ANNUAL REPORT
OF THE
CONTINUING SURFACE WATER QUALITY
MONITORING PROGRAM
FOR THE PALMER RANCH
APRIL 1986 - MARCH 1987
SARASOTA COUNTY, FLORIDA

January 1988

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ANNUAL REPORT OF THE CONTINUING SURFACE WATER QUALITY MONITORING PROGRAM THE PALMER RANCH SARASOTA COUNTY, FLORIDA

1.0 INTRODUCTION

A master development plan for the North Tract of the Palmer Ranch is being implemented pursuant to the terms and conditions of the Master Development Order (MDO) which was adopted on December 24, 1984 by the Board of County Commissioners of Sarasota County. The MDO calls for planning and developing the 5,119-acre North Tract of the Palmer Ranch in incremental developments. Construction of the first incremental development (Prestancia) was initiated in 1986 and involved the realignment of various streams flowing through the property. As shown in Figure 1.1, the North Tract of the Palmer Ranch is located in west-central Sarasota County.

Pursuant to the conditions of the MDO, a "Continuing Surface Water Quality Monitoring Program" is required to be performed prior to and during construction of the North Tract except during the period in which a storm event monitoring is to be performed as specified in the Agreement of Understanding between Sarasota County and Palmer Venture established during August 1987. Additionally, annual reports of the monitoring program are required to be provided to the Sarasota County Planning Department, the Southwest Florida Regional Planning Council, the Florida Bureau of Land and Water Management, and all affected permitting agencies pursuant to the requirements of Chapter

