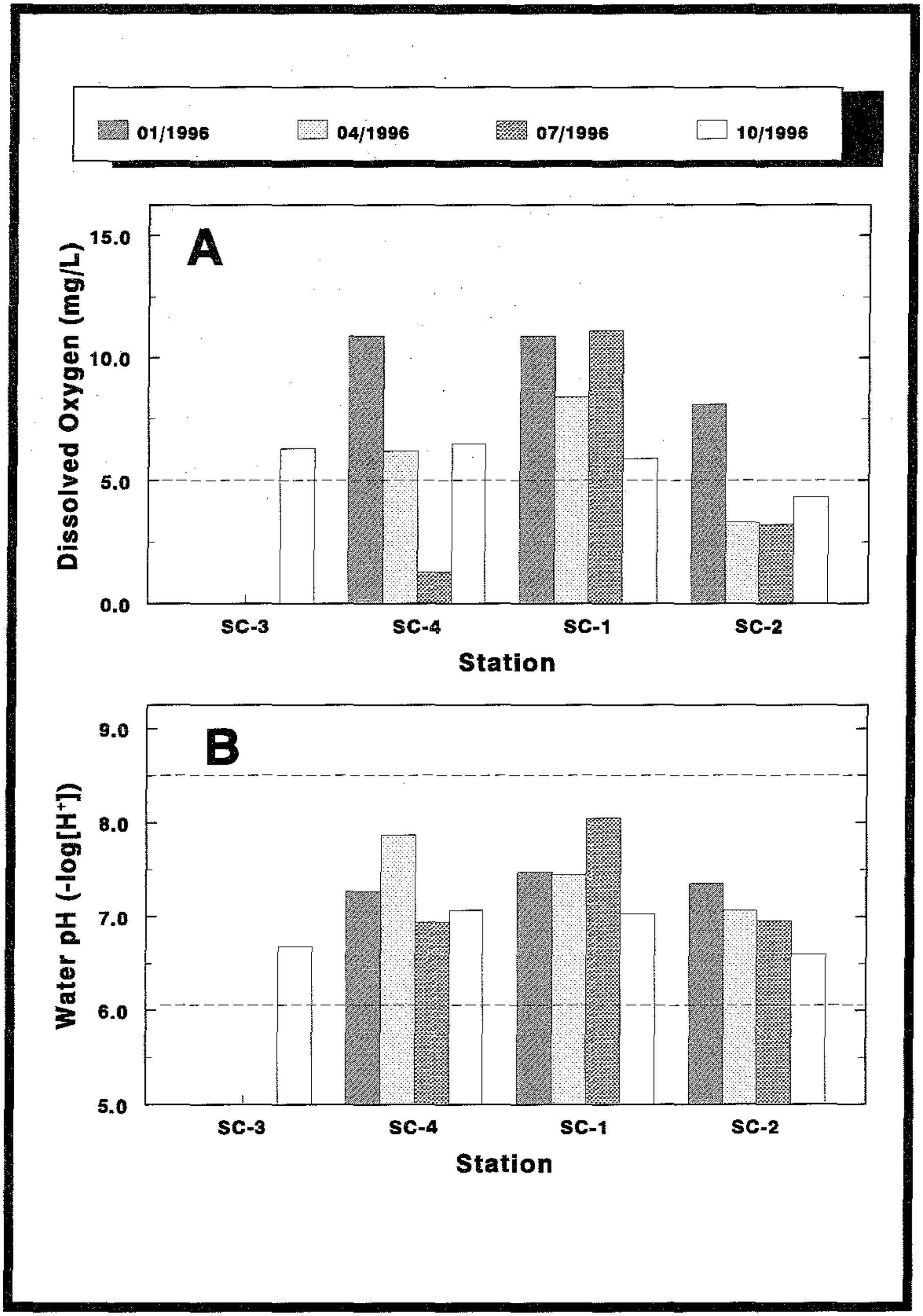


Figure 4.6 (A) Dissolved Oxygen and (B) Water pH Levels Measured During Quarterly Sampling from January to December 1996 at the Palmer Ranch, Sarasota County. Dashed Lines Depict State Standards for both Dissolved Oxygen and Water pH.

The results obtained for dissolved oxygen concentrations during the 1996 monitoring year for South Creek are generally comparable to those measured during the third, fourth, fifth, sixth, tenth, and eleventh monitoring years (CCI, 1988a, 1988b, 1990, 1991, 1995, and 1996) but slightly higher than the concentrations determined during the first two years of the monitoring program (Palmer Venture, 1986; and CCI, 1986). During the first year of monitoring dissolved oxygen levels averaged 3.0 mg/L with 58 percent of measurements being less than 4.0 mg/L (Palmer Venture, 1986). The third, fourth, fifth, and sixth monitoring years (CCI, 1988a, 1988b, and 1991) had dissolved oxygen concentrations averaging 5.8, 7.3, 6.4, and 5.8 mg/L, respectively.

An evaluation of diurnal variations in dissolved oxygen in 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 twelfth monitoring year, dissolved oxygen concentrations in South Creek infrequently occurred at levels below the 5.0 mg/L criteria specified by FAC Chapter 62-302 and the 4.0 mg/L standard specified by Sarasota County Ordinance 72-37 for predominantly freshwater. Of the 13 dissolved oxygen measurements made during the 1996 monitoring year, four measurements were below the 5.0 mg/L state criteria with three of the measurements being below the 4.0 mg/L County Criteria.

### 4.3.3 *Water pH*

Results of pH monitoring in South Creek during 1996 are given in **Appendix Table B-9** with temporal and spatial distributions shown in **Figure 4.6B**. During the 1996 monitoring year, surface water quality stations along South Creek exhibited pH levels ranging from 6.6 to 8.1. The range of pH observed during the 1996 monitoring year was similar to that observed during previous years of monitoring (Palmer Venture, 1986; and CCI, 1986, 1988a, 1988b, 1991, 1992a, 1995, and 1996).

As expected, the lowest pH levels were observed at SC-2 and SC-4 with pH levels averaging 7.0 and 7.3 units, respectively. The highest pH levels were recorded at Station SC-1 with an average of 7.5. These slight differences in pH distributions in South Creek are primarily attributed 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:

$$H_2 + CO_{2_{(g)}} \rightleftharpoons H_2CO_{3_{(aq)}} \rightleftharpoons H^+ + HCO_3^-$$

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 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 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, South Creek exhibited changes in pH ranging up to a 1 to 2 unit increase with maximum diurnal changes observed 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. 72-37, 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 twelfth year of monitoring, all pH measurements in South Creek were within the allowable range of 6.0 to 8.5 (**Figure 4.6B**).

## 4.4 Macronutrients

### 4.4.1 *Total Nitrogen*

Total nitrogen measurements acquired during the 1996 monitoring year in South Creek are provided in **Appendix Table B-10**. Spatial and temporal distributions of total nitrogen concentrations for the 1996 monitoring year are shown in **Figure 4.7**. Average total nitrogen concentrations measured in South Creek during the 1996 monitoring year were lower than measured during the 1994 and 1995 monitoring years (CCI, 1995 and 1996). In addition, the average total nitrogen concentration measured in South Creek during 1996 was lower to that reported during 1991 (CCI, 1992a). Total nitrogen levels measured in 1996 exhibited similar spatial and compositional trends to those observed during previous monitoring years. During the twelfth year of monitoring, the highest total nitrogen concentrations were observed at Station SC-4 that exhibited an average total nitrogen concentration of 1.26 mg/L for the four monitoring events. Total nitrogen concentrations of 1.86 and 1.51 mg/L measured at SC-4 during the July 1996 and October 1996 monitoring events, respectively, contributed to a higher annual average concentration determined for this site. Station SC-1 exhibited the lowest average total nitrogen concentration at 0.91 mg/L during the 1996 monitoring year.

Seasonally, the highest total nitrogen concentrations were observed for the July and October monitoring events. The higher total nitrogen concentration measured during the July event probably reflects a large standing crop of aquatic vegetation during the sampling period, especially at Station SC-4. This conclusion is supported by TSS,

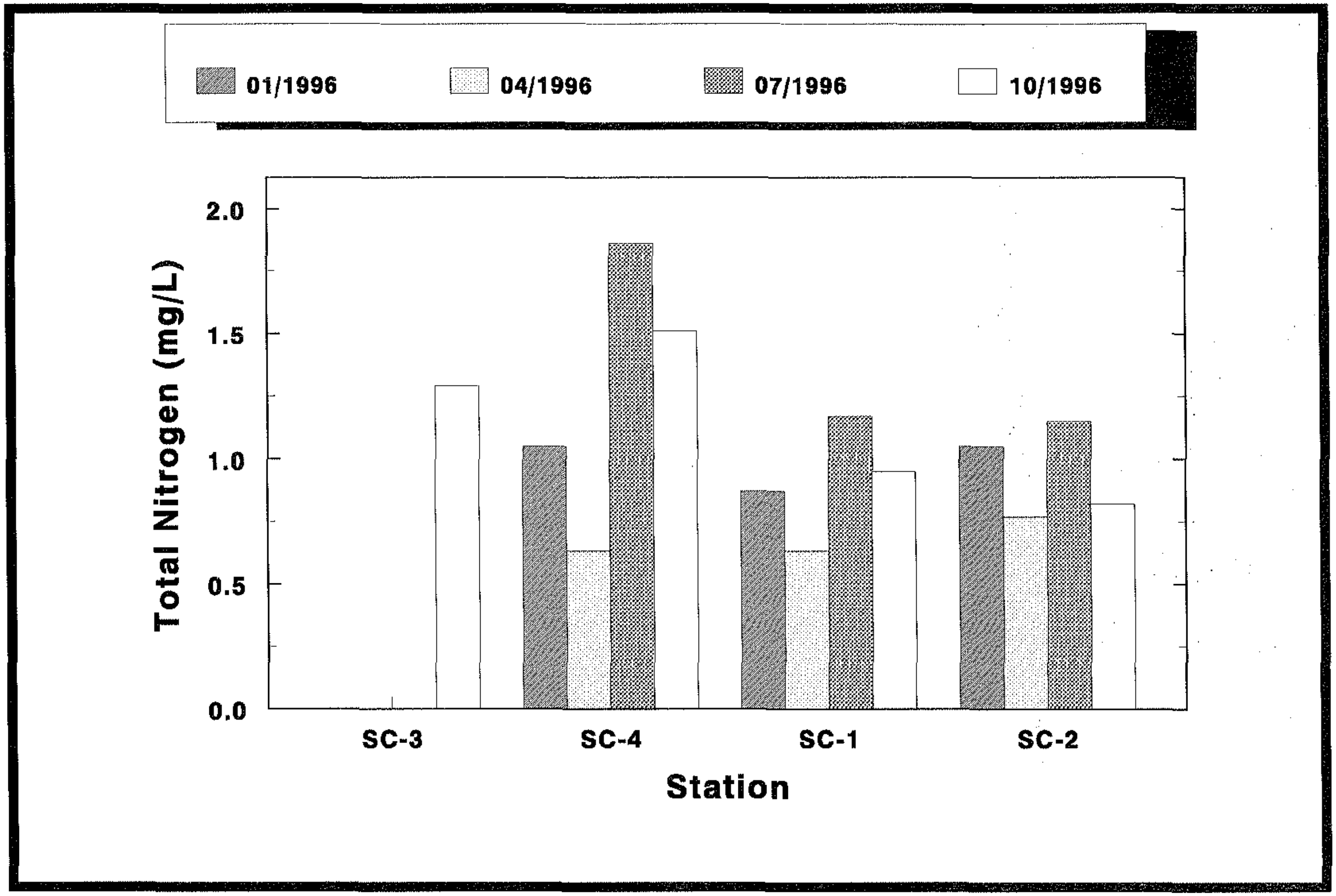


Figure 4.7 Total Nitrogen Levels Measured During Quarterly Sampling from January to December 1996 at the Palmer Ranch, Sarasota County.

$BOD_5$, and dissolved oxygen levels measured at this site during the July event. Relatively higher rainfall amounts during September and October (9.13 inches) and the subsequent increase in runoff contributed to the high nitrogen levels observed during the October 1996 monitoring event. During the April 1996 monitoring event when stormwater runoff and the amount of aquatic vegetation were minimal, the total nitrogen concentrations were at their lowest.

Overall, total nitrogen levels in South Creek averaged 1.06 mg/L during the 1996 monitoring year. Higher averages were observed for the second through seventh year of monitoring with ranges from 1.44 to 2.72 mg/L (CCI, 1986, 1988a, 1988b, 1990, and 1991 and 1992a). A lower average total nitrogen concentration (1.08 mg/L) was reported for the South Creek Basin during the first monitoring year (Palmer, 1986).

**Figure 4.8** provides the mean total nitrogen concentrations observed for the streams traversing the Palmer Ranch during the second, third, fourth, fifth, sixth, seventh, tenth, eleventh, and twelfth monitoring years. Also included in **Figure 4.8** is the average total nitrogen concentration measured in South Creek during the "Stormwater Pollutant Loading Monitoring Program" performed at the Palmer Ranch (CCI, 1992b). In addition, 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 to compare the relative importance of each nitrogen fraction. In general, average total nitrogen concentrations in South Creek have decreased over the past several years. The average total nitrogen concentration measured during the 1996 monitoring year

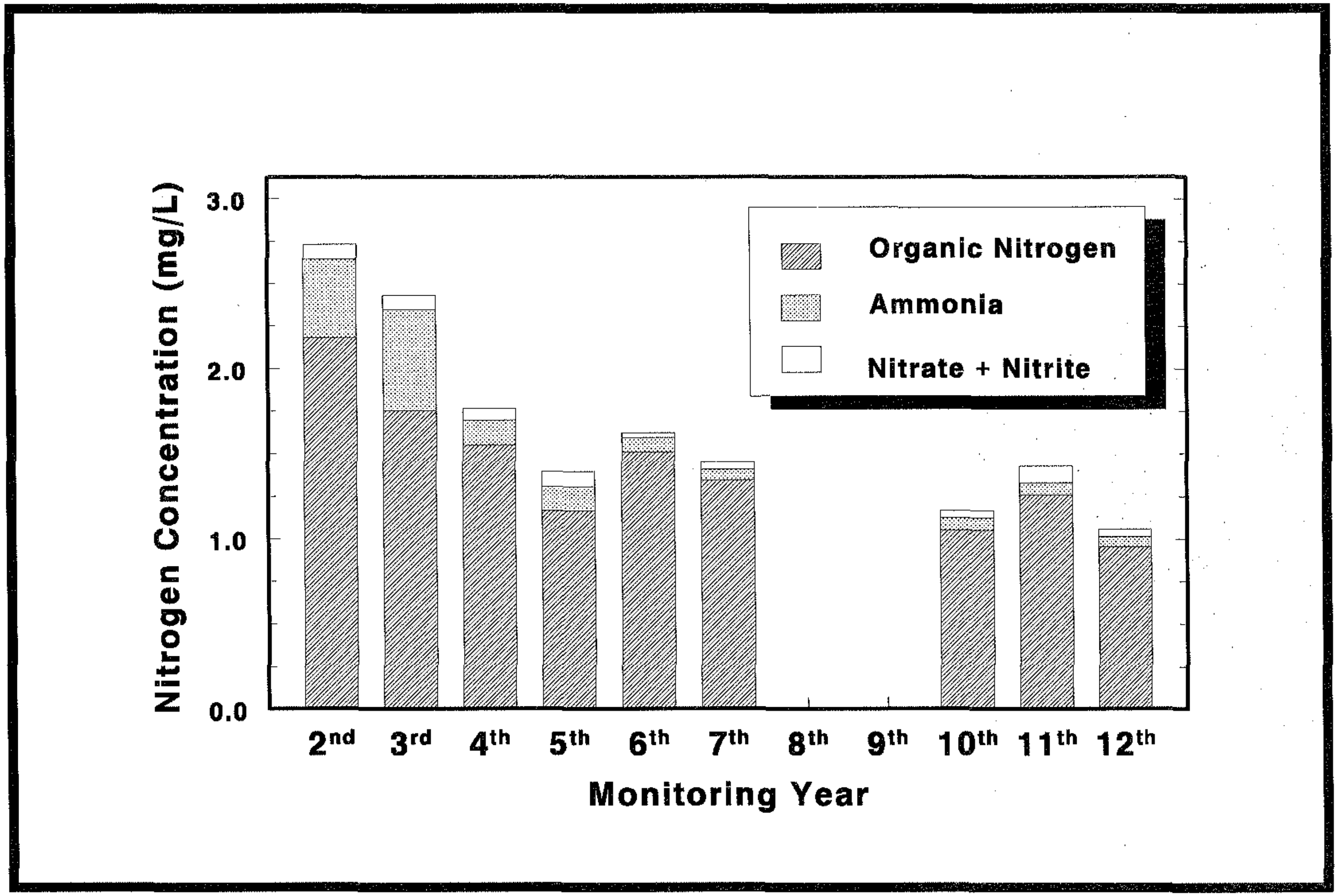


**Figure 4.8 Average Nitrogen Concentrations from the Second Through the Twelfth Year of Monitoring at the Palmer Ranch, Sarasota County. Fifth Year Data Collected at the Palmer Ranch During the "Pollutant Loading Monitoring Program".**

is the lowest of the 12 years monitored. The most pronounced decrease in nitrogen content occurred after the third monitoring year (*i.e.*, 1987) (**Figure 4.8**). At that time, an area located upstream of the eastern branch of South Creek on the Palmer Ranch property was used as a dairy farm (August 1987). Before the deactivation of the dairy farm, ammoniacal nitrogen comprised from 11 to 25 percent of the total nitrogen. After the deactivation of the dairy farm, 4 to 6 percent of the total nitrogen content of South Creek was in the form of ammonia. Not only have total nitrogen levels decreased, the forms of nitrogen that are readily assimilated by algae and plants (*i.e.*, nitrate + nitrite and ammonia) have also declined.

The largest fraction of total nitrogen observed during the entire monitoring program is organic nitrogen. During the twelfth monitoring year, organic nitrogen represented approximately 90 percent of total nitrogen and averaged 0.95 mg/L. The second most abundant form of nitrogen was ammoniacal nitrogen (*i.e.*, ionized and un-ionized ammonia) which represented approximately 5 percent of the total nitrogen with an average concentration of 0.06 mg/L. Nitrate nitrogen represented approximately 5 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 less than 1 percent of the total nitrogen concentration.

As stated previously, different breakdowns of total nitrogen were reported for South Creek during previous monitoring years (CCI, 1986, 1988a, 1988b, 1991 and

1992a). The largest fraction of total nitrogen observed during the previous years of monitoring also occurred in the form of organic nitrogen. Prior to 1988, organic nitrogen represented from 71 to 84 percent of the total nitrogen content and averaged from 1.08 to 2.18 mg/L. After the fourth monitoring year, organic nitrogen comprised $\geq$90 percent of the total nitrogen measured in South Creek.

Similarly, the second most abundant form of nitrogen prior to 1988 was ammoniacal nitrogen that represented from 11 to 24 percent of the total nitrogen content with average levels of 0.15 to 0.59 mg/L. Ammoniacal nitrogen also represented the second most abundant form of nitrogen after 1987. However, only 4 to 5 percent of the nitrogen was present in the ammonia fraction. Nitrate and nitrite represented approximately from 2 to 7 percent of the total nitrogen content with an average nitrate concentration ranging from 0.02 to 0.08 mg/L during the previous years of monitoring. As during the 1996 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 all years.

During the first year monitoring, however, Palmer Venture (1986) reported a significantly different breakdown with an average total nitrogen concentration 1.05 mg/L. Thus, total nitrogen was composed of 66 percent organic nitrogen, 10 percent ammonia nitrogen, 24 percent nitrate nitrogen, and less than 1 percent nitrite nitrogen. It is not completely understood why nitrate levels exceeded ammonia levels by approximately two times 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 and 1992a). Results obtained during the 1996 monitoring year indicate that none of the 12 of total nitrogen samples collected on the Palmer Ranch exceeded the screening level of 2.0 mg/L considered by the FDEP (FDER, 1990) to be characteristic of eutrophic conditions.

### 4.4.2 *Nitrite*

Nitrite levels observed in South Creek during the twelfth year of monitoring are provided in **Appendix Table B-11**. In addition, spatial and temporal distributions of nitrite concentrations measured during the 1996 monitoring year are presented in **Figure 4.9A**.

As expected, nitrite concentrations throughout South Creek were much lower than the other forms of nitrogen, and too low to be a significant nutrient source. Of the 13 samples collected during the 1996 monitoring year, two samples contained nitrite concentrations above the 0.01 mg/L analytical detection limit. Overall, nitrite

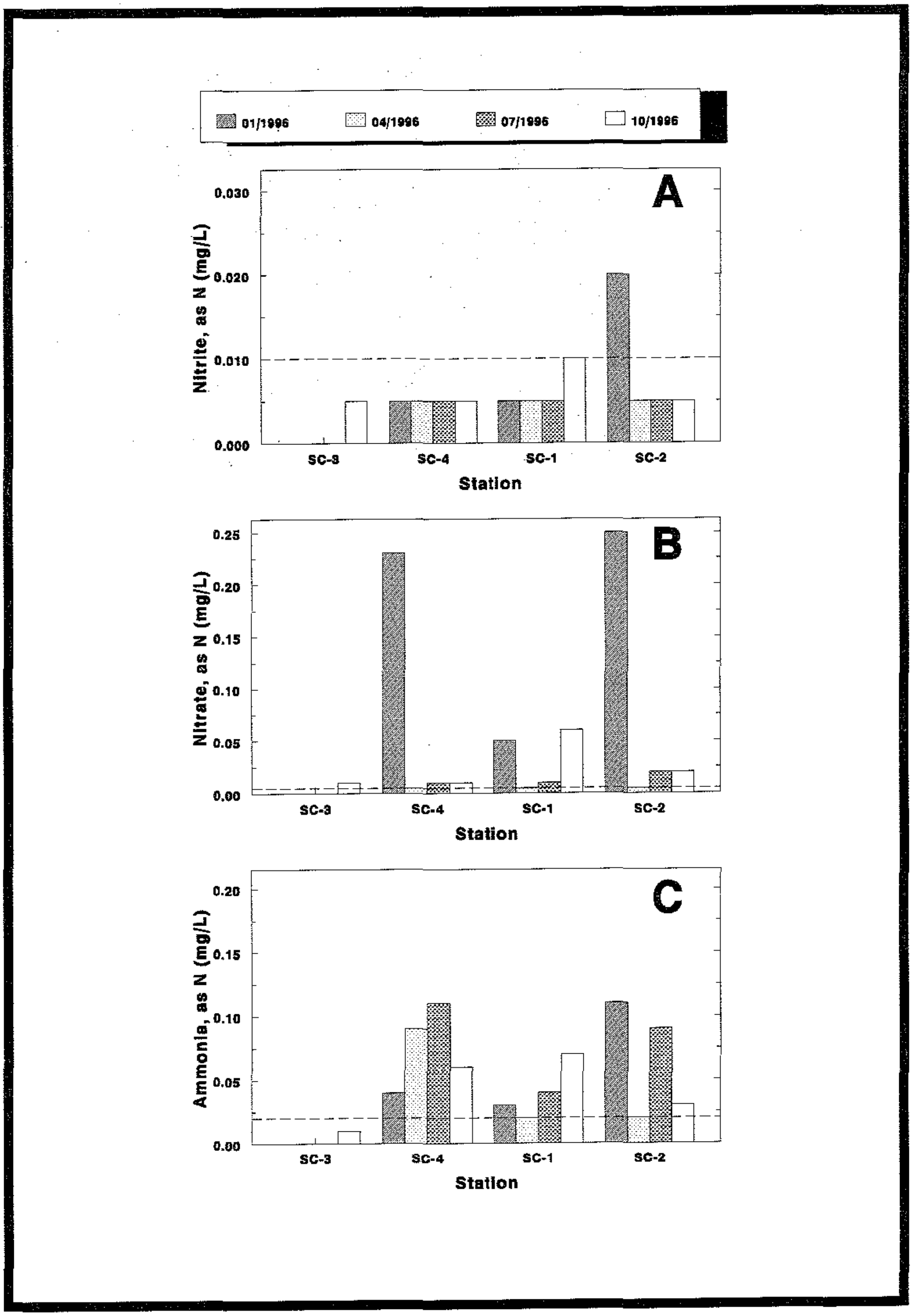


**Figure 4.9** **(A) Nitrite, (B) Nitrate, and (C) Ammonia Concentrations Measured During Quarterly Sampling from January to December 1996 at the Palmer Ranch, Sarasota County.**

concentrations averaged approximately 0.01 mg/L with a range of <0.01 to 0.02 mg/L. The highest nitrite concentration was reported at Station SC-2 during the January monitoring event and corresponds to overall elevated inorganic nitrogen concentrations from increased runoff resulting from relatively high amounts of rainfall recorded prior to the sampling event (*i.e.*, 1.99 inches during two week antecedent conditions). During the previous monitoring years, nitrite concentrations measured in South Creek averaged <0.01 to 0.02 mg/L and had a range from <0.01 to 0.13 mg/L (CCI, 1986, 1987, 1988a, 1988b, 1991, 1992a, 1995, and 1996).

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 found to be of little importance as a nutrient in the streams of the Palmer Ranch. For all practical purposes, nitrite is considered to meet applicable standards.

### 4.4.3 ***Nitrate***

As shown in the results provided in **Appendix Table B-12** and **Figure 4.9B**, nitrate levels observed for South Creek the Palmer Ranch during 1996 exhibited a yearly average of 0.05 mg/L with a range of <0.01 to 0.25 mg/L. These results are comparable to those determined during the second through fifth and eleventh monitoring years in South Creek with nitrate concentrations averaging 0.06 to 0.08 mg/L and ranging from <0.01 to 0.54 mg/L (CCI, 1986, 1988a, 1988b, 1990 and 1996). Lower nitrate concentrations were reported for the sixth, seventh, and tenth monitoring years when nitrate exhibited yearly averages from 0.02 to 0.03 mg/L and ranged from <0.01 to 0.21 mg/L (CCI, 1991 and 1992a).

Seasonally, the highest nitrate levels for the three monitoring sites were observed during the January 1996 monitoring event (**Figure 4.9B**). These higher nitrate levels in January can be attributed to lower rates of nitrate assimilation and/or higher denitrification rates during the winter season as primary productivity declines. Low levels of nitrate (averaging 0.01 mg/L) were observed during April and July at all three monitoring sites in the South Creek Basin (**Figure 4.9B**). These low concentrations of nitrate probably are a result of low inputs of nutrients in the form of stormwater runoff as well as higher nutrient uptake by aquatic vegetation.

Overall, South Creek exhibited relatively low nitrate levels. Spatially, the highest average nitrate concentration of 0.07 mg/L was recorded in the lower reach (Station SC-2) of the creek. However, this average nitrate concentration is only slightly higher than reported for Station SC-4 (**Appendix Table B-12**). In addition, both Station SC-2 and SC-4 exhibited similar ranges in nitrate concentrations. Average nitrate concentrations for the 1996 monitoring year decreased by approximately 50 percent from Station SC-4 to Station SC-1. During the January 1996 monitoring event, this decrease was more substantial with nitrate concentration decreasing from 0.23 mg/L at Station SC-4 to 0.05 at Station SC-1. Station SC-4 is located in the mid-reach of South Creek, upstream of the Turtle Rock development. Most of its runoff drains from the adjacent pastures. In contrast, Station SC-1 is located immediately downstream of the Turtle Rock development. At Station SC-2, nitrate concentrations increased to levels measured at Station SC-4. The increased nitrate levels from Station SC-1 to SC-2 are probably associated with runoff from pastures located downstream and adjacent to Station SC-1.

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 1996 monitoring year were among the lowest recorded during the twelve-year monitoring program and are not thought to represent an important source of nitrogen in the streams of the Palmer Ranch. Therefore, nitrate is considered to meet applicable 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 twelfth year of monitoring. Also, spatial and temporal distributions of ammoniacal nitrogen are illustrated in **Figure 4.9C**. As described previously, ammoniacal nitrogen represented 5 percent of the total nitrogen measured during the 1996 monitoring year. Overall, ammoniacal nitrogen exhibited an average of 0.06 mg/L with a range from <0.02 to 0.11 mg/L.

The highest ammoniacal nitrogen concentrations in South Creek were recorded during the July 1996 sampling event averaging 0.08 mg/L. These higher ammoniacal nitrogen concentrations are believed to be associated with the decay of vegetation in the creek. Additional ammoniacal nitrogen input is also associated with stormwater runoff entering the creek, especially during the summer wet season.

Although ammoniacal nitrogen is a potentially important nutrient to the primary producers in the streams of the Palmer Ranch, the results suggest that nitrate might be the preferred nitrogen source. This indication is based on two annual trends observed during the 1996 monitoring year as well as previous monitoring years as related to normal plant production and decay. During the growing season (*i.e.*, April to September), the concentration of ammoniacal nitrogen in South Creek was generally higher and ranged from 0.02 to 0.11 mg/L. Nitrate concentrations for the same period ranged from <0.01 to 0.02 mg/L. The lower nitrate concentrations, relative to ammoniacal nitrogen, indicate a preferential uptake of nitrate as opposed to ammonia. Second, both ammoniacal nitrogen and nitrate levels were elevated during the January event averaging 0.11 and 0.07 mg/L, respectively. Since December is considered to be the beginning of the winter season when net (primary) production is minimal, assimilation of nutrients should also be minimal. Because nutrients should be more available when they are assimilated at minimal rates, and vice versa, their concentrations should be elevated during the winter season and depressed during the summer (*i.e.*, primary production). Furthermore, nitrification (biological oxidation of organic nitrogen to nitrate) is expected to increase in association with the die-off and decay of plant material under aerobic conditions. Moreover, die-off and decay of plant material are expected to increase immediately following the period in which its standing crop peaks. This can occur in the streams of the Palmer Ranch from October to January. Since it was evident that the streams of the Palmer Ranch followed these trends of primary production, decay, nitrification, and minimal levels of nitrate during the growing season, it is concluded that nitrate is the preferred nitrogen source. Other freshwater studies (Wetzel, 1975) have also concluded that aquatic vegetation, including algae, prefer nitrate to ammonia.

During the previous years of monitoring (Palmer Venture, 1986; and CCI, 1986, 1988a, and 1988b) ammonia concentrations were much higher than those measured during the 1996 monitoring year. These higher levels can be attributed to runoff originating from a dairy farm upstream of the Palmer Ranch property. In contrast, ammoniacal nitrogen concentrations measured for the sixth, seventh, tenth, and eleventh monitoring years were comparable to the those measured during the present monitoring year (CCI, 1991, 1992a, 1995, and 1996).

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 (*i.e.*, ionized and un-ionized ammonia). Increases in ammonia have the potential 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 1995 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 South Creek within the Palmer Ranch during the 1996 monitoring year are provided in **Appendix Table B-14** and graphically depicted in **Figure 4.10**. An average organic nitrogen concentration of 0.95 mg/L was measured in this stream of the Palmer Ranch during the twelfth year of monitoring with a range from 0.52 to 1.74 mg/L. Overall, organic nitrogen levels during the 1996 monitoring year were the lowest measured in South Creek. Slightly higher organic nitrogen concentrations, averaging 1.35, 1.05, and 1.26 were observed for the 1991, 1994, and 1995 monitoring years (CCI, 1992a, 1995, and 1996). Similarly, average organic nitrogen concentrations were also higher for the second through sixth monitoring years (CCI, 1986, 1988a, 1988b, 1990 and 1991).

The concentration of organic nitrogen followed a seasonal trend similar to that observed during previous monitoring years with the level of organic nitrogen increasing through the spring and summer. The maximum organic nitrogen

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

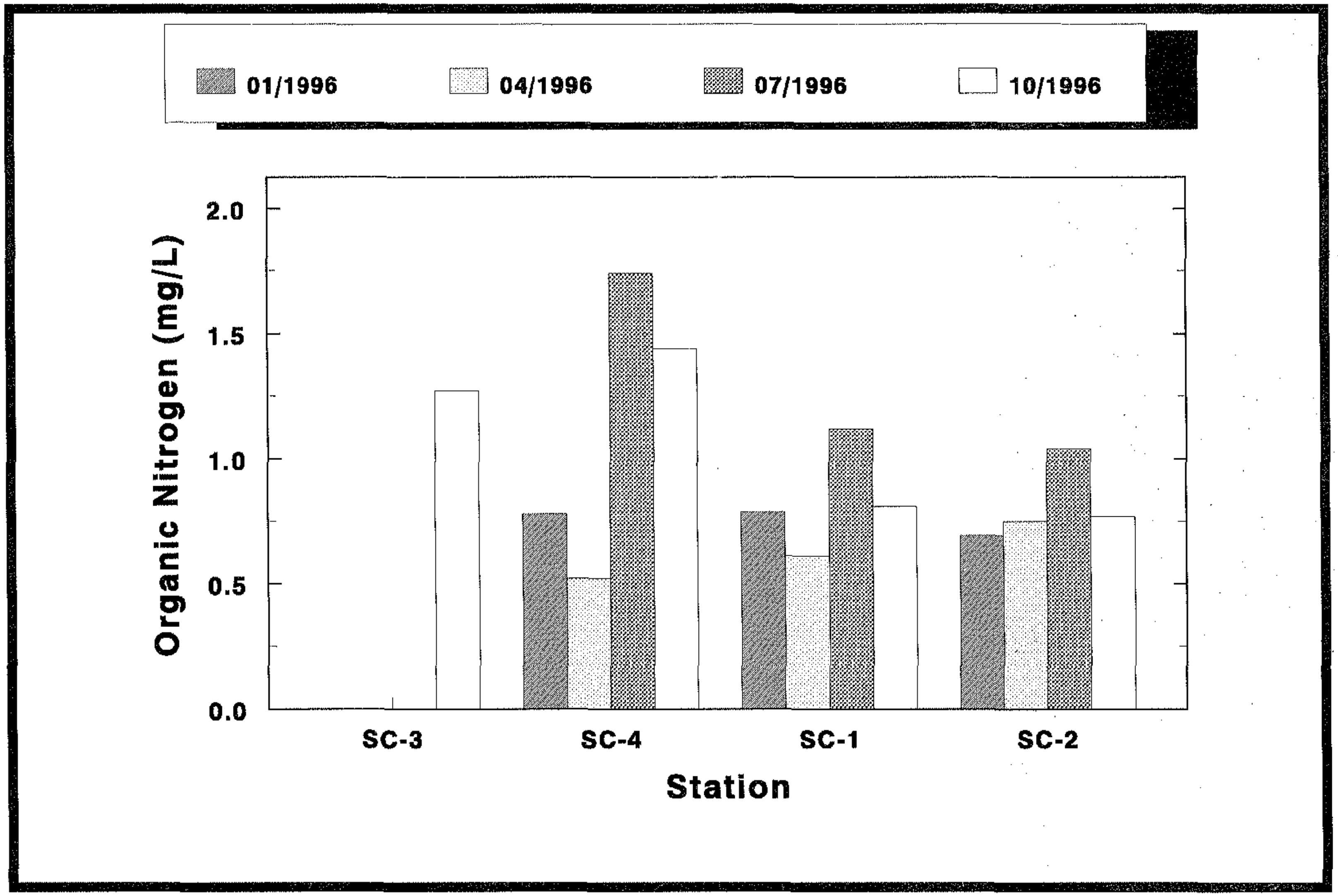



Figure 4.10 Organic Nitrogen Concentrations Measured During Quarterly Sampling from January to December 1996 at the Palmer Ranch, Sarasota County.

concentration was recorded during the summer season (*i.e.*, July) with organic nitrogen concentrations declining during the fall (**Figure 4.10**). The lowest concentrations of organic nitrogen were observed in April 1996 averaging 0.63 mg/L (**Appendix Table B-14**). During the July 1996 monitoring event, organic nitrogen levels in South Creek averaged 1.30 mg/L decreasing to an average of 1.07 mg/L for the October event.

The peak in organic nitrogen during July is apparently associated with a peak in the standing crop of aquatic vegetation as well as increased runoff during the primary wet season. Standing crop of vegetation declined during the fall and winter in association with low production rates and the decay of plant material. During this period, organic nitrogen exhibited a concomitant decline as the plant material was depleted by the microbial heterotrophs. Additionally, stormwater loading rates most likely declined in association with minimal runoff during the relatively drier months of October through January.

### 4.4.6 *Total Phosphorus*

During the 1996 monitoring year, total phosphorus in South Creek averaged 0.28 mg/L with a range of 0.13 to 0.38 mg/L (**Appendix Table B-15**). The highest total phosphorus level (0.38 mg/L) was recorded at Station SC-2 during the July monitoring event (**Figure 4.11**). The lowest total phosphorus concentration (0.13 mg/L) was observed in April 1996 at SC-1. Overall, the average total phosphorus

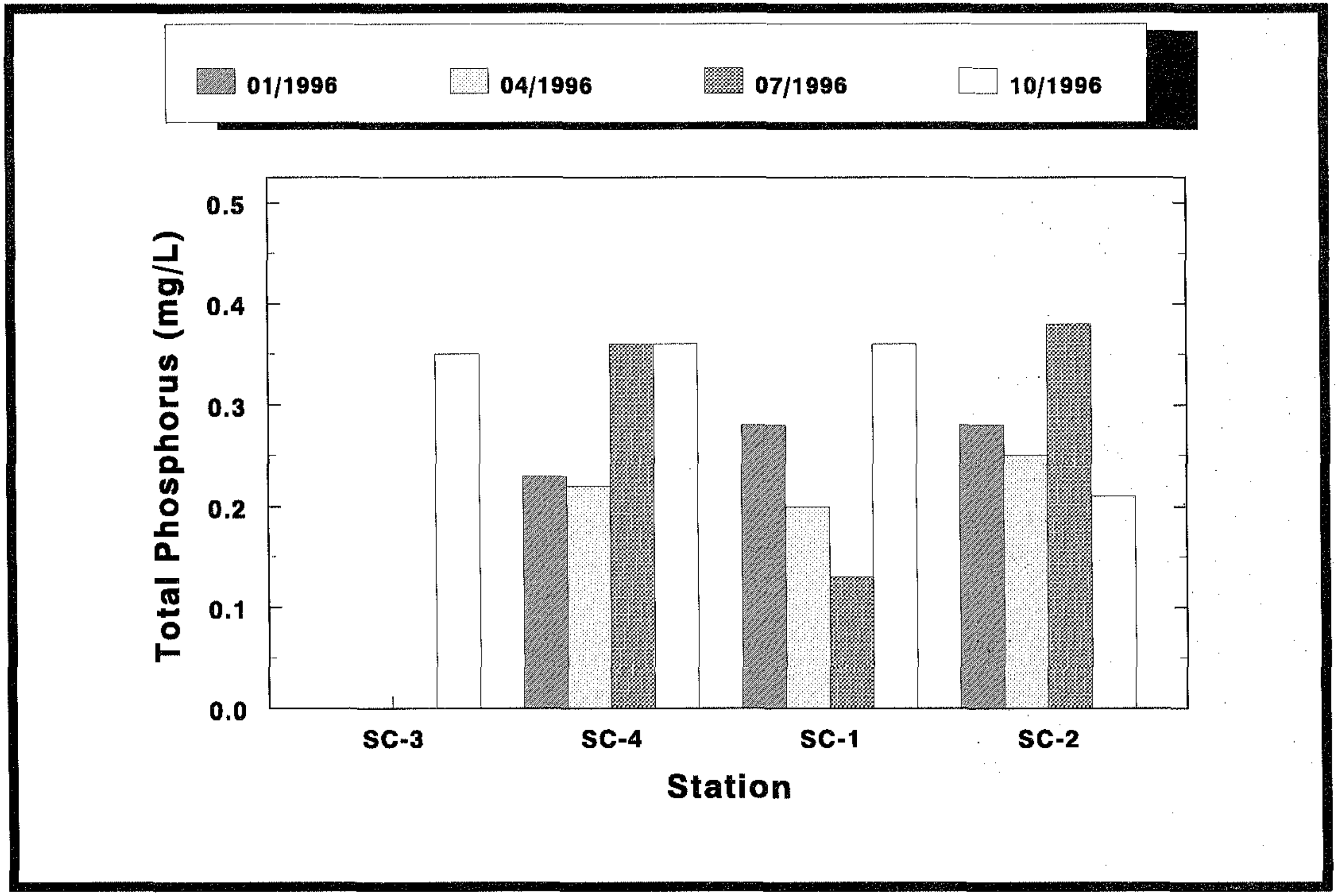



Figure 4.11 Total Phosphorus Concentrations Measured During Quarterly Sampling from January to December 1996 at the Palmer Ranch, Sarasota County.

concentrations in the South Creek Basin were observed to decrease in a downstream direction (**Appendix Table B-15**).

Comparable total phosphorus levels were observed during the seventh and tenth year of monitoring when phosphorus averaged 0.38 and 0.29 mg/L, respectively (CCI, 1992a and 1995). Generally, total phosphorus concentrations observed in 1996 were lower than those reported for first through fourth monitoring years (Palmer Venture, 1986; CCI, 1886, 1988a, 1988b). Total phosphorus concentrations averaged from 0.64 to 1.48 mg/L during these monitoring years. The highest total phosphorus levels were reported for the second monitoring year with concentrations averaging 1.48 mg/L (CCI, 1986). The source of this phosphorus in the South Creek Basin of Palmer Ranch during the second year of monitoring was attributed to runoff originating from the dairy farm draining into the eastern tributary of the creek. A pronounced decrease in total phosphorus concentration was observed after the deactivation of the dairy farm located upstream of the Palmer Ranch property.

Overall, average phosphorus concentrations in the South Creek Basin declined during the second, third, fourth, fifth, sixth, seventh, tenth and twelfth years of monitoring, as illustrated in **Figure 4.12**. However, total phosphorus concentrations increased slightly during the eleventh year of monitoring. This increase is attributed to higher nutrient input to South Creek in the form of runoff resulting from higher than normal rainfall recorded for the 1995 monitoring year.

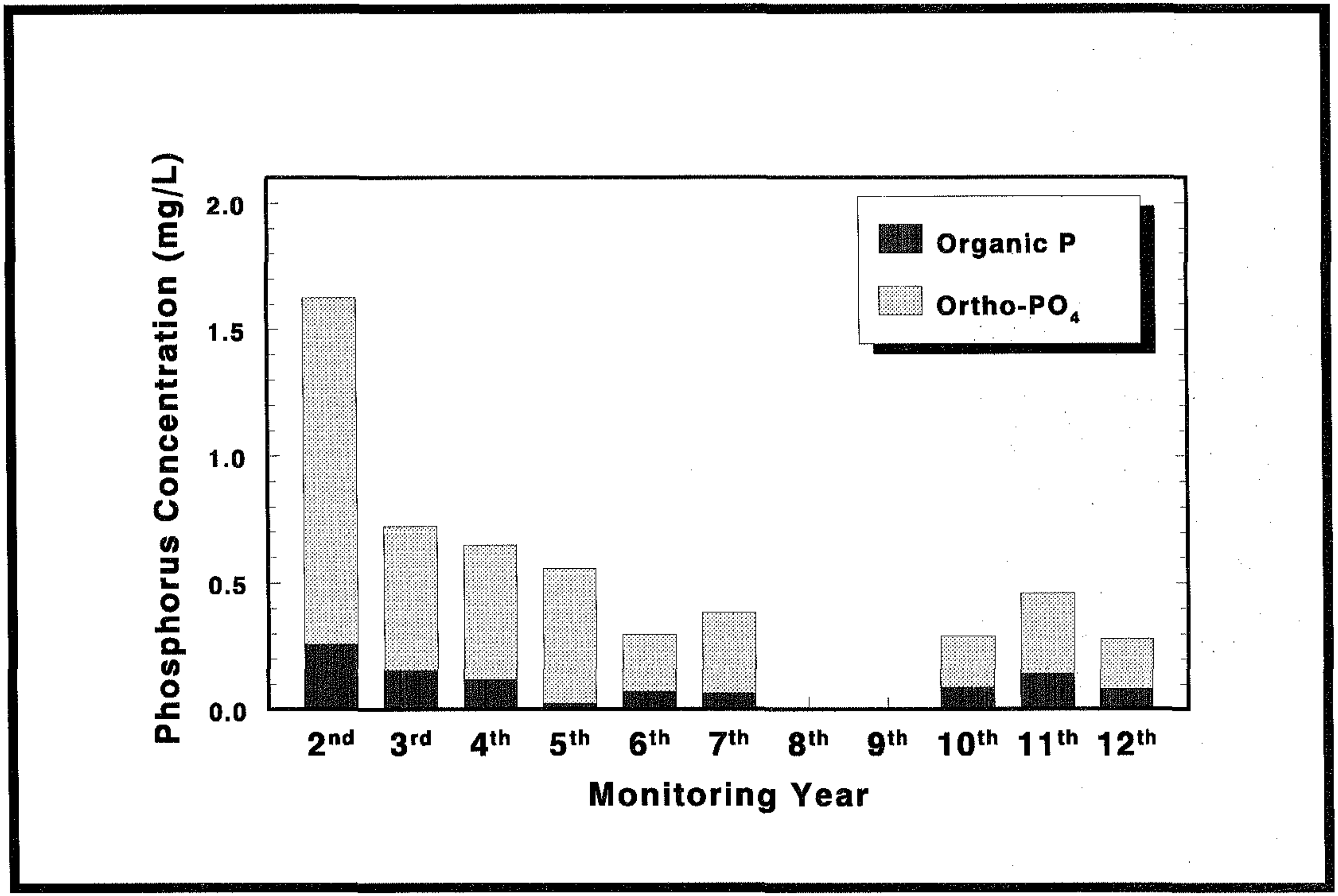



Figure 4.12 Average Phosphorus Concentrations from the Second through the Twelfth Year of Monitoring at the Palmer Ranch, Sarasota County. Fifth Year Data Collected at the Palmer Ranch During the "Pollutant Loading Monitoring Program".

For comparison, the fractionation of orthophosphate and organic phosphorus levels is also provided in **Figure 4.12**. In general, orthophosphate comprised greater than 70 percent of the total phosphorus content in South Creek.

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 twelfth year of monitoring indicate that the total phosphorus concentrations in the streams of the Palmer Ranch never exceeded the FDEP screening level of 0.46 mg/L (FDER, 1990) which is considered to be indicative of water quality problems. The total phosphorus concentrations were consistently 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). As in the past years, a correlation between the total phosphorus concentrations and TSS concentrations 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 1996 monitoring year are provided in **Appendix Table B-16** and **Figure 4.13**. Overall, the South Creek Basin of the Palmer Ranch exhibited an average orthophosphate concentration of 0.20 mg/L during the twelfth year of monitoring with a range from 0.07 to 0.37 mg/L. As with total phosphorus, the highest orthophosphate concentrations observed during the 1996 monitoring year occurred in July 1996 (**Figure 4.13**). In general, similar orthophosphate concentrations were observed during the 1994 monitoring year with concentrations also averaging 0.20 mg/L (CCI, 1995). Slightly higher orthophosphate concentrations were recorded during the sixth, seventh, and eleventh monitoring years. During these three previous years mean orthophosphate concentrations 0.23 and 0.32 mg/L (CCI, 1991, 1992a, and 1995). Significantly higher orthophosphate concentrations were reported for the third through fifth monitoring years. During these monitoring periods, orthophosphate concentrations averaged from 0.53 to 0.57 mg/L (CCI, 1988a, 1988b and 1990). The highest orthophosphate content was observed during the second monitoring year with concentrations averaging 1.37 mg/L and ranging

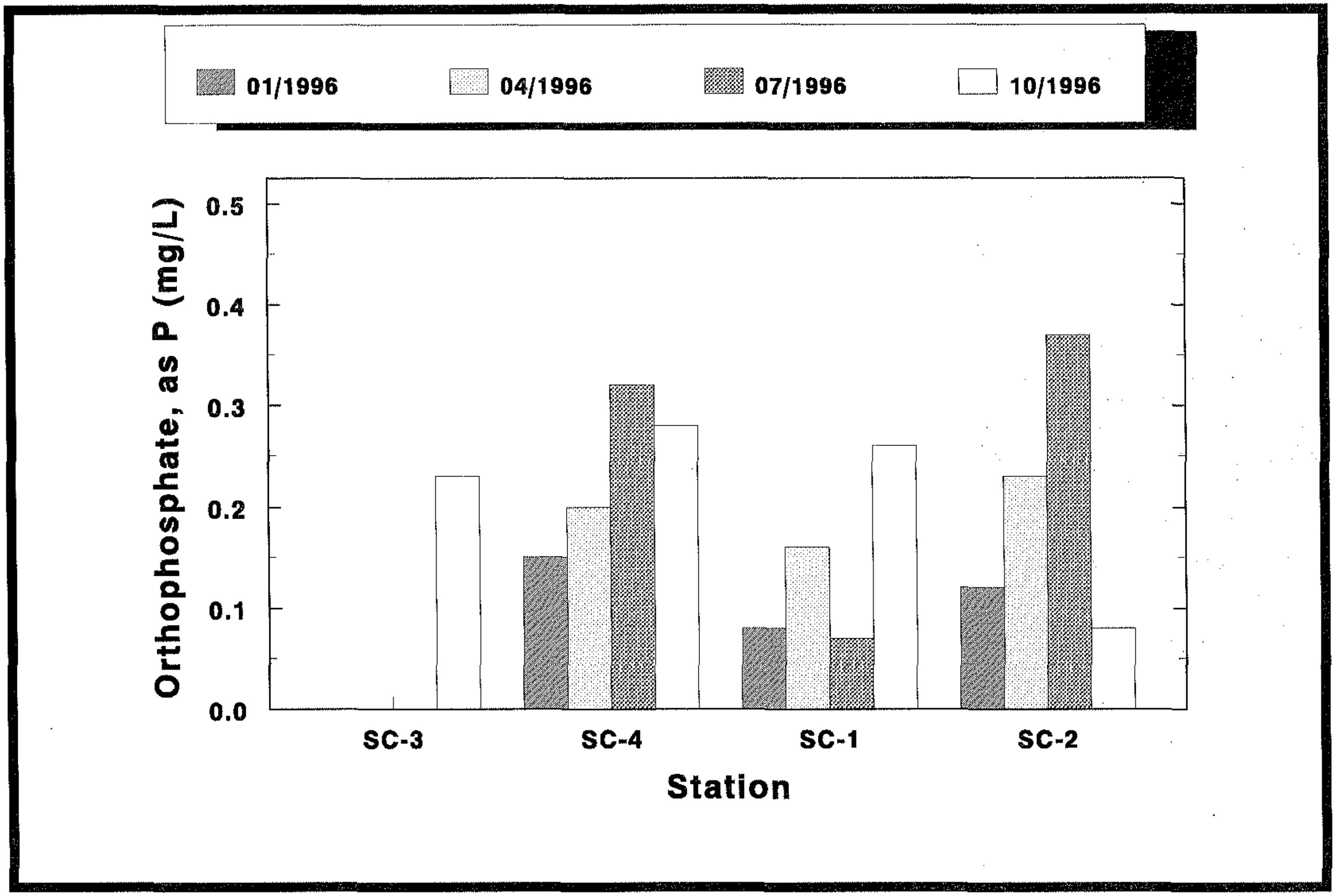



Figure 4.13 Orthophosphate Concentrations Measured During Quarterly Sampling from January to December 1996 at the Palmer Ranch, Sarasota County.

from 0.09 to 6.40 mg/L (CCI, 1986). These higher orthophosphate levels reported for previous monitoring years were attributed to runoff originating from a deactivated dairy farm that discharged into the eastern tributary of South Creek.

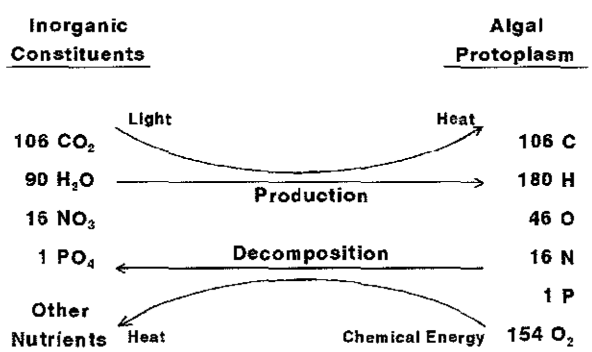
Although the phosphorus concentrations have varied considerably over the previous ten years of monitoring in South Creek, the percentage of total phosphorus consisting of orthophosphate has remained relatively constant ranging from 71 to 95 percent. In 1996, orthophosphate represented approximately 71 percent of the total phosphorus.

During the twelfth year of monitoring, apparent spatial and temporal trends in orthophosphate concentrations indicate that orthophosphate levels in the South Creek Basin generally decrease in a downstream direction (**Figure 4.13**). Increased orthophosphate concentrations were observed during the April (*i.e.*, beginning of the secondary, dry season), July, and October monitoring events (**Figure 4.13**). Similar trends were observed during the previous years of monitoring for the South Creek Basin. These spatial and temporal declines are attributed to the following: (1) the inactivation of the dairy farm and subsequent residual effects; (2) downstream dilution of dairy farm drainage; and (3) phosphate uptake by biological and physico-chemical processes.

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. 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 1996 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, role 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 $N_i$:$P_i$[3] 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 twelfth year of monitoring were used to determine the weight ratios of nitrogen to phosphorus in the streams of the Palmer Ranch (**Figures 4.14A** and **4.14B**). 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**.

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3 $N_i$:$P_i$ is the nitrogen to phosphorus ratio based on inorganic fractions of the nutrient (*i.e.*, nitrite, nitrate, ammonia as nitrogen; orthophosphate as phosphorus).

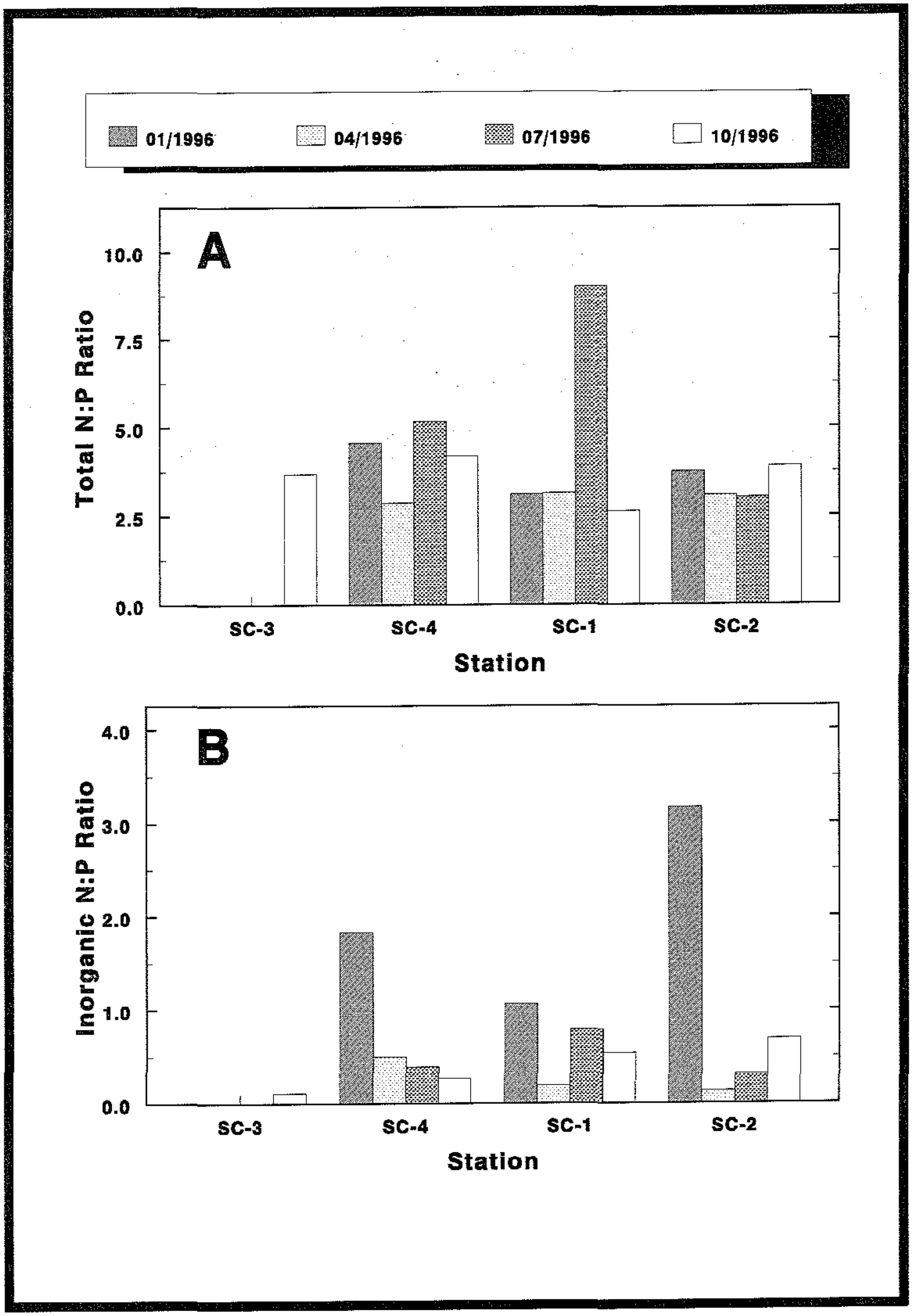


**Figure 4.14** (A) Total Nitrogen to Phosphorus Ratios and (B) Inorganic Nitrogen to Phosphorus Ratios determined from Quarterly Data Collected from January to December 1996 at the Palmer Ranch, Sarasota County.

The $N_i$:$P_i$ ratios are consistently low and found to average approximately 0.7:1, indicative of conditions in which fixed inorganic nitrogen would limit plant growth before orthophosphate (**Figure 4.14B**). Similarly, $N_t$:$P_t$ ratios were found to average 3.8:1 also indicating nitrogen as the limiting nutrient (**Figure 4.14A**). In a nutrient-balanced system, neither nitrogen nor phosphorus limit plant growth because both are present in the proper proportions for plant growth. The lower $N_i$:$P_i$ ratios calculated from the 1996 data are attributed to the naturally high levels of orthophosphate, as well as the high percentage of total phosphorus represented by orthophosphate (71 percent of total phosphorus) while only approximately 10 percent of the total nitrogen is comprised of inorganic nitrogen.

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. During the twelfth year of monitoring, the $N_i$:$P_i$ ratios were generally indicative of excess phosphorus with respect to nitrogen (*i.e.*, nitrogen limited system) during the four quarterly events. During July and October, $N_i$:$P_i$ ratios averaged approximately 0.4:1 (**Figure 4.14B**). The $N_i$:$P_i$ ratio for the January and April monitoring events were higher averaging approximately 1.1:1.

## 4.5 Oils and Greases

Three of the 12 oil and grease concentrations determined for water samples collected in the South Creek during the 1996 monitoring year were at or below analytical detections limits (**Appendix Table B-19**). Overall, oil and grease content in South Creek averaged 0.5 mg/L and ranged from <0.2 to 1.2 mg/L. All of the 12 measurements during the past year of monitoring were below the State standard of ≤5 mg/L specified in FAC Chapter 62-302. In addition, all 12 measurements were also in compliance with the Sarasota County standard of ≤15 mg/L.

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, and 1993), ranged from less than 1 mg/L to 11 mg/L. Approximately 99 percent of the observations (*i.e.*, 98 of 99) in Palmer Ranch portion of South Creek were found to be lower than the maximum allowable State criteria of 5 mg/L. During the twelve years of monitoring stations in South Creek, no observations were greater than the maximum allowable County criteria of 15 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 frequent violations of the State and County standards for total coliform bacteria during the 1996 monitoring year. Both the State and County standards, which allow up to 2,400 colonies/100 mL, were exceeded in four of the

13 samples collected during the 1996 monitoring year (**Figure 4.15A**). The highest bacteria concentrations were observed in the mid-reach (*i.e.*, Station SC-4) of the South Creek Basin (**Figure 4.15A**). Overall, total coliform bacteria levels in South Creek averaged 1,448 colonies/100 mL during the 1996 monitoring year and ranged from 60 to 6,000 colonies/100 mL. The highest mean total coliform bacteria level was observed at Station SC-1. The higher bacterial level probably resulted from cattle using the area around SC-1, which is a primary cattle crossing for South Creek.

Higher total coliform bacteria levels were observed during the 1994 and 1995 monitoring years. During these monitoring years, total coliform bacteria levels for monitoring stations in South Creek averaged 2,293 and 2,704 colonies/100 mL, respectively (CCI, 1995 and 1996). Higher total coliform bacteria levels were also observed during the 1990 and 1991 monitoring years when total coliform bacteria averaged 3,946 and 4,984 colonies/100 mL, respectively (CCI, 1991 and 1992a). Overall, approximately 46 percent of the total coliform concentrations reported during these two monitoring years exceed both the State and County standard of ≤2,400 colonies/100 mL. During the second, third and fourth (CCI, 1986, 1988a and 1988b), the total coliform concentrations in South Creek were also found to commonly exceed the State and County standards with 52, 39, and 65 percent of the results being higher than the 2,400 colonies/100 mL criteria, respectively.

As during previous monitoring years, the highest total coliform bacteria levels observed during 1996 occurred at the end of the primary wet season (*i.e.*, October)

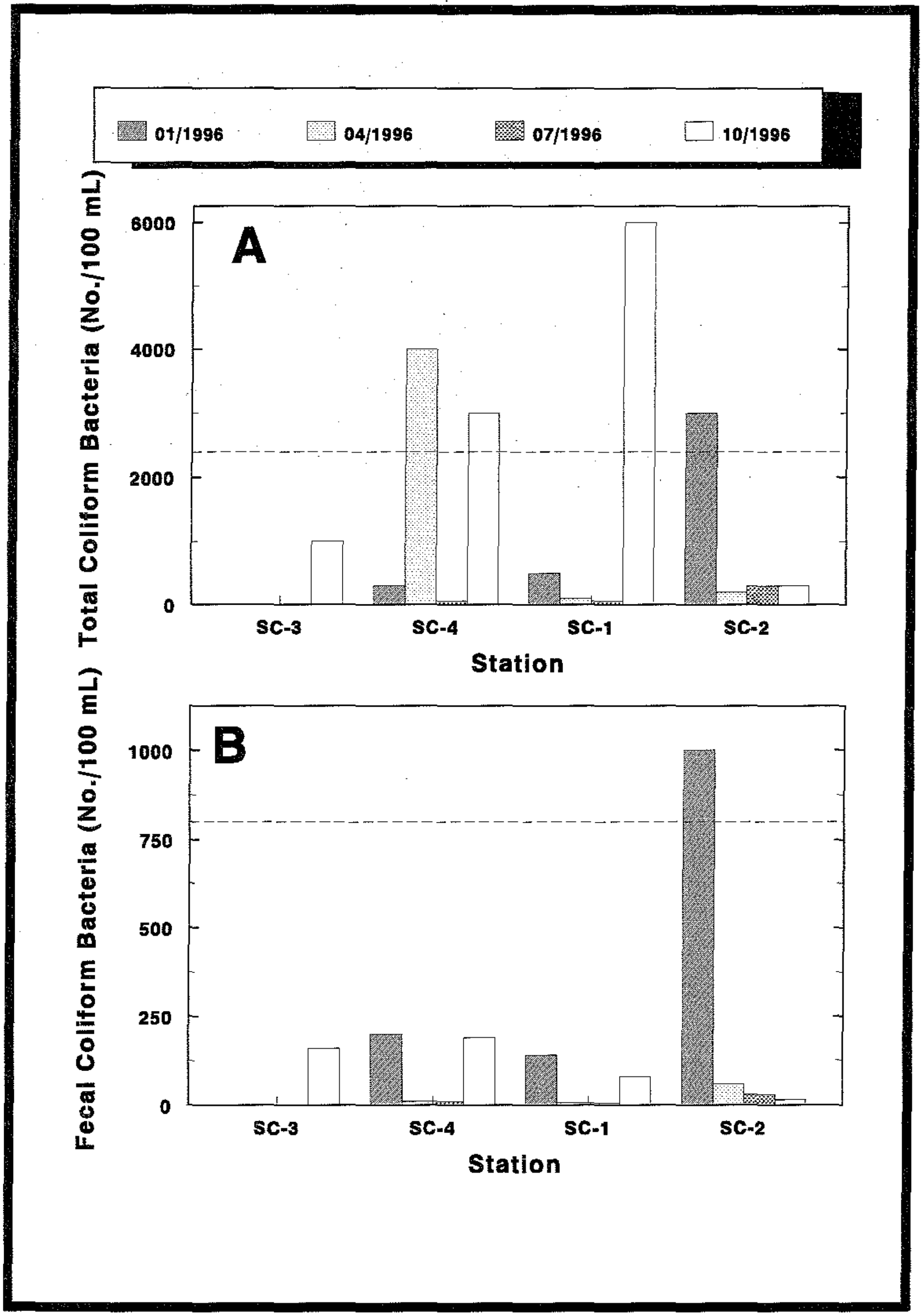


**Figure 4.15** **(A) Total Coliform Bacteria and (B) Fecal Coliform Bacteria Counts Measured During Quarterly Sampling from January to December 1996 at the Palmer Ranch, Sarasota County. Dashed Lines Depict State Standards.**

with bacteria levels averaging 2,575 colonies/100 mL. This trend is expected since the primary mode of transport of the coliform bacteria to the streams traversing the ranch is surface runoff, consequently resulting in seasonal trends associated with rainfall.

As noted in previous years (CCI, 1988a, 1988b, 1991, 1992a, 1995, and 1996), 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. 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 twelfth year of monitoring, the South Creek Basin of the Palmer Ranch exhibited fecal coliform densities that ranged from <10 to 1,000 colonies/100 mL (**Appendix Table B-21**) as compared to a range of 20 to 1,000 colonies/100 mL during the tenth year (CCI, 1996). Of the 13 samples collected during the twelfth year of monitoring, only one exceeded the Class III State and County Standard of 800 colonies/100 mL (**Figure 4.15B**). The percentage of exceedances recorded during the third, fourth, sixth, and seventh monitoring years ranged from 15 to 29 percent.

However, it is important to note that fewer samples were collected during the fourth year than during other years of monitoring.

Station SC-2 had the highest concentration of fecal coliform colonies during the 1996 monitoring year at 1,000 colonies/100 mL (**Figure 4.15B**) probably due to a greater number of warm-blooded animals in the stream communities associated with this portion of the creek. The high fecal coliform bacteria level which was observed at this site indicates a significant source of fecal coliform bacteria originating both upstream and within the ranch, with dogs, cats, birds, cattle, and other warm-blooded wild animals considered the primary sources.

## 4.7 Trace Elements

During the 1996 monitoring event, samples were collected for the analyses of trace elements (*i.e.*, arsenic, copper, lead, and zinc) during the October event. The results 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 1996 monitoring year ranged from 1 to 5 $\mu$g/L and averaged 3.5 $\mu$g/L (**Appendix Table B-22**). However, none of the arsenic levels, and therefore, none of the measured arsenic concentrations exceeded the State standard of 50 $\mu$g/L[4], or the 100 $\mu$g/L County criteria. Possible sources of arsenic include naturally occurring minerals and the use of arsenic-based pesticides on and upstream of the Palmer Ranch.

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

Concentrations of total copper measured in the South Creek Basin during the 1996 monitoring period were all below analytical detection (**Appendix Table B-22**). Therefore, all of the measured copper concentrations were in compliance with the State standard and Sarasota County criteria. 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 1996 were below detection limits (**Appendix Table B-22**). Therefore, all of the measured lead concentrations were in compliance with both the State standard of 3.6 $\mu$g/L[5] and the less stringent 10 $\mu$g/L criteria for Sarasota County. 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 three monitoring stations during 1996 were also be low detection limits. Therefore, none of the seven zinc concentrations determined during the 1995 monitoring events exceeded the State standard of 115 $\mu$g/L[6], or more stringent 10 $\mu$g/L criteria of Sarasota County. Possible sources of zinc include the use of zinc containing fertilizers and runoff from roads on and upstream of the Palmer Ranch.

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[5] *Ibid*.

[6] *Ibid*.

## 5.0 SUMMARY

During the twelfth year of the "Continuing Surface Water Quality Monitoring Program", sampling was performed at three stations located in the South Creek Basin of the Palmer Ranch from January through December 1996 as specified in the **Amended and Restated Master Development Order.** Quarterly monitoring events were performed during January, April, July, and October 1996. Water quality monitoring has been performed at approximately the same three locations in the South Creek Basin during the previous ten years. During three of the four monitoring events in 1996, only Stations SC-1, SC-2, and SC-4 were monitored because no construction extended beyond Station SC-4. Sampling at Station SC-3 was initiated in October 1996 when construction activity moved upstream of Station SC-4.

Bimonthly monitoring was performed 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 seven years of monitoring may be reviewed in the annual reports prepared by Palmer Venture (1986) and CCI (1986, 1988a, 1988b, 1990, 1991, and 1992a). In addition, results from the "Stormwater Pollutant Loading Monitoring Program" for the Palmer Ranch performed from August 1988 to April 1990 can be reviewed in a final report prepared by CCI (1992b).

Monitoring was suspended after the 1991 monitoring year until one month prior to any commencement of development. Surface water quality monitoring was resumed with the January 1994 sampling event. 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, oil and greases, and bacteriological quality during each quarterly sampling event. In addition, samples for the determination of trace elements were collected at all three sites on the Palmer Ranch during an annual basis. These results of the tenth year of monitoring can be reviewed in the report prepared by CCI (1995).

Water quality data and hydrographic results collected during the twelfth year of monitoring are summarized in **Table 5.1**. A complete tabulation of results by parameter is provided in **Appendix B**.

The twelfth year of monitoring exhibited lower than normal amounts of rainfall with a total of approximately 44 inches of precipitation occurring on the Palmer Ranch. During the sixth, seventh, and tenth monitoring years only 38, 44, and 48 inches of rainfall were recorded, respectively. Meanwhile, 51 and 52 inches of rainfall were reported during the third and fourth years of monitoring, respectively. The highest rainfall was recorded during the eleventh year of monitoring with 65 inches reported at the Palmer Ranch. A drought was experienced during much of the second year resulting in only 33 inches of rainfall being recorded. The historical amount of rainfall for the region based on a 30-year record is 54 inches per year (NOAA, 1982).

The specific conductance measured in the South Creek Basin ranged from 526 to 1,072 $\mu$mhos/cm, as compared with ranges of 650 to 890 $\mu$mhos/cm, 672 to 1,363

## TABLE 5.1 SUMMARY OF RESULTS FOR THE PALMER RANCH WATER QUALITY MONITORING PROGRAM FOR THE PERIOD FROM JANUARY THROUGH DECEMBER, 1996

| Parameter | SC-1 Mean | SC-2 Mean | SC-3 Mean | SC-4 Mean | South Creek Basin Mean | N | Min | Max | Applicable Criteria[a] |
|---|---|---|---|---|---|---|---|---|---|
| **PHYSICAL** | | | | | | | | | |
| Depth (ft) | 1.0 | 1.5 | 0.6 | 2.2 | 1.5 | 13 | 0.5 | 3.5 | ----- |
| Flow (GPM) | 314 | 900 | 190 | 249 | 465 | 13 | 0 | 2,006 | ----- |
| Temperature (°C) | 24.4 | 23.6 | 26.6 | 23.2 | 24.0 | 13 | 16.2 | 31.5 | ----- |
| Conductivity (µmhos/cm)[b] | 692 | 759 | 526 | 659 | 690 | 13 | 526 | 1,072 | +50%, +100% |
| Total Suspended Solids (mg/L) | 4 | 6 | 2 | 7 | 5 | 13 | 0 | 16 | ----- |
| Turbidity (NTU)[c] | 5.2 | 4.2 | 2.5 | 4.4 | 4.4 | 13 | 1.2 | 10.2 | +29, +25 |
| **OXYGEN DEMAND AND RELATED PARAMETERS** | | | | | | | | | |
| Biochemical Oxygen Demand (mg/L) | 2.7 | 2.0 | 0.9 | 4.0 | 2.7 | 13 | 0.9 | 10.8 | ----- |
| Dissolved Oxygen (mg/L) | 9.1 | 4.7 | 6.3 | 6.2 | 6.6 | 13 | 1.3 | 11.1 | ≥5.0,≥4.0 |
| pH (-log[H$^+$]) | 7.5 | 7.0 | 6.7 | 7.3 | 7.2 | 13 | 6.6 | 8.0 | 6.0 - 8.5 |
| **MACRONUTRIENTS** | | | | | | | | | |
| Nitrite Nitrogen (mg/L) | 0.01 | 0.01 | <0.01 | 0.00 | 0.01 | 13 | <0.01 | 0.02 | ----- |
| Nitrate Nitrogen (mg/L) | 0.03 | 0.07 | 0.01 | 0.06 | 0.05 | 13 | <0.01 | 0.25 | ----- |
| Ammonia Nitrogen (mg/L)[d] | 0.04 | 0.06 | 0.00 | 0.08 | 0.06 | 13 | <0.02 | 0.11 | -----[e] |
| Organic Nitrogen (mg/L) | 0.83 | 0.81 | 1.27 | 1.12 | 0.95 | 13 | 0.52 | 1.74 | ----- |
| Total Nitrogen (mg/L) | 0.90 | 0.95 | 1.29 | 1.26 | 1.06 | 13 | 0.63 | 1.86 | ----- |
| Orthophosphate (mg/L) | 0.14 | 0.20 | 0.23 | 0.24 | 0.20 | 13 | 0.07 | 0.37 | ----- |
| Total Phosphorus (mg/L) | 0.24 | 0.28 | 0.35 | 0.29 | 0.28 | 13 | 0.13 | 0.38 | ----- |
| **ORGANIC CONSTITUENTS** | | | | | | | | | |
| Oil and greases (mg/L) | 0.6 | 0.5 | 0.0 | 0.4 | 0.5 | 13 | <0.2 | 1.2 | ≤5, ≤15 |
| **BIOLOGICAL** | | | | | | | | | |
| Total Coliform Bacteria (count/100 mL) | 1,665 | 950 | 1,000 | 1,840 | 1,448 | 13 | 60 | 6,000 | ≤2,400 |
| Fecal Coliform Bacteria (count/100 mL) | 58 | 276 | 160 | 102 | 147 | 13 | <10 | 1,000 | ≤800 |

[a] State and County Criteria, respectively.
[b] State Criteria allows 50% increase above background to 1,275 µmhos/cm and County Ordinance No. 72-37 allows 100% increase above background to 500 µmhos/cm.
[c] State Criteria allows a maximum increase of 29 NTU above background and County Ordinancce 72-37 allows a maximum increase of 25 JTU above background.
[d] Ionized plus un-ionized ammonia.
[e] State Criteria allows a maximum of 0.02 mg/L unionized ammonia, County ordinance allows a maximum un-ionized ammonia concentration of 0.2 to 2.0 mg/L depending on pH.

μmhos/cm, 472 to 1,263 μmhos/cm, 463 to 1,324 μmhos/cm, and 289 to 1,100 μmhos/cm during the fourth, sixth, seventh, tenth and eleventh monitoring years, respectively. Seasonally, lower conductivities were recorded during the quarterly survey performed in October 1996. These lower conductivities most likely resulted from the cumulative effects of increased surface runoff of low conductivity stormwater during the primary wet season.

The highest average TSS level of 16.2 mg/L was observed for the July 1996 event compared to 0.2 mg/L reported for the April 1996 monitoring event. A similar trend was observed during the previous monitoring years with peak TSS concentration occurring during the wet season and lower concentrations being reported during the drier period of the year.

This apparent annual cycle of suspended solids is related to a combination of the annual distribution of rainfall and seasonal changes in primary production. Additionally, an apparent ongoing trend in suspended solids during previous years is also related to these factors. During the 1990 and 1991 monitoring years, South Creek exhibited slightly lower TSS levels than observed in 1995. The lower TSS levels reported for these two years are probably associated to the lack of stormwater runoff and the associated reduction in mass transport. The third and fourth monitoring years had greater TSS levels to those reported during 1996.

Turbidity levels generally followed the same seasonal trend as TSS. As in previous years, turbidity and TSS levels measured during 1996 were found to be positively correlated (*i.e.*, $r = 0.71$).

Five-day biochemical oxygen demand was found to average 2.7 mg/L for this stream of the North Tract. The $BOD_5$ levels measured in the South Creek Basin during 1996 averaged slightly higher than during the 1991 monitoring year and comparable to the third, fourth, sixth, and tenth monitoring years. As observed during prior monitoring years, a positive correlation was found between $BOD_5$ and TSS suggesting that decaying vegetation and other organic matter in the water column may be contributing to observed TSS levels.

Dissolved oxygen levels were found to average 6.6 mg/L with a range from 1.3 to 11.1 mg/L. The results obtained for dissolved oxygen concentrations during the 1996 monitoring year for South Creek are generally comparable to those reported during the third, fourth, sixth, seventh, eighth, tenth, and eleventh monitoring years. Of the 13 dissolved oxygen measurements made during 1995, four were below the ≥5.0 mg/L State standard. Only three measurements were below the less stringent County standard of ≥4.0 mg/L.

A steady decline of nutrients during the previous monitoring years has been observed in the surface waters of the Palmer Ranch. Nutrient concentrations during the 1996 monitoring year never exceeded the threshold levels characteristic of eutrophic conditions. During the twelfth year of monitoring, stations along South Creek exhibited annual average total nitrogen and total phosphorus concentrations of 1.06 and 0.28 mg/L, respectively. Total nitrogen and phosphorus concentrations measured during the 1996 monitoring period were lower than measured previously in South Creek. During the third and fourth years of monitoring, total nitrogen and total phosphorus levels were much higher than measured in 1996.

Inorganic nitrogen and phosphorus fractions that are required by plants during the process of photosynthesis were also readily available during 1996. Orthophosphate comprised approximately 71 percent of the total phosphorus concentration while inorganic nitrogen represented approximately 10 percent of the total nitrogen content. Although the availability of inorganic nitrogen was found to be substantial, its low ratio to orthophosphate 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 found to average 0.4:1 (by weight), as compared to algal protoplasm that is approximately 6.8:1 (by weight). Interestingly, the average ratio of total nitrogen to total phosphorus determined from 1996 nutrient concentrations was 3.8:1 also implying nitrogen species should become limiting to primary producers before phosphorus.

During prior years of monitoring, inorganic phosphorus comprised 71 to 95 percent of the total phosphorus. In addition, the inorganic nitrogen fraction constituted ≤10 to 34 percent of the total nitrogen content during the first seven years. The ratios of inorganic nitrogen and inorganic phosphorus averaged from 0.8:1 to 4:1 during the previous years of monitoring.

Potential sources of nutrients upstream of the Palmer Ranch are surface runoff originating from a dairy farm that was changed to a sod farm in August 1987, a golf course, and a mobile home park. Within the ranch, potential sources of nutrients include active pastures and an effluent spray field. Additionally, rainfall and surficial phosphate deposits represent two ubiquitous sources of phosphate and fixed nitrogen throughout the ranch.

During the twelfth year of monitoring, all oil and grease concentrations were in compliance with the State standard of ≤5.0 mg/L. Overall, oil and grease levels averaged 0.5 mg/L and ranged from <0.2 to 1.2 mg/L. Approximately 23 percent of oil and grease measurements were at or below analytical detection limits. During previous years of monitoring in South Creek, oil and grease concentrations ranged from <1 to 11 mg/L with only one of the 99 observations exceeding the State standard.

The bacteriological quality of the streams on the Palmer Ranch was found to be comparable to previous years of monitoring. Of the 13 total coliform analyses performed during 1996, four exceeded the maximum allowable limit of 2,400 colonies/100 mL. Similarly, one of the 13 fecal coliform counts was found to exceed the maximum allowable limit of 800 colonies/100 mL. During the previous sampling years, 39 to 65 percent of samples collected annually and measured for total coliform bacteria exceeded the 2,400 colonies/100 mL as specified in the State and County standards. In addition, 15 to 29 percent of the fecal coliform bacteria measurements in the streams of the North Tract exceeded the 800 colonies/100 mL State and County standards during previous monitoring years. The primary sources of coliform bacteria on 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 October 1996 sampling event. Concentrations of arsenic measured during 1996 averaged 3.5 $\mu$g/L with a range from 1 to 5 $\mu$g/L. All arsenic concentrations measured in South Creek in compliance with both the State and County standards.

Copper concentrations measured in South Creek during the 1996 monitoring year were all below detection limits. Thus, all of the copper concentrations measured reported for South Creek were in compliance with both State and County standards.

Total lead concentrations in 1996 were below the analytical detection limits. All lead concentrations measured in samples collected in the streams of the North Tract were in compliance with both the State and County standards.

The concentration of zinc measured in samples collected at the four monitoring stations in South Creek during 1996 were all below analytical detection limits. Therefore, zinc concentrations reported for the South Creek Basin in 1995 were in compliance with both the State and County standards.

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# APPENDIX A:

# EXHIBIT "E"

0380-084

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 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:

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

- Copper
- Arsenic
- Lead
- 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, 1996

| | South Creek | | | | All Stations | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Sampling Date | SC-1 | SC-2 | SC-3 | SC-4 | Mean | STD | Min | Max | N |
| 16-Jan-96 | 0.7 | 1.2 | ---- | 3.0 | 1.6 | 1.2 | 0.7 | 3.0 | 3 |
| 23-Apr-96 | 0.5 | 1.2 | ---- | 3.5 | 1.7 | 1.6 | 0.5 | 3.5 | 3 |
| 30-Jul-96 | 1.0 | 1.0 | ---- | 1.2 | 1.1 | 0.1 | 1.0 | 1.2 | 3 |
| 16-Oct-96 | 2.0 | 2.5 | 0.6 | 1.0 | 1.5 | 0.9 | 0.6 | 2.5 | 4 |
| Mean | 1.1 | 1.5 | 0.6 | 2.2 | | | | | |
| Minimum | 0.5 | 1.0 | ---- | 1.0 | | | | | |
| Maximum | 2.0 | 2.5 | ---- | 3.5 | | | | | |
| Std. Deviation | 0.7 | 0.7 | ---- | 1.3 | | | | | |
| N | 4 | 4 | 1 | 4 | | | | | |

| Stations | Mean | STD | Min | Max | N |
|---|---|---|---|---|---|
| SC-4, SC-1 | 1.6 | 1.1 | 0.5 | 3.5 | 8 |
| SC-2 | 1.5 | 0.7 | 1.0 | 2.5 | 4 |
| Entire Basin | 1.5 | 1.0 | 0.5 | 3.5 | 13 |

STD - Standard deviation
N - Number of observations

## Appendix Table B-2
## Continuing Surface Water Quality Monitoring Program
## Stream Flow (GPM)
## January - December, 1996

| | South Creek | | | | All Stations | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Sampling Date | SC-1 | SC-2 | SC-3 | SC-4 | Mean | STD | Min | Max | N |
| 16-Jan-96 | 920 | 2,006 | ---- | 668 | 1,198 | 711 | 668 | 2,006 | 3 |
| 23-Apr-96 | 3 | 58 | ---- | 81 | 48 | 40 | 3 | 81 | 3 |
| 30-Jul-96 | 0 | 40 | ---- | 0 | 13 | 23 | 0 | 40 | 3 |
| 16-Oct-96 | 335 | 1,495 | 190 | 245 | 566 | 622 | 190 | 1,495 | 4 |
| Mean | 314 | 900 | 190 | 249 | | | | | |
| Minimum | 0 | 40 | ---- | 0 | | | | | |
| Maximum | 920 | 2,006 | ---- | 668 | | | | | |
| Std. Deviation | 433 | 1,004 | ---- | 297 | | | | | |
| N | 4 | 4 | 1 | 4 | | | | | |

| Stations | Mean | STD | Min | Max | N |
|---|---|---|---|---|---|
| SC-4, SC-1 | 281 | 346 | 0 | 920 | 8 |
| SC-2 | 900 | 1,004 | 40 | 2,006 | 4 |
| Entire Basin | 465 | 643 | 0 | 2,006 | 13 |

STD - Standard deviation
N - Number of observations

## Appendix Table B-3
## Continuing Surface Water Quality Monitoring Program
## Water Temperature (°C)
## January - December, 1996

| | South Creek | | | | All Stations | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Sampling Date | SC-1 | SC-2 | SC-3 | SC-4 | Mean | STD | Min | Max | N |
| 16-Jan-96 | 16.3 | 16.6 | ---- | 16.2 | 16.4 | 0.2 | 16.2 | 16.6 | 3 |
| 23-Apr-96 | 25.8 | 22.6 | ---- | 23.5 | 24.0 | 1.7 | 22.6 | 25.8 | 3 |
| 30-Jul-96 | 30.3 | 31.5 | ---- | 28.9 | 30.2 | 1.3 | 28.9 | 31.5 | 3 |
| 16-Oct-96 | 25.2 | 23.9 | 26.7 | 24.1 | 25.0 | 1.3 | 23.9 | 26.7 | 4 |
| Mean | 24.4 | 23.6 | 26.7 | 23.2 | | | | | |
| Minimum | 16.3 | 16.6 | ---- | 16.2 | | | | | |
| Maximum | 30.3 | 31.5 | ---- | 28.9 | | | | | |
| Std.Deviation | 5.9 | 6.1 | ---- | 5.2 | | | | | |
| N | 4 | 4 | 1 | 4 | | | | | |

| Stations | Mean | STD | Min | Max | N |
|---|---|---|---|---|---|
| SC-4, SC-1 | 23.8 | 5.2 | 16.2 | 30.3 | 8 |
| SC-2 | 23.6 | 6.1 | 16.6 | 31.5 | 4 |
| EntireBasin | 24.0 | 5.1 | 16.2 | 31.5 | 13 |

STD - Standard deviation
N - Number of observations

**Appendix Table B-4**
**Continuing Surface Water Quality Monitoring Program**
**Specific Conductance (μmhos/cm)[a]**
**January - December, 1996**

| | South Creek | | | | All Stations | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Sampling Date | SC-1 | SC-2 | SC-3 | SC-4 | Mean | STD | Min | Max | N |
| 16-Jan-96 | 718 | 705 | ---- | 554 | 659 | 91 | 554 | 718 | 3 |
| 23-Apr-96 | 758 | 570 | ---- | 669 | 666 | 94 | 570 | 758 | 3 |
| 30-Jul-96 | 667 | 1,072 | ---- | 747 | 829 | 214 | 667 | 1,072 | 3 |
| 16-Oct-96 | 625 | 688 | 526 | 665 | 626 | 72 | 526 | 688 | 4 |
| Mean | 692 | 759 | 526 | 659 | | | | | |
| Minimum | 625 | 570 | ---- | 554 | | | | | |
| Maximum | 758 | 1,072 | ---- | 747 | | | | | |
| Std. Deviation | 58 | 217 | ---- | 79 | | | | | |
| N | 4 | 4 | 1 | 4 | | | | | |

| Stations | Mean | STD | Min | Max | N |
|---|---|---|---|---|---|
| SC-4, SC-1 | 675 | 67 | 554 | 758 | 8 |
| SC-2 | 759 | 217 | 570 | 1,072 | 4 |
| Entire Basin | 690 | 136 | 526 | 1,072 | 13 |

[a] Applicable surface water quality criteria:

State - Maximum allowable of 50% above background or to 1,275 μmhos/cm which ever is greater;

Sarasota County - Maximu allowable increase of 100% above background to a maximum of 500 μmhos/cm.

STD - Standard deviation
N - Number of observations

## Appendix Table B-5
## Continuing Surface Water Quality Monitoring Program
## Total Suspended Solids (mg/L)
## January - December, 1996

| | South Creek | | | | All Stations | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Sampling Date | SC-1 | SC-2 | SC-3 | SC-4 | Mean | STD | Min | Max | N |
| 16-Jan-96 | 4.4 | 10.0 | ---- | 2.6 | 5.7 | 3.9 | 3 | 10 | 3 |
| 23-Apr-96 | 0.2 | 0.9 | ---- | 0.4 | 0.5 | 0.4 | 0 | 1 | 3 |
| 30-Jul-96 | 6.6 | 8.2 | ---- | 16.2 | 10.3 | 5.1 | 7 | 16 | 3 |
| 16-Oct-96 | 4.0 | 4.0 | 1.6 | 7.0 | 4.2 | 2.2 | 2 | 7 | 4 |
| Mean | 3.8 | 5.8 | 1.6 | 6.6 | | | | | |
| Minimum | 0.2 | 0.9 | ---- | 0.4 | | | | | |
| Maximum | 6.6 | 10.0 | ---- | 16.2 | | | | | |
| Std. Deviation | 2.7 | 4.1 | ---- | 7.0 | | | | | |
| N | 4 | 4 | 1 | 4 | | | | | |

| Stations | Mean | STD | Min | Max | N |
|---|---|---|---|---|---|
| SC-4, SC-1 | 5.2 | 5.1 | 0.2 | 16.2 | 8 |
| SC-2 | 5.8 | 4.1 | 0.9 | 10.0 | 4 |
| Entire Basin | 5.1 | 4.5 | 0.2 | 16.2 | 13 |

STD - Standard deviation
N - Number of observations

## Appendix Table B-6
## Continuing Surface Water Quality Monitoring Program
## Turbidity (NTU)[a]
## January - December, 1996

| Sampling Date | South Creek SC-1 | SC-2 | SC-3 | SC-4 | All Stations Mean | STD | Min | Max | N |
|---|---|---|---|---|---|---|---|---|---|
| 16-Jan-96 | 8.6 | 2.2 | ---- | 1.7 | 4.2 | 3.8 | 1.7 | 8.6 | 3 |
| 23-Apr-96 | 1.9 | 2.3 | ---- | 1.2 | 1.8 | 0.6 | 1.2 | 2.3 | 3 |
| 30-Jul-96 | 6.3 | 9.6 | ---- | 10.2 | 8.7 | 2.1 | 6.3 | 10.2 | 3 |
| 16-Oct-96 | 3.8 | 2.8 | 2.5 | 4.6 | 3.4 | 1.0 | 2.5 | 4.6 | 4 |
| Mean | 5.2 | 4.2 | 2.5 | 4.4 | | | | | |
| Minimum | 1.9 | 2.2 | ---- | 1.2 | | | | | |
| Maximum | 8.6 | 9.6 | ---- | 10.2 | | | | | |
| Std. Deviation | 2.9 | 3.6 | ---- | 4.1 | | | | | |
| N | 4 | 4 | 1 | 4 | | | | | |

| Stations | Mean | STD | Min | Max | N |
|---|---|---|---|---|---|
| SC-4, SC-1 | 4.8 | 3.3 | 1.2 | 10.2 | 8 |
| SC-2 | 4.2 | 3.6 | 2.2 | 9.6 | 4 |
| Entire Basin | 4.4 | 3.2 | 1.2 | 10.2 | 13 |

[a] Applicable surface water quality criteria:

State - Allows a maximum increase of 29 NTU above background
Sarasota County - Allows a maximum increase of 25 JTU 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, 1996

| | South Creek | | | | All Stations | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Sampling Date | SC-1 | SC-2 | SC-3 | SC-4 | Mean | STD | Min | Max | N |
| 16-Jan-96 | 1.4 | 1.5 | ---- | 1.6 | 1.1 | 0.8 | 0.0 | 1.6 | 4 |
| 23-Apr-96 | 1.8 | 1.4 | ---- | 2.4 | 1.9 | 0.5 | 1.4 | 2.4 | 3 |
| 30-Jul-96 | 6.7 | 3.4 | ---- | 10.8 | 7.0 | 3.7 | 3.4 | 10.8 | 3 |
| 16-Oct-96 | 1.0 | 1.6 | 0.9 | 1.0 | 1.1 | 0.3 | 0.9 | 1.6 | 4 |
| Mean | 2.7 | 2.0 | 0.9 | 4.0 | | | | | |
| Minimum | 1.0 | 1.4 | ---- | 1.0 | | | | | |
| Maximum | 6.7 | 3.4 | ---- | 10.8 | | | | | |
| Std. Deviation | 2.7 | 1.0 | ---- | 4.6 | | | | | |
| N | 4 | 4 | 1 | 4 | | | | | |

| Stations | Mean | STD | Min | Max | N |
|---|---|---|---|---|---|
| SC-4, SC-1 | 3.3 | 3.5 | 1.0 | 10.8 | 8 |
| SC-2 | 2.0 | 1.0 | 1.4 | 3.4 | 4 |
| Entire Basin | 2.7 | 2.9 | 0.9 | 10.8 | 13 |

STD - Standard deviation
N - Number of observations

## Appendix Table B-8
## Continuing Surface Water Quality Monitoring Program
## Dissolved Oxygen (mg/L)[a]
## January - December, 1996

| | South Creek | | | | All Stations | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Sampling Date | SC-1 | SC-2 | SC-3 | SC-4 | Mean | STD | Min | Max | N |
| 16-Jan-96 | 10.9 | 8.1 | ---- | 10.9 | 9.9 | 1.6 | 8.1 | 10.9 | 3 |
| 23-Apr-96 | 8.4 | 3.3 | ---- | 6.2 | 6.0 | 2.6 | 3.3 | 8.4 | 3 |
| 30-Jul-96 | 11.1 | 3.2 | ---- | 1.3 | 5.2 | 5.2 | 1.3 | 11.1 | 3 |
| 16-Oct-96 | 5.9 | 4.3 | 6.3 | 6.5 | 5.7 | 1.0 | 4.3 | 6.5 | 4 |
| Mean | 9.1 | 4.7 | 6.3 | 6.2 | | | | | |
| Minimum | 5.9 | 3.2 | ---- | 1.3 | | | | | |
| Maximum | 11.1 | 8.1 | ---- | 10.9 | | | | | |
| Std. Deviation | 2.5 | 2.3 | ---- | 3.9 | | | | | |
| N | 4 | 4 | 1 | 4 | | | | | |

| Stations | Mean | STD | Min | Max | N |
|---|---|---|---|---|---|
| SC-4, SC-1 | 7.6 | 3.4 | 1.3 | 11.1 | 8 |
| SC-2 | 4.7 | 2.3 | 3.2 | 8.1 | 4 |
| Entire Basin | 6.6 | 3.1 | 1.3 | 11.1 | 13 |

[a] Applicable surface water quality criteria:
State - Minimum allowable concentration of 5.0 mg/L
Sarasota County - Minimum allowable concentration of 4.0 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, 1996

| | South Creek | | | | All Stations | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Sampling Date | SC-1 | SC-2 | SC-3 | SC-4 | Mean | STD | Min | Max | N |
| 16-Jan-96 | 7.5 | 7.4 | ---- | 7.3 | 7.4 | 0.1 | 7.3 | 7.5 | 3 |
| 23-Apr-96 | 7.5 | 7.1 | ---- | 7.9 | 7.5 | 0.4 | 7.1 | 7.9 | 3 |
| 30-Jul-96 | 8.1 | 7.0 | ---- | 6.9 | 7.3 | 0.6 | 6.9 | 8.1 | 3 |
| 16-Oct-96 | 7.0 | 6.6 | 6.7 | 7.1 | 6.8 | 0.2 | 6.6 | 7.1 | 4 |
| Mean | 7.5 | 7.0 | 6.7 | 7.3 | | | | | |
| Minimum | 7.0 | 6.6 | ---- | 6.9 | | | | | |
| Maximum | 8.1 | 7.4 | ---- | 7.9 | | | | | |
| Std. Deviation | 0.4 | 0.3 | ---- | 0.4 | | | | | |
| N | 4 | 4 | 1 | 4 | | | | | |

| Stations | Mean | STD | Min | Max | N |
|---|---|---|---|---|---|
| SC-4, SC-1 | 7.4 | 0.4 | 6.9 | 8.1 | 8 |
| SC-2 | 7.0 | 0.3 | 6.6 | 7.4 | 4 |
| Entire Basin | 7.2 | 0.4 | 6.6 | 8.1 | 13 |

[a] Applicable surface water quality criteria: State and Sarasota County - Allowable range of 6.0 - 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, 1996

| | South Creek | | | | All Stations | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Sampling Date | SC-1 | SC-2 | SC-3 | SC-4 | Mean | STD | Min | Max | N |
| 16-Jan-96 | 0.87 | 1.05 | ---- | 1.05 | 0.99 | 0.10 | 0.87 | 1.05 | 3 |
| 23-Apr-96 | 0.63 | 0.77 | ---- | 0.63 | 0.68 | 0.08 | 0.63 | 0.77 | 3 |
| 30-Jul-96 | 1.17 | 1.15 | ---- | 1.86 | 1.39 | 0.40 | 1.15 | 1.86 | 3 |
| 16-Oct-96 | 0.95 | 0.82 | 1.29 | 1.51 | 1.14 | 0.32 | 0.82 | 1.51 | 4 |
| Mean | 0.91 | 0.95 | 1.29 | 1.26 | | | | | |
| Minimum | 0.63 | 0.77 | ---- | 0.63 | | | | | |
| Maximum | 1.17 | 1.15 | ---- | 1.86 | | | | | |
| Std. Deviation | 0.22 | 0.18 | ---- | 0.54 | | | | | |
| N | 4 | 4 | 1 | 4 | | | | | |

| Stations | Mean | STD | Min | Max | N |
|---|---|---|---|---|---|
| SC-4, SC-1 | 1.08 | 0.43 | 0.63 | 1.86 | 8 |
| SC-2 | 0.95 | 0.18 | 0.77 | 1.15 | 4 |
| Entire Basin | 1.06 | 0.35 | 0.63 | 1.86 | 13 |

STD - Standard deviation
N - Number of observations

## Appendix Table B-11
## Continuing Surface Water Quality Monitoring Program
## Nitrite (mg/L as N)
## January - December, 1996

| | South Creek | | | | All Stations | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Sampling Date | SC-1 | SC-2 | SC-3 | SC-4 | Mean | STD | Min | Max | N |
| 16-Jan-96 | <0.01 | 0.02 | ---- | <0.01 | 0.01 | 0.01 | <0.01 | 0.02 | 3 |
| 23-Apr-96 | <0.01 | <0.01 | ---- | <0.01 | <0.01 | ---- | ---- | ---- | 3 |
| 30-Jul-96 | <0.01 | <0.01 | ---- | <0.01 | <0.01 | ---- | ---- | ---- | 3 |
| 16-Oct-96 | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.00 | <0.01 | 0.01 | 4 |
| Mean | 0.01 | 0.01 | <0.01 | 0.01 | | | | | |
| Minimum | <0.01 | <0.01 | ---- | <0.01 | | | | | |
| Maximum | 0.01 | 0.02 | ---- | 0.01 | | | | | |
| Std. Deviation | 0.00 | 0.01 | ---- | 0.00 | | | | | |
| N | 4 | 4 | 1 | 4 | | | | | |

| Stations | Mean | STD | Min | Max | N |
|---|---|---|---|---|---|
| SC-4, SC-1 | 0.01 | 0.00 | <0.01 | 0.01 | 8 |
| SC-2 | 0.01 | 0.01 | <0.01 | 0.02 | 4 |
| Entire Basin | 0.01 | 0.00 | <0.01 | 0.02 | 13 |

STD - Standard deviation
N - Number of observations

**Appendix Table B-12**
**Continuing Surface Water Quality Monitoring Program**
**Nitrate (mg/L as N)**
**January - December, 1996**

| | South Creek | | | | All Stations | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Sampling Date | SC-1 | SC-2 | SC-3 | SC-4 | Mean | STD | Min | Max | N |
| 16-Jan-96 | 0.05 | 0.25 | ---- | 0.23 | 0.18 | 0.11 | 0.05 | 0.25 | 3 |
| 23-Apr-96 | <0.01 | <0.01 | ---- | <0.01 | <0.01 | ---- | ---- | ---- | 3 |
| 30-Jul-96 | 0.01 | 0.02 | ---- | 0.01 | 0.01 | 0.01 | 0.01 | 0.02 | 3 |
| 16-Oct-96 | 0.06 | 0.02 | 0.01 | 0.01 | 0.03 | 0.02 | 0.01 | 0.06 | 4 |
| Mean | 0.03 | 0.07 | 0.01 | 0.06 | | | | | |
| Minimum | <0.01 | <0.01 | ---- | <0.01 | | | | | |
| Maximum | 0.06 | 0.25 | ---- | 0.23 | | | | | |
| Std. Deviation | 0.03 | 0.12 | ---- | 0.11 | | | | | |
| N | 4 | 4 | 1 | 4 | | | | | |

| Stations | Mean | STD | Min | Max | N |
|---|---|---|---|---|---|
| SC-4, SC-1 | 0.05 | 0.08 | <0.01 | 0.23 | 8 |
| SC-2 | 0.07 | 0.12 | <0.01 | 0.25 | 4 |
| Entire Basin | 0.05 | 0.08 | <0.01 | 0.25 | 13 |

STD - Standard deviation
N - Number of observations

## Appendix Table B-13
## Continuing Surface Water Quality Monitoring Program
## Ammoniacal Nitrogen (mg/L as N)
## January - December, 1996

| | South Creek | | | | All Stations | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Sampling Date | SC-1 | SC-2 | SC-3 | SC-4 | Mean | STD | Min | Max | N |
| 16-Jan-96 | 0.03 | 0.11 | ---- | 0.04 | 0.06 | 0.04 | 0.03 | 0.11 | 3 |
| 23-Apr-96 | 0.02 | 0.02 | ---- | 0.09 | 0.04 | 0.04 | 0.02 | 0.09 | 3 |
| 30-Jul-96 | 0.04 | 0.09 | ---- | 0.11 | 0.08 | 0.04 | 0.04 | 0.11 | 3 |
| 16-Oct-96 | 0.07 | 0.03 | <0.02 | 0.06 | 0.04 | 0.03 | <0.02 | 0.07 | 4 |
| Mean | 0.04 | 0.06 | <0.02 | 0.08 | | | | | |
| Minimum | 0.02 | 0.02 | ---- | 0.04 | | | | | |
| Maximum | 0.07 | 0.11 | ---- | 0.11 | | | | | |
| Std. Deviation | 0.02 | 0.04 | ---- | 0.03 | | | | | |
| N | 4 | 4 | 1 | 4 | | | | | |

| Stations | Mean | STD | Min | Max | N |
|---|---|---|---|---|---|
| SC-4, SC-1 | 0.06 | 0.03 | 0.02 | 0.11 | 8 |
| SC-2 | 0.06 | 0.04 | 0.02 | 0.11 | 4 |
| Entire Basin | 0.06 | 0.04 | <0.02 | 0.11 | 13 |

STD - Standard deviation
N - Number of observations

**Appendix Table B-14**
**Continuing Surface Water Quality Monitoring Program**
**Organic Nitrogen (mg/L)[a]**
**January - December, 1996**

| | South Creek | | | | All Stations | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Sampling Date | SC-1 | SC-2 | SC-3 | SC-4 | Mean | STD | Min | Max | N |
| 16-Jan-96 | 0.79 | 0.69 | ---- | 0.78 | 0.75 | 0.06 | 0.69 | 0.79 | 3 |
| 23-Apr-96 | 0.61 | 0.75 | ---- | 0.52 | 0.63 | 0.12 | 0.52 | 0.75 | 3 |
| 30-Jul-96 | 1.12 | 1.04 | ---- | 1.74 | 1.30 | 0.38 | 1.04 | 1.74 | 3 |
| 16-Oct-96 | 0.81 | 0.77 | 1.27 | 1.44 | 1.07 | 0.33 | 0.77 | 1.44 | 4 |
| Mean | 0.83 | 0.81 | 1.27 | 1.12 | | | | | |
| Minimum | 0.61 | 0.69 | ---- | 0.52 | | | | | |
| Maximum | 1.12 | 1.04 | ---- | 1.74 | | | | | |
| Std. Deviation | 0.21 | 0.16 | ---- | 0.57 | | | | | |
| N | 4 | 4 | 1 | 4 | | | | | |

| Stations | Mean | STD | Min | Max | N |
|---|---|---|---|---|---|
| SC-4, SC-1 | 0.98 | 0.42 | 0.52 | 1.74 | 8 |
| SC-2 | 0.81 | 0.16 | 0.69 | 1.04 | 4 |
| Entire Basin | 0.95 | 0.36 | 0.52 | 1.74 | 13 |

[a] Organic Nitrogen = Total Kjeldahl 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, 1996

| | South Creek | | | | All Stations | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Sampling Date | SC-1 | SC-2 | SC-3 | SC-4 | Mean | STD | Min | Max | N |
| 16-Jan-96 | 0.28 | 0.28 | ---- | 0.23 | 0.26 | 0.03 | 0.23 | 0.28 | 3 |
| 23-Apr-96 | 0.20 | 0.25 | ---- | 0.22 | 0.22 | 0.03 | 0.20 | 0.25 | 3 |
| 30-Jul-96 | 0.13 | 0.38 | ---- | 0.36 | 0.29 | 0.14 | 0.13 | 0.38 | 3 |
| 16-Oct-96 | 0.36 | 0.21 | 0.35 | 0.36 | 0.32 | 0.07 | 0.21 | 0.36 | 4 |
| Mean | 0.24 | 0.28 | 0.35 | 0.29 | | | | | |
| Minimum | 0.13 | 0.21 | ---- | 0.22 | | | | | |
| Maximum | 0.36 | 0.38 | ---- | 0.36 | | | | | |
| Std. Deviation | 0.10 | 0.07 | ---- | 0.08 | | | | | |
| N | 4 | 4 | 1 | 4 | | | | | |

| Stations | Mean | STD | Min | Max | N |
|---|---|---|---|---|---|
| SC-4, SC-1 | 0.27 | 0.09 | 0.13 | 0.36 | 8 |
| SC-2 | 0.28 | 0.07 | 0.21 | 0.38 | 4 |
| Entire Basin | 0.28 | 0.08 | 0.13 | 0.38 | 13 |

STD - Standard deviation
N - Number of observations

## Appendix Table B-16
## Continuing Surface Water Quality Monitoring Program
## Orthophosphate (mg/L)
## January - December, 1996

| | South Creek | | | | All Stations | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Sampling Date | SC-1 | SC-2 | SC-3 | SC-4 | Mean | STD | Min | Max | N |
| 16-Jan-96 | 0.08 | 0.12 | ---- | 0.15 | 0.12 | 0.04 | 0.08 | 0.15 | 3 |
| 23-Apr-96 | 0.16 | 0.23 | ---- | 0.20 | 0.20 | 0.04 | 0.16 | 0.23 | 3 |
| 30-Jul-96 | 0.07 | 0.37 | ---- | 0.32 | 0.25 | 0.16 | 0.07 | 0.37 | 3 |
| 16-Oct-96 | 0.26 | 0.08 | 0.23 | 0.28 | 0.21 | 0.09 | 0.08 | 0.28 | 4 |
| Mean | 0.14 | 0.20 | 0.23 | 0.24 | | | | | |
| Minimum | 0.07 | 0.08 | ---- | 0.15 | | | | | |
| Maximum | 0.26 | 0.37 | ---- | 0.32 | | | | | |
| Std. Deviation | 0.09 | 0.13 | ---- | 0.08 | | | | | |
| N | 4 | 4 | 1 | 4 | | | | | |

| Stations | Mean | STD | Min | Max | N |
|---|---|---|---|---|---|
| SC-4, SC-1 | 0.19 | 0.09 | 0.07 | 0.32 | 8 |
| SC-2 | 0.20 | 0.13 | 0.08 | 0.37 | 4 |
| Entire Basin | 0.20 | 0.10 | 0.07 | 0.37 | 13 |

STD - Standard deviation
N - Number of observations

# Appendix Table B-17
## Continuing Surface Water Quality Monitoring Program
## Total Nitrogen to Total Phosphorus Ratios ($N_t$:$P_t$)
## January - December, 1996

| | South Creek | | | | All Stations | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Sampling Date | SC-1 | SC-2 | SC-3 | SC-4 | Mean | STD | Min | Max | N |
| 16-Jan-96 | 3.1 | 1.0 | ---- | 4.6 | 2.9 | 1.8 | 1.0 | 4.6 | 3 |
| 23-Apr-96 | 3.2 | 3.1 | ---- | 2.9 | 3.0 | 0.1 | 2.9 | 3.2 | 3 |
| 30-Jul-96 | 9.0 | 3.0 | ---- | 5.2 | 5.7 | 3.0 | 3.0 | 9.0 | 3 |
| 16-Oct-96 | 2.6 | 3.9 | 3.7 | 4.2 | 3.6 | 0.7 | 2.6 | 4.2 | 4 |
| Mean | 4.5 | 2.8 | 3.7 | 4.2 | | | | | |
| Minimum | 2.6 | 1.0 | ---- | 2.9 | | | | | |
| Maximum | 9.0 | 3.9 | ---- | 5.2 | | | | | |
| Std. Deviation | 3.0 | 1.2 | ---- | 1.0 | | | | | |
| N | 4 | 4 | 1 | 4 | | | | | |

| Stations | Mean | STD | Min | Max | N |
|---|---|---|---|---|---|
| SC-4, SC-1 | 4.3 | 2.1 | 2.6 | 9.0 | 8 |
| SC-2 | 2.8 | 1.2 | 1.0 | 3.9 | 4 |
| Entire Basin | 3.8 | 1.9 | 1.0 | 9.0 | 13 |

STD - Standard deviation
N - Number of observations

## Appendix Table B-18
## Continuing Surface Water Quality Monitoring Program
## Inorganic Nitrogen to Inorganic Phosphorus Ratios ($N_i$:$P_i$)
## January - December, 1996

| | South Creek | | | | All Stations | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Sampling Date** | **SC-1** | **SC-2** | **SC-3** | **SC-4** | **Mean** | **STD** | **Min** | **Max** | **N** |
| 16-Jan-96 | 1.06 | 3.17 | ---- | 1.83 | 2.02 | 1.06 | 1.06 | 3.17 | 3 |
| 23-Apr-96 | 0.19 | 0.13 | ---- | 0.05 | 0.12 | 0.07 | 0.05 | 0.19 | 3 |
| 30-Jul-96 | 0.79 | 0.31 | ---- | 0.05 | 0.38 | 0.37 | 0.05 | 0.79 | 3 |
| 16-Oct-96 | 0.54 | 0.69 | 0.11 | 0.27 | 0.40 | 0.26 | 0.11 | 0.69 | 4 |
| Mean | 0.64 | 1.07 | 0.11 | 0.55 | | | | | |
| Minimum | 0.19 | 0.13 | ---- | 0.05 | | | | | |
| Maximum | 1.06 | 3.17 | ---- | 1.83 | | | | | |
| Std. Deviation | 0.37 | 1.41 | ---- | 0.86 | | | | | |
| N | 4 | 4 | 1 | 4 | | | | | |

| **Stations** | **Mean** | **STD** | **Min** | **Max** | **N** |
|---|---|---|---|---|---|
| SC-4, SC-1 | 0.60 | 0.62 | 0.05 | 1.83 | 8 |
| SC-2 | 1.07 | 1.41 | 0.13 | 3.17 | 4 |
| Entire Basin | 0.71 | 0.90 | 0.05 | 3.17 | 13 |

STD - Standard deviation
N - Number of observations

## Appendix Table B-19
## Continuing Surface Water Quality Monitoring Program
## Oils and Grease (mg/L)[a]
## January - December, 1994

| | South Creek | | | | All Stations | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Sampling Date | SC-1 | SC-2 | SC-3 | SC-4 | Mean | STD | Min | Max | N |
| 16-Jan-96 | 0.6 | <0.2 | ---- | 0.2 | 0.3 | 0.3 | <0.2 | 0.6 | 3 |
| 23-Apr-96 | 1.2 | 1.0 | ---- | 0.4 | 0.9 | 0.4 | 0.4 | 1.2 | 3 |
| 30-Jul-96 | 0.6 | 0.6 | ---- | 0.8 | 0.7 | 0.1 | 0.6 | 0.8 | 3 |
| 16-Oct-96 | <0.2 | <0.2 | 0.4 | 0.2 | 0.2 | 0.1 | <0.2 | 0.4 | 4 |
| Mean | 0.6 | 0.5 | 0.4 | 0.4 | | | | | |
| Minimum | <0.2 | <0.2 | ---- | 0.2 | | | | | |
| Maximum | 1.2 | 1.0 | ---- | 0.8 | | | | | |
| Std. Deviation | 0.5 | 0.4 | ---- | 0.3 | | | | | |
| N | 4 | 4 | 1 | 4 | | | | | |

| Stations | Mean | STD | Min | Max | N |
|---|---|---|---|---|---|
| SC-4, SC-1 | 0.5 | 0.4 | <0.2 | 1.2 | 8 |
| SC-2 | 0.5 | 0.4 | <0.2 | 1.0 | 4 |
| Entire Basin | 0.5 | 0.4 | <0.2 | 1.2 | 13 |

[a] Applicable surface water criteria: State - Maximum allowable concentration of 5.0 mg/L
Sarasota County - Maximum allowable concentration of 15.0 mg/L

STD - Standard deviation
N - Number of observations

## Appendix Table B-20
## Continuing Surface Water Quality Monitoring Program
## Total Coliform Bacteria (count/100 mL)[a]
## January - December, 1996

| | South Creek | | | | All Stations | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Sampling Date | SC-1 | SC-2 | SC-3 | SC-4 | Mean | STD | Min | Max | N |
| 16-Jan-96 | 500 | 3,000 | ---- | 300 | 1,267 | 1,504 | 300 | 3,000 | 3 |
| 23-Apr-96 | 100 | 200 | ---- | 4,000 | 1,433 | 2,223 | 100 | 4,000 | 3 |
| 30-Jul-96 | 60 | 300 | ---- | 60 | 140 | 139 | 60 | 300 | 3 |
| 16-Oct-96 | 6,000 | 300 | 1,000 | 3,000 | 2,575 | 2,554 | 300 | 6,000 | 4 |
| Mean | 1,665 | 950 | 1,000 | 1,840 | | | | | |
| Minimum | 60 | 200 | ---- | 60 | | | | | |
| Maximum | 6,000 | 3,000 | ---- | 4,000 | | | | | |
| Std. Deviation | 2897 | 1367 | ---- | 1962 | | | | | |
| N | 4 | 4 | 1 | 4 | | | | | |

| Stations | Mean | STD | Min | Max | N |
|---|---|---|---|---|---|
| SC-4, SC-1 | 1,753 | 2,292 | 60 | 6,000 | 8 |
| SC-2 | 950 | 1,367 | 200 | 3,000 | 4 |
| Entire Basin | 1,448 | 1,922 | 60 | 6,000 | 13 |

[a] Applicable surface water criteria: State and Sarasota County - Maximum of 2,400/100 mL
STD - Standard deviation
N - Number of observations

## Appendix Table B-21
## Continuing Surface Water Quality Monitoring Program
## Fecal Coliform Bacteria (count/100 mL)[a]
## January - December, 1996

| Sampling Date | South Creek SC-1 | SC-2 | SC-3 | SC-4 | All Stations Mean | STD | Min | Max | N |
|---|---|---|---|---|---|---|---|---|---|
| 16-Jan-96 | 140 | 1,000 | ---- | 200 | 447 | 480 | 140 | 1,000 | 3 |
| 23-Apr-96 | <10 | 60 | ---- | 10 | 25 | 30 | <10 | 60 | 3 |
| 30-Jul-96 | <10 | 30 | ---- | 10 | 15 | 13 | <10 | 30 | 3 |
| 16-Oct-96 | 80 | 15 | 160 | 190 | 111 | 79 | 15 | 190 | 4 |
| Mean | 58 | 276 | 160 | 103 | | | | | |
| Minimum | <10 | 15 | ---- | 10 | | | | | |
| Maximum | 140 | 1,000 | ---- | 200 | | | | | |
| Std. Deviation | 65 | 483 | ---- | 107 | | | | | |
| N | 4 | 4 | 1 | 4 | | | | | |

| Stations | Mean | STD | Min | Max | N |
|---|---|---|---|---|---|
| SC-4, SC-1 | 80 | 85 | <10 | 200 | 8 |
| SC-2 | 276 | 483 | 15 | 1,000 | 4 |
| Entire Basin | 147 | 267 | <10 | 1,000 | 13 |

[a] Applicable surface water criteria: State and Sarasota County - Maximum of 800/100 mL
STD - Standard deviation
N - Number of observations

## Appendix Table B-22
## Continuing Surface Water Quality Monitoring Program
## Trace Metals ($\mu$g/L)[a]
## January - December, 1996

| | South Creek | | | | All Stations | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Parameter | SC-1 | SC-2 | SC-3 | SC-4 | Mean | STD | Min | Max | N |
| Arsenic, Total | 1 | 4 | 5 | 4 | 3.5 | 1.7 | 1 | 5 | 4 |
| Copper, Total | <5 | <5 | <5 | <5 | <5 | ---- | ---- | ---- | 4 |
| Lead, Total | <0.4 | <0.4 | <0.4 | <0.4 | <0.4 | ---- | ---- | ---- | 4 |
| Zinc, Total | <14 | <14 | <14 | <14 | <14 | ---- | ---- | ---- | 4 |

[a] Applicable surface water criteria:

State - Maximum allowable concentrations of 50 $\mu$g/L for arsenic, 12.8 $\mu$g/L for copper, 3.6 $\mu$g/L for lead, and 115 $\mu$g/L for zinc

Sarasota County - Maximum allowable concentrations of 100 $\mu$g/L for arsenic, 10 $\mu$g/L for copper, 10 $\mu$g/L for lead, and 15 $\mu$g/L for zinc

STD - Standard deviation
N - Number of observations

# APPENDIX C:
# LABORATORY REPORTS

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Tampa (813) 229-3516
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CCI ENVIRONMENTAL SERVICES, INC.

# LABORATORY REPORT

**REPORT FOR:** Mr. Jim Paulmann
PALMER VENTURE
7184 Beneva Road
Sarasota, Florida 34238

**Report Number:** 658/Mar2996
**Project Number:** 0380-084
**Sampling Date:** 03-11-96
**Sample Source:** Surface Water
**Sampled By:** K. Guettler
N. Iricanin



| RESULTS OF ANALYSIS: | CC-1 | CC-2 | CC-3 | Units |
|---|---|---|---|---|
| Laboratory Number | 14229 | 14230 | 14231 | -------- |
| Sample Time | 1110 | 1120 | 1150 | hours |
| **ANALYSIS PERFORMED BY CCI** | | | | |
| Oil and Grease | 1.6 | <0.2 | 1.6 | mg/l |
| Biochemical Oxygen Demand | 1.4 | 1.2 | 1.2 | mg/l |
| Fecal Coliform Bacteria | 1000 | 3000 | 500 | No./100ml |
| Total Coliform Bacteria | 1000 | 8000 | 3000 | No./100ml |
| Ammonia Nitrogen | 0.05 | 0.02 | 0.11 | mg/l |
| Nitrate Nitrogen | 0.18 | 0.16 | 0.33 | mg/l |
| Nitrite Nitrogen | <0.01 | <0.01 | 0.02 | mg/l |
| Total Kjeldahl Nitrogen | 0.49 | 1.02 | 1.83 | mg/l |
| Total Nitrogen | 0.67 | 1.18 | 2.16 | mg/l |
| Total Phosphorus | 0.14 | 0.19 | 0.06 | mg/l |
| Total Reactive Phosphate | 0.08 | 0.18 | 0.04 | mg/l |
| Total Suspended Solids | 4.2 | 2.0 | 3.0 | mg/l |
| Turbidity | 3.6 | 1.0 | 7.9 | NTU |
| Dissolved Oxygen (field) | 8.0 | 9.4 | 5.0 | mg/l |
| pH (field) | 7.5 | 8.1 | 7.0 | pH units |
| Specific Conductivity, (field) | 594 | 904 | 1170 | µmhos/cm |
| Temperature (field) | 24.6 | 26.2 | 22.6 | °C |

FDHRS Drinking Water Certification #84243
FDHRS Environmental Certification #E84017

Analysis performed in accordance with E.P.A., Standard Methods or other FDHRS approved methodology.

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CCI ENVIRONMENTAL SERVICES, INC.

# LABORATORY REPORT

**REPORT FOR:** Mr. Jim Paulmann
PALMER VENTURE
7184 Beneva Road
Sarasota, Florida 34238

**Report Number:** 658/Mar2996
**Project Number:** 0380-084
**Sampling Date:** 03-11-96
**Sample Source:** Surface Water
**Sampled By:** K. Guettler
N. Iricanin



| RESULTS OF ANALYSIS: | CC-4 | CC-5 | NC-6 | Units |
|---|---|---|---|---|
| Laboratory Number | 14232 | 14233 | 14234 | -------- |
| Sample Time | 1200 | 1225 | 1245 | hours |
| **ANALYSIS PERFORMED BY CCI** | | | | |
| Oil and Grease | 1.0 | <0.2 | <0.2 | mg/l |
| Biochemical Oxygen Demand | 1.5 | 2.2 | 1.1 | mg/L |
| Fecal Coliform Bacteria | 10 | 60 | 40 | No./100ml |
| Total Coliform Bacteria | 150 | 60 | 80 | No./100ml |
| Ammonia Nitrogen | 0.06 | <0.02 | 0.12 | mg/l |
| Nitrate Nitrogen | 0.22 | 0.03 | 0.11 | mg/l |
| Nitrite Nitrogen | <0.01 | <0.01 | <0.01 | mg/l |
| Total Kjeldahl Nitrogen | 1.12 | 1.01 | 0.90 | mg/l |
| Total Nitrogen | 1.34 | 1.04 | 1.01 | mg/l |
| Total Phosphorus | 0.12 | 0.05 | 0.08 | mg/l |
| Total Reactive Phosphate | 0.08 | 0.02 | 0.07 | mg/l |
| Total Suspended Solids | 8.6 | 6.8 | 1.5 | mg/l |
| Turbidity | 2.5 | 4.9 | 4.6 | NTU |
| Dissolved Oxygen (field) | 8.4 | 8.3 | 1.65 | mg/l |
| pH (field) | 7.4 | 7.3 | 6.7 | pH units |
| Specific Conductivity, (field) | 708 | 786 | 741 | µmhos/cm |
| Temperature (field) | 24.8 | 23.8 | 20.0 | °C |

Robert B. Mason
Laboratory Supervisor

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CCI ENVIRONMENTAL SERVICES, INC.

# LABORATORY REPORT

**REPORT FOR:** Mr. Jim Paulmann
PALMER VENTURE
7184 Beneva Road
Sarasota, Florida 34238

**Report Number:** 609/Mar0596
**Project Number:** 0380-118
**Sampling Date:** 01-16-96
**Sample Source:** Surface Water
**Sampled By:** K. Guettler
N. Iricanin



| **RESULTS OF ANALYSIS:** | **SC-1** | **SC-2** | **SC-4** | **Units** |
|---|---|---|---|---|
| Laboratory Number | 14034 | 14035 | 14036 | ------- |
| Sampling Time | 1128 | 1100 | 1150 | 24 hours |
| **ANALYSIS PERFORMED BY CCI** | | | | |
| Oil and Grease | 0.6 | <0.2 | 0.2 | mg/l |
| Biochemical Oxygen Demand | 1.4 | 1.5 | 1.6 | mg/l |
| Fecal Coliform Bacteria | 140 | 1000 | 200 | No./100 ml |
| Total Coliform Bacteria | 500 | 3000 | 300 | No./100 ml |
| Ammonia Nitrogen | 0.03 | 0.11 | 0.04 | mg/l |
| Nitrate Nitrogen | 0.05 | 0.25 | 0.23 | mg/l |
| Nitrite Nitrogen | <0.01 | 0.02 | <0.01 | mg/l |
| Total Kjeldahl Nitrogen | 0.82 | 0.80 | 0.82 | mg/l |
| Total Nitrogen | 0.87 | 1.05 | 1.05 | mg/l |
| Total Phosphorus | 0.28 | 0.28 | 0.23 | mg/l |
| Total Reactive Phosphate | 0.08 | 0.12 | 0.15 | mg/l |
| Total Suspended Solids | 4.4 | 10.0 | 2.6 | mg/l |
| Turbidity | 8.6 | 2.2 | 1.7 | NTU |
| Dissolved Oxygen (field) | 10.9 | 7.35 | 10.9 | mg/l |
| pH (field) | 7.5 | 7.4 | 7.3 | pH units |
| Specific Conductivity, (field) | 718 | 705 | 554 | µmhos/cm |
| Temperature (field) | 16.3 | 16.6 | 16.2 | °C |

Robert B. Mason
Laboratory Supervisor

FDHRS Drinking Water Certification #84243
FDHRS Environmental Certification #E84017

Analysis performed in accordance with E.P.A., Standard Methods or other FDHRS approved methodology.

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CCI ENVIRONMENTAL SERVICES, INC.

# LABORATORY REPORT

**REPORT FOR:** Mr. Jim Paulmann
PALMER VENTURE
7184 Beneva Road
Sarasota, Florida 34238

**Report Number:** 609/Mar0596
**Project Number:** 0380-118
**Sampling Date:** 01-16-96
**Sample Source:** Surface Water
**Sampled By:** K. Guettler
N. Iricanin



| **RESULTS OF ANALYSIS:** | **SC-1** | **SC-2** | **SC-4** | **Units** |
|---|---|---|---|---|
| Laboratory Number | 14034 | 14035 | 14036 | ------- |
| Sampling Time | 1128 | 1100 | 1150 | 24 hours |
| **ANALYSIS PERFORMED BY CCI** | | | | |
| Oil and Grease | 0.6 | <0.2 | 0.2 | mg/l |
| Biochemical Oxygen Demand | 1.4 | 1.5 | 1.6 | mg/l |
| Fecal Coliform Bacteria | 140 | 1000 | 200 | No./100 ml |
| Total Coliform Bacteria | 500 | 3000 | 300 | No./100 ml |
| Ammonia Nitrogen | 0.03 | 0.11 | 0.04 | mg/l |
| Nitrate Nitrogen | 0.05 | 0.25 | 0.23 | mg/l |
| Nitrite Nitrogen | <0.01 | 0.02 | <0.01 | mg/l |
| Total Kjeldahl Nitrogen | 0.82 | 0.80 | 0.82 | mg/l |
| Total Nitrogen | 0.87 | 1.05 | 1.05 | mg/l |
| Total Phosphorus | 0.28 | 0.28 | 0.23 | mg/l |
| Total Reactive Phosphate | 0.08 | 0.12 | 0.15 | mg/l |
| Total Suspended Solids | 4.4 | 10.0 | 2.6 | mg/l |
| Turbidity | 8.6 | 2.2 | 1.7 | NTU |
| Dissolved Oxygen (field) | 10.9 | 7.35 | 10.9 | mg/l |
| pH (field) | 7.5 | 7.4 | 7.3 | pH units |
| Specific Conductivity, (field) | 718 | 705 | 554 | µmhos/cm |
| Temperature (field) | 16.3 | 16.6 | 16.2 | °C |

Robert B. Mason
Laboratory Supervisor

FDHRS Drinking Water Certification #84243
FDHRS Environmental Certification #E84017

Analysis performed in accordance with E.P.A., Standard Methods or other FDHRS approved methodology.

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# LABORATORY REPORT

**REPORT FOR:** Mr. Jim Paulmann
PALMER VENTURE
7184 Beneva Road
Sarasota, Florida 34238

**Report Number:** 768/NOV1196
**Project Number:** 0380-118
**Sampling Date:** 07-30-96
**Sample Source:** Surface Water
**Sampled By:** K. Guettler
N. Iricanin



| **RESULTS OF ANALYSIS:** | **SC-1** | **SC-2** | **SC-4** | **Units** |
|---|---|---|---|---|
| Laboratory Number | 15050 | 15051 | 15052 | ------- |
| Sampling Time | 1050 | 1110 | 1130 | 24 hours |
| **ANALYSIS PERFORMED BY CCI** | | | | |
| Oil and Grease | 0.8 | 0.6 | 0.8 | mg/l |
| Biochemical Oxygen Demand | 3.4 | 6.7 | 10.8 | mg/l |
| Fecal Coliform Bacteria | 30 | <10 | 10 | No./100 ml |
| Total Coliform Bacteria | 300 | 60 | 60 | No./100 ml |
| Ammonia Nitrogen | 0.09 | 0.04 | 0.11 | mg/l |
| Nitrate Nitrogen | 0.02 | 0.01 | 0.01 | mg/l |
| Nitrite Nitrogen | <0.01 | <0.01 | <0.01 | mg/l |
| Total Kjeldahl Nitrogen | 1.13 | 1.16 | 1.85 | mg/l |
| Total Nitrogen | 1.15 | 1.17 | 1.86 | mg/l |
| Total Phosphorus | 0.38 | 0.13 | 0.36 | mg/l |
| Total Reactive Phosphate | 0.37 | 0.07 | 0.32 | mg/l |
| Total Suspended Solids | 8.2 | 6.6 | 16.2 | mg/l |
| Turbidity | 9.6 | 6.3 | 10.2 | NTU |
| Dissolved Oxygen (field) | 3.2 | 11.1 | 1.3 | mg/l |
| pH (field) | 7.0 | 8.0 | 6.9 | pH units |
| Specific Conductivity, (field) | 1,072 | 667 | 747 | µmhos/cm |
| Temperature (field) | 30.3 | 31.5 | 28.9 | °C |
| Water Depth | 1.0 | 1.0 | 1.2 | ft |

Nenad Iricanin for
Robert B. Mason
Laboratory Supervisor

FDHRS Drinking Water Certification #84243
FDHRS Environmental Certification #E84017

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# LABORATORY REPORT

**REPORT FOR:** Mr. Jim Paulmann
PALMER VENTURE
7184 Beneva Road
Sarasota, Florida 34238

**Report Number:** 833/DEC0396
**Project Number:** 0380-118
**Sampling Date:** 10-16-96
**Sample Source:** Surface Water
**Sampled By:** K. Guettler
N. Iricanin



| **RESULTS OF ANALYSIS:** | **SC-1** | **SC-2** | **SC-3** | **SC-4** | **Units** |
|---|---|---|---|---|---|
| Laboratory Number | 15317 | 15318 | 15319 | 15320 | ------- |
| **ANALYSIS PERFORMED BY SUBCONTRACT LABORATORY[a]** | | | | | |
| Arsenic | 1 | 4 | 5 | 4 | µg/l |
| ***IN SITU* MEASUREMENTS PERFORMED BY CCI** | | | | | |
| Dissolved Oxygen (field) | 3.2 | 11.1 | | 1.3 | mg/l |
| pH (field) | 7.0 | 8.0 | | 6.9 | pH units |
| Specific Conductivity, (field) | 1,072 | 667 | | 747 | µmhos/cm |
| Temperature (field) | 30.3 | 31.5 | | 28.9 | °C |
| Water Depth | 1.0 | 1.0 | | 1.2 | ft |

[a] HRS Certification #E86240, 86356

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# LABORATORY REPORT

**REPORT FOR:** Mr. Jim Paulmann
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Sarasota, Florida 34238

**Report Number:** 833/DEC0396
**Project Number:** 0380-118
**Sampling Date:** 10-16-96
**Sample Source:** Surface Water
**Sampled By:** K. Guettler
N. Iricanin



| RESULTS OF ANALYSIS: | SC-1 | SC-2 | SC-3 | SC-4 | Units |
|---|---|---|---|---|---|
| Laboratory Number | 15317 | 15318 | 15319 | 15320 | ------- |
| Sampling Time | 1115 | 1045 | 1200 | 1130 | 24 hours |
| **ANALYSIS PERFORMED BY CCI** | | | | | |
| Oil and Grease | <0.2 | <0.2 | 0.4 | 0.2 | mg/l |
| Biochemical Oxygen Demand | 1.0 | 1.6 | 0.9 | 1.0 | mg/l |
| Fecal Coliform Bacteria | 80 | 15 | 160 | 190 | No./100 ml |
| Total Coliform Bacteria | 6,000 | 300 | 1,000 | 3,000 | No./100 ml |
| Ammonia Nitrogen | 0.07 | 0.03 | 0.01 | 0.01 | mg/l |
| Nitrate Nitrogen | 0.06 | 0.02 | 0.01 | 0.01 | mg/l |
| Nitrite Nitrogen | 0.01 | <0.01 | <0.01 | <0.01 | mg/l |
| Total Kjeldahl Nitrogen | 0.88 | 0.80 | 1.28 | 1.50 | mg/l |
| Total Nitrogen | 0.95 | 0.82 | 1.29 | 1.51 | mg/l |
| Total Phosphorus | 0.36 | 0.21 | 0.35 | 0.36 | mg/l |
| Total Reactive Phosphate | 0.26 | 0.08 | 0.23 | 0.28 | mg/l |
| Total Suspended Solids | 4.0 | 4.0 | 1.6 | 7.0 | mg/l |
| Turbidity | 3.8 | 2.8 | 2.5 | 4.6 | NTU |
| Copper | <5.0 | <5.0 | <5.0 | <5.0 | µg/l |
| Lead | <0.4 | <0.4 | <0.4 | <0.4 | µg/l |
| Zinc | <14 | <14 | <14 | <14 | µg/l |

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# APPENDIX D:

# PROJECT TEAM

## WILLIAM W. HAMILTON

**Principal Scientist**

### 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-three 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 environmental investigations to serve as a basis for surface water management permitting, dredge and fill 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 provided design of mitigative efforts related to permit issuance. 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 a member of the work group appointed to assist the Southwest Florida Water Management District in establishing the Eastern Tampa Bay Water Use Caution Area Management Plan.

### Education

| Year | School |
|---|---|
| 1970 | University of North Carolina<br>Charlotte, North Carolina<br>B.S. - Biology |

**Employment History**

| | |
|---|---|
| 1972 - Present | CCI Environmental Services, Inc.<br>(f.k.a. Conservation Consultants, Inc.) |
| 1970 - 1972 | Consultant to Conservation Consultants, Inc. |
| 1969 - 1970 | University of North Carolina<br>Zoological Museum<br>Charlotte, North Carolina<br>Assistant Curator of Fishes |

**Key Projects**

*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.

*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.

*Miller Sellen & Associates, 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.

*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.

**Key Projects (Continued)**

*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.

*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.

**Key Projects (Continued)**

*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.

*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.

*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.

## NENAD IRICANIN, Ph.D. — Environmental Scientist

### Fields of Competence

Water Quality Based Effluent Limitation Studies, Pollutant Loading Analyses, Sediment Geochemistry, Aquatic Chemistry, Nutrient Exchange Rates and Nutrient Budgets, Data Acquisition and Interpretation, Computer Programming.

### Experience Summary

Dr. Nenad Iricanin has nine years of applied research and consulting experience in the field of water resource science. His applied research experience includes particulate nutrient investigations in Florida waters, pollutant loading evaluations for both fresh water and marine systems, bulk sediment analyses for trace metals and nutrients, interstitial water analyses for trace metals and nutrients, water column analyses fro trace metals and nutrients, and *in situ* measurements of trace metals fluxes, sediment oxygen demand and nutrient regeneration from sediments using cores and chambers.

At CCI Environmental Services, Inc., Dr. Iricanin's responsibilities include implementation of Water Quality Based Effluent Limitations studies, evaluation of urban and industrial discharges, pollutant loading evaluations, conceptual stormwater management plans, sediment geochemistry and water/sediment interactions, waste load allocations, nutrient exchange rates, and nutrient budget determinations. Additionally, he performs statistical analyses and data interpretations of water resources and ecological assessments.

Dr. Iricanin is also a member of the American Society of Limnology and Oceanography, the American Geophysical Union, and the Oceanography Society

### Education

| Year | School |
|---|---|
| 1990 | Florida Institute of Technology<br>Ph.D. - Chemical Oceanography |
| 1984 | Florida Institute of Technology<br>M.S. - Chemical Oceanography |
| 1982 | Florida Institute of Technology<br>B.S. - Chemical Oceanography |

**Employment History**

1990 - Present

CCI Environmental Services, Inc.
(*f.k.a.* Conservation Consultants, Inc.)
Environmental Scientist

**Key Projects**

*Royster Phosphates, Inc.*: Project Scientist responsible for synthesizing water quality data from a Water Quality Based Limitation study and preparation of the "Intensive Survey" document for submittal to the Florida Department of Environmental Regulations. Manatee County, Florida.

*IMC Fertilizer, Inc.*: Project Scientist responsible for data collection and interpretation, and preparation of narrative report for submittal to the Florida Department of Environmental Regulation regarding a Water Quality Based Effluent Limitations study performed at the Hopewell facility. Hillsborough County, Florida.

*IMC Fertilizer, Inc.*: Project Scientist responsible for data collection and interpretation, and preparation of narrative report for submission to the Florida Department of Environmental Regulation regarding a Water Quality Based Effluent Limitations study performed at the Lonesome, Kingsford, Noralyn/Phosphoria, Four Corners, Clear Springs, and Haynsworth mines. Hillsborough, Manatee, and Polk counties, Florida.

*Florida Department of Environmental Regulation*: Project Scientist responsible for the collection of water samples during bi-weekly and storm event sampling in the Turkey Creek watershed and data management including performing statistical analysis of particulate nutrient loading and preparation of final report for submittal to the Florida Department of Environmental Regulation. Turkey Creek, Brevard County, Florida.

Department of Interior/U.S. Fish and Wildlife Service: Project Scientist during the second joint U.S.A.-U.S.S.R. ecosystem investigation of the Bering Sea responsible for the collection of sediment cores from 26 locations in the Bering Sea and subsequent analysis of trace metals in the upper sediment layer. Other responsibilities included data management, graphics generation, and report preparations for submittal to the U.S. Department of Interior. Bering Sea.

*National Oceanic and Atmospheric Administration (NOAA)*: Project Scientist on the P-Prime (Pollutant-particle relationships in the marine environment) project responsible for the collection of interstitial water samples and subsequent analyses for nutrients and trace metals. Other responsibilities included data management, report preparation and submittal to the National Oceanic and Atmospheric Administration. Mississippi River delta.

**Key Projects (Continued)**

*St. Johns River Water Management District*: Project Scientist responsible for the investigation of the quantity, composition, and sources of suspended matter loading to Turkey Creek. Other responsibilities included data management and pollutant loading analyses from urban and rural watersheds. Turkey Creek, Brevard County, Florida.

*Walt Disney EPCOT*: Project Scientist responsible for the monthly collection of trace metal and major cation samples in an artificial seawater aquarium. Also responsible for analyses of water quality samples, data management, and monthly report submittal to Walt Disney World EPCOT. The Living Seas, Orange County, Florida.

*King Engineering Associates*: Project Scientist for the evaluation of stormwater quality and pollutant loading for the Lake Tarpon watershed. Responsibilities included a bathymetric survey of the lake, sediment nutrient exchange rates, sediment oxygen demand, and evaluation of a nutrient budget for Lake Tarpon. Also, responsible for data management and preparation of final report for submittal to Pinellas County. Lake Tarpon, Pinellas County, Florida.

*Palmer Venture*: Project Scientist responsible for pollutant loading analysis for pre- and post-development conditions for the 2,200-acre Palmer Eastside Planned Community and preparation of the final report for submittal to Sarasota County Pollution Control Division. Palmer Ranch, Sarasota County, Florida.

*Schroeder-Manatee, Inc.*: Project Scientist responsible for pollutant loading analysis for pre- and post-development, conceptual stormwater management plan and report preparation for the University Place Development of Regional Impact. Sarasota County, Florida.

*Palmer Venture*: Project Manager responsible for data management and statistical analysis of water quality data collected during various storm events at stations located in Catfish and South Creeks. In addition, responsible for preparation of interpretative water quality report for submittal to the Sarasota County Pollution Control Division. Palmer Ranch, Sarasota County, Florida.

*Gulf Coast Pinellas Development*: Project Scientist responsible for implementation and evaluation of a hydrographic and water quality study performed at the proposed Bay Pines Station Marina. Also, performed a biological and a geochemical study of sediments within the proposed marina basin and prepared an interpretative report of results for submittal to the Florida Department of Environmental Regulation and Pinellas County. Bay Pines, Pinellas County, Florida

**Key Projects (Continued)**

*Kimley-Horn & Assoc.*: Project Manager for the Sarasota County Interstate Business Center Development of Regional Impact. Responsible for pollutant loading analyses for pre- and post-development land uses. In addition, responsible for summarization of existing water quality at the development site and preparation of report. Sarasota County, Florida.

*Palmer Venture*: Project Manager for the Continuing Surface Water Monitoring Program at the Palmer Ranch. Responsible for surface water data collection, data interpretation and preparation of annual narrative report for submittal to the Sarasota County Pollution Control Division. Sarasota County, Florida.

*Kimley-Horn & Assoc.*: Project Manager responsible for the implementation of a surface water quality and sediment quality survey in the Matheny Creek watershed. Other responsibilities included performing a pollutant loading evaluation for the watershed for various land use scenarios utilizing a spreadsheet mathematical model and preparation of interpretative report for existing water and sediment quality and pollutant loading assessments for submittal to the Sarasota County Stormwater Division as part of the NPDES permitting process. Matheny Creek, Sarasota County, Florida.

*Smith & Gillespie Engineering*: Project Manager responsible for the implementation hydrographic and water quality data collection program in the tidal Braden River. In addition, responsible for management of collected data and utilization of hydrographic and water quality data in a statistical or mathematical model to determine the effects various freshwater flow scenarios on the salt regime of the tidal Braden River. Braden River, Manatee County, Florida.

*Kimley-Horn & Assoc.*: Project Manager responsible for performing a pollutant loading evaluation for the watershed for various land use scenarios utilizing a spreadsheet mathematical model and preparation of interpretative report for submittal to the Sarasota County Stormwater Division as part of the NPDES permitting process. Matheny Creek, Sarasota County, Florida.

*Pasadena Yacht and Country Club*: Project Manager responsible for the implementation of a post-construction compliance monitoring program. Other responsibilities included collection of hydrographic measurements and water and sediment quality samples within the marina basin and surrounding waters. In addition, responsible for data management and preparation of monitoring reports for submittal to the Florida Department of Environmental Protection. Boca Ciega, Pinellas County, Florida.

**Key Projects (Continued)**

*Lansbrook Development Corporation:* Project Scientist for the evaluation of water quality in existing stormwater lakes at the Carlyle Subdivision and their effects on receiving waters. Other responsibilities included data management and report preparation for submittal to Pinellas County.

*Pinellas County, Florida.City of Gulfport:* Project Manager for hydrographic and water and sediment quality monitoring of a municipal marina applying for a dredge and fill permit. Other responsibilities included data management, statistical evaluations, and report preparation for submittal to the Florida Department of Environmental Protection. Gulfport, Pinellas County, Florida.

**Selected Publications**

Iricanin, N., Seasonal trends and benthic fluxes of interstitial manganese. (1984). M.S. Thesis.

Gu, D., N. Iricanin, and J.H. Trefry (1987), The geochemistry of interstitial water for a sediment core from the Indian River Lagoon, Florida, *Florida Scient.*, 50, 99 - 110.

Iricanin, N., J.H. Trefry, R.P. Trocine, T.W. Vetter, and S. Metz, Seasonal and spatial variations of interstitial Mn and Fe in Mississippi Delta Sediments, *Geochimica Cosmochimica Acta* (in preparation).

Iricanin, N., The role of storms in the transport and composition of particles in a Florida creek. Ph.D. Dissertation.

Iricanin, N. and J.H. Trefry (1990). Trace metal distribution in sediments from the Bering Sea. In: P.F. Rosigno (ed.), *Results from the second joint U.S.-U.S.S.R. Bering Sea expedition, summer 1984*. U.S. Fish. Wildl. Serv. Biol. Rep. 90(13).x + 317 pp.

**G. GARRY PAYNE, Ph.D.** **Senior Environmental Scientist**

**Fields of Competence**

Chemical Analysis of Water and Sediment Samples, Design and Implementation of WQBEL Studies, Stormwater Quality and Drainage Impact Assessments, Pollutant Loading Evaluations, and Groundwater Quality Monitoring, Data Acquisition and Interpretation, Statistical Analysis of Data, and Computer Programming.

**Experience Summary**

Dr. G. Garry Payne has thirteen years of applied research and environmental chemistry experience. Applied research has included effects of common land use practices on water quality and environmental quality in general. He has supervised an analytical laboratory conducting analyses of plant, soil and water samples. Experience includes teaching applied chemistry procedures at the college level, and supervision of lab and field personnel.

Before joining CCI, Dr. Payne worked with research teams from 1981 to 1989, where he investigated nutrient chemistry from field research sites and was responsible for quality control and maintenance of modern analytical equipment. He has investigated the effects of metal-rich wastes on soil chemistry. He has considerable experience in the experimental design of field and laboratory studies, including effects of acidity and nutrients on plants. After obtaining his doctorate in agronomy with an emphasis in soil chemistry, Dr. Payne's work has centered on applied chemical research and methods of minimizing detrimental environmental impacts resulting from nutrient losses, in Florida.

At CCI, Dr. Payne serves as Director of the Water Resource Management Division and oversees professional staff involved with surface and groundwater quality monitoring, data management and laboratory services. He is directly involved with planning, monitoring, and permitting studies for industries, utilities, municipalities, land developers and water management authorities. Many of these projects involve groundwater monitoring programs, pollutant loading evaluations and stormwater impact assessment and management, monitoring of potable water supplies, FDEP and NPDES permitting, development of nutrient and hydrologic budgets, and diagnostic studies of freshwater and estuarine water bodies.

**Education**

| Year | School |
|---|---|
| 1986 | Virginia Polytechnic Institute & State University<br>Ph.D. - Agronomy (Soil Chemistry) |
| 1983 | University of Georgia<br>M.S. - Agronomy (Soil Fertility) |
| 1981 | Christopher Newport College<br>B.S. - Biology |

**Employment History**

| | |
|---|---|
| 1989 - Present | CCI Environmental Services, Inc.<br>(f.k.a., Conservation Consultants, Inc.)<br>Senior Scientist |
| 1987 - 1989 | University of Florida Agricultural Research Center:<br>Postdoctoral Fellow |
| 1983 - 1987 | Virginia Polytechnic Institute & State University<br>Research & Teaching Assistant |
| 1981 - 1983 | University of Georgia: Research Assistant |

**Key Projects**

*City of Sarasota:* Project Manager for the design and implementation of a FDER-approved Plan of Study for a Water Quality Based Effluent Limitation Study (WQBEL) for the City's discharge from the Reverse Osmosis Plant and Ion Exchange Facility. Also responsible of data collection, statistical analysis, and preparation of an interpretative report of results. Sarasota, Florida.

*City of Palmetto:* Project Scientist for the design and implementation of a FDER-approved Plan of Study for a Minimal Impact Assessment for the surface water discharge to Terra Ceia Bay from City of Palmetto's Advanced Waste Water Treatment Plant. Palmetto, Florida.

*IMC Fertilizer:* Project Manager for the design and implementation of a FDER-approved Plan of Study for a Level I Water Quality Based Effluent Limitation (WQBEL) study for the surface water discharge from the Hopewell Phosphate Mining Facility. Responsibilities included data analysis, and preparation of an interpretative report of results. Study was performed in support of FDER permit renewal. Hillsborough County, Florida.

*IMC-Agrico Company:* Project Manager for the design and implementation of a FDEP-approved Plan of Study for a Level I Water Quality Based Effluent Limitation (WQBEL) study for six Phosphate Mining and Washer/Beneficiation Facilities covering three major river systems. The study was performed to support applications for the renewal of FDEP discharge permits. Hillsborough, Manatee, and Polk Counties, Florida.

*Havens & Emerson:* Project Manager for the design and implementation of a FDEP-approved Plan of Study for a Minimal Impact Assessment for Hillsborough County's proposed surface water discharge from the South County AWT Plant at Port Redwing. Hillsborough County, Florida.

*Palmer Venture:* Project Scientist for design and implementation of a Storm Event Pollutant Loading Monitoring Program in Catfish and South Creeks on Palmer Ranch. Responsible for data collection, data analysis, and preparation of an interpretative report of results. Sarasota County, Florida.

**Key Projects (Continued)**

*Pasadena Yacht and Country Club:* Project Manager for the design and 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.

*Lake Tarpon Swim Study:* Task manager for the assessment of the impacts of groundwater inputs on the quality of Lake Tarpon and the analyses and mapping of sediments to determine their impact on lake quality. Also evaluated stormwater quality and pollutant loadings, sediment nutrient exchange rates, sediment oxygen demand, and nutrient budgets. Pinellas County, Florida.

*Palmer Venture:* Project Scientist for an Assessment of Post-Development Pollutant Loading Rates including predictions of stormwater loadings from planned residential, transportation, and other land uses and predictions of pollutant removal rates for planned grassed swales, extended detention basins with long-term residence times and biological filters. Palmer Ranch. Increment VI and East Side. Sarasota County, Florida.

*Gulfstream Development Corporation:* Project Manager responsible for the implementation of agency approved workscopes for various water resource assessments and construction monitoring programs required by the DRI Development Orders prior to initiating construction of Woodmere Community Center and Woodmere Village. Venice, Florida.

*Palmer Venture:* Project Scientist for an Assessment of Post-Development Pollutant Loading Rates including predictions of stormwater loadings from planned residential, transportation, and other land uses and predictions of pollutant removal rates for planned grassed swales, extended detention basins with long-term residence times and biological filters. Palmer Ranch. Increment VI and East Side. Sarasota County, Florida.

*Power Corporation:* Project Manager responsible for the 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 Manager responsible for the design and 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 Manager responsible for the 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.

**Key Projects (Continued)**

Pursley Communities, Inc.,: Project Manager responsible for the implementation of agency approved workscopes for various surface and ground water resource monitoring programs required by the DRI Development Order during construction of the River Club Development. Manatee County, Florida.

*Terra Ceia Isles:* Project Manager responsible for the design and implementation of agency approved workscopes for various surface water quality monitoring programs required by the DRI Development Order during construction of the Terra Ceia Isles Development. Manatee County, Florida.

*Kimley-Horn & Assoc.*: Project Scientist on the Sarasota County Interstate Business Center Development of Regional Impact. Responsible for pollutant loading analyses for pre- and post-development land uses. In addition, responsible for summarization of existing water quality at the development site and preparation of report. Sarasota County, Florida.

*Kimley-Horn & Assoc.*: Project Scientist responsible for the implementation of a surface water quality and sediment quality survey in the Matheny Creek watershed. Other responsibilities included performing a pollutant loading evaluation for the watershed for various land use scenarios utilizing a spreadsheet mathematical model and preparation of interpretative report for existing water and sediment quality and pollutant loading assessments for submittal to the Sarasota County Stormwater Division as part of the NPDES permitting process. Matheny Creek, Sarasota County, Florida.

*Smith & Gillespie Engineers*: Project Scientist responsible for the implementation hydrographic and water quality data collection program in the tidal Braden River. In addition, responsible for management of collected data and utilization of hydrographic and water quality data in statistical and mathematical model to determine the effects various freshwater flow scenarios on the salt regime of the tidal Braden River. Braden River, Manatee County, Florida.

*Kimley-Horn & Assoc.*: Project Scientist responsible for performing a pollutant loading evaluation for the watershed for various land use scenarios utilizing a spreadsheet mathematical model and preparation of interpretative report for submittal to the Sarasota County Stormwater Division as part of the NPDES permitting process. Matheny Creek, Sarasota County, Florida.

*Van Der Noord Enterprises:* Project Manager for the design and implementation of agency approved workscopes for water quality, hydrographic, and micro-faunal assessments in the Manatee River for the Regatta Pointe Marina. Studies were performed in support of an application for agency permits required for the expansion of the marina. Palmetto, Florida.

**Key Projects (Continued)**

*Lombardo & Skipper:* Project Manager responsible for the design and implementation of agency approved workscopes for water and sediment quality and hydrographic assessments in Sarasota Bay for the Sarabay Marina. Studies were performed in support of an application for a Wetland Resource Management Permit relative to the expansion of the marina. Cortez, Florida.

*Larson Communities:* Project Manager responsible for the design and implementation of agency approved workscopes for water quality and hydrographic assessments in Tampa Bay for the Placido Bayou Development. Studies were performed in support of an application for a FDER Dredge and Fill Permit relative to the construction of a proposed docking facilities at the Placido Bayou Development. St. Petersburg, Florida.

**Selected Publications**

Payne, G.G. and J.E. Rechcigl. 1989. Influence of various drying techniques on the extractability of plant nutrients from selected soils. Soils Science.

Payne, G.G. and M.E. Sumner. 1986. Yield and composition of soybeans as influenced by soil pH, phosphorus, zinc and copper. Communications in Soil Science and Plant Analysis 17:257-273.

Payne, G.G. and D.C. Martens. 1988. Form and availability of Cu and Zn following long-term $CuSO_4$ and $ZnSO_4$ applications to a Rhodic Paleudult. Journal of Environmental Quality 17:707-711.

Payne, G.G. and D.C. Martens. 1986. Lead in soils. p. 78-89. In Soils. Brooklyn Botanic Garden, Inc., Brooklyn, NY.

Martens, D.C., G.G. Payne, C. Winarko, E.T. Kornegay and M.D. Lindemann. 1985. Crop response to high levels of copper application. Internat. Copper Research Association, Research Report 292(F). 38 p.

Payne, G.G., J.E. Rechcigl and A.B. Bottcher. 1988. Development of fertilization practices for beef cattle pastures to minimize nutrient loss in runoff. Annual Report. South Florida Water Management District. 125 p.

Payne, G.G., J.E. Rechcigl and R.J. Stephenson. 1990. Development of DRIS norms for bahiagrass. Agronomy Journal 82:711-715.

## KEVIN P. GUETTLER

**Environmental Scientist**

### Fields of Competence

Implementation of Surface Water, Groundwater, Hydrologic, and Sediment Monitoring Programs; Maintenance of Field and Laboratory Instrumentation and Equipment; SCUBA Certified; Proficient in the use of Outboard and Inboard Boats; Water Quality Data Analysis; and Computer Programming.

### Experience Summary

Mr. Guettler has two years experience in environmental technical services. He is experienced with various aspects of surface water investigations including in-situ measurements, surface water level instrumentation, flow determination, and grab/composite sampling techniques. He has also monitored groundwater quality via water level measurements and grab samples.

Mr. Guettler serves as an Environmental Scientist in the Water Resources Division and is responsible for the implementation of surface and ground water monitoring programs. He is knowledgeable in the operation and maintenance of water quality sampling equipment and instrumentation. He serves as Project Manager for various projects involving surface water, water level and groundwater investigations. In addition, he assists in the day-to-day operations of CCI's analytical laboratory, including routine analyses of surface and groundwaters. Prior to joining CCI, Mr. Guettler worked for the Florida Department of Environmental Protection/Florida Marine Research Institute where he was involved in research on hatchery production of marine/estuarine fish and population dynamics of local stocks.

### Education

| Year | School |
|---|---|
| 1992 | University of Florida<br>B.S. - Wildlife Ecology |

**Employment History**

| | |
|---|---|
| 1994 - Present | CCI Environmental Services, Inc.<br>(*f.k.a.* Conservation Consultants, Inc.)<br>Environmental Scientist |
| 1993 - 1994 | Florida Department of Environmental Protection<br>Biological Scientist I |
| 1992 - 1993 | University of Florida<br>Whitney Marine Laboratory<br>Research Assistant |

**Key Projects**

*Power Corporation*: Project Manager responsible for the implementation of agency approved workscopes for various water resource assessments required by the DRI Development Order for the Tara Development. Responsibilities include a monthly sample collection, surface water level recording, analysis and reporting of water quality. Manatee County, Florida.

*Palmer Venture*: Project Scientist and Field Team Leader responsible for the implementation of a surface and groundwater quality and hydrographic monitoring program in Catfish Creek on Palmer Ranch. Sarasota County, Florida.

*Palmer Venture*: Project Scientist and Field Team Leader responsible for the implementation of a surface and groundwater quality and hydrographic monitoring program in South Creek on Palmer Ranch. Sarasota County, Florida.

*SOS Associates, LTD.:* Project Scientist and Field Team Leader responsible for the 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. Manatee County, Florida.

*Wilma Southeast:* Project Manager and Field Team Leader responsible for the 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. Manatee County, Florida.

*Pursley Communities, Inc.:* Project Scientist and Field Team Leader responsible for the implementation of agency approved workscopes for various surface and groundwater resource monitoring programs required by the DRI Development Order during construction of the River Club Development. Manatee County, Florida.

**Key Projects (Continued)**

*City of Bradenton:* Project Scientist and Field Team Leader responsible for the implementation of a water quality monitoring program to assess the impact of the City of Bradenton's WWTP discharge on the Manatee River. Manatee County, Florida.

*Smith & Gillespie Engineers:* Project Scientist and Field Team Leader for a post-construction water quality monitoring program in the Evers Reservoir and Braden River. The source for the City of Bradenton's principal drinking water. Responsibilities include data collection, data interpretation, and preparation of reports of results. Manatee County, Florida.

*Smith & Gillespie Engineers:* Project Scientist and Field Team Leader for an ongoing surface water quality monitoring program in the Braden River downstream of the Evers Reservoir Dam. Responsibilities include data collection, data interpretation, and preparation of reports of results. Manatee County, Florida.

*Smith & Gillespie Engineers:* Project Scientist and Field Team Leader responsible for the mobilization and implementation of a hydrographic and surface water quality monitoring program in the Braden River downstream of the Evers Reservoir Dam. Designed to evaluate the impacts of fresh water flow over the dam on the estuarine waters of the Braden River. Manatee County, Florida.

*SMR Communities, Inc.:* Project Manager and Field Team Leader responsible for the implementation of agency approved workscopes for various surface water resource assessments and monitoring programs specified by the DRI Development Order during construction of the Lakewood Ranch Boulevard within the Cypress Banks Development. Manatee County, Florida.

*Terra Ceia Isles:* Project Scientist and Field Team Leader responsible for the implementation of a surface water quality monitoring program in and around Terra Ceia Isles. Manatee County, Florida.

*Pasadena Yacht and Country Club:* Project Scientist and Field Team Leader for the implementation of agency approved workscopes for various hydrographic, sediment and surface water quality monitoring programs required for FDEP permit compliance. Pinellas County, Florida.

*Sarasota County:* Project Scientist and Field Team Leader responsible for the mobilization and implementation of an ambient water quality monitoring program in Sarasota County Bays and the Lower Myakka River. The monitoring program was designed to allow the status and trends of environmental quality indicators to be determined in order to track the estuarine health. Sarasota County, Florida.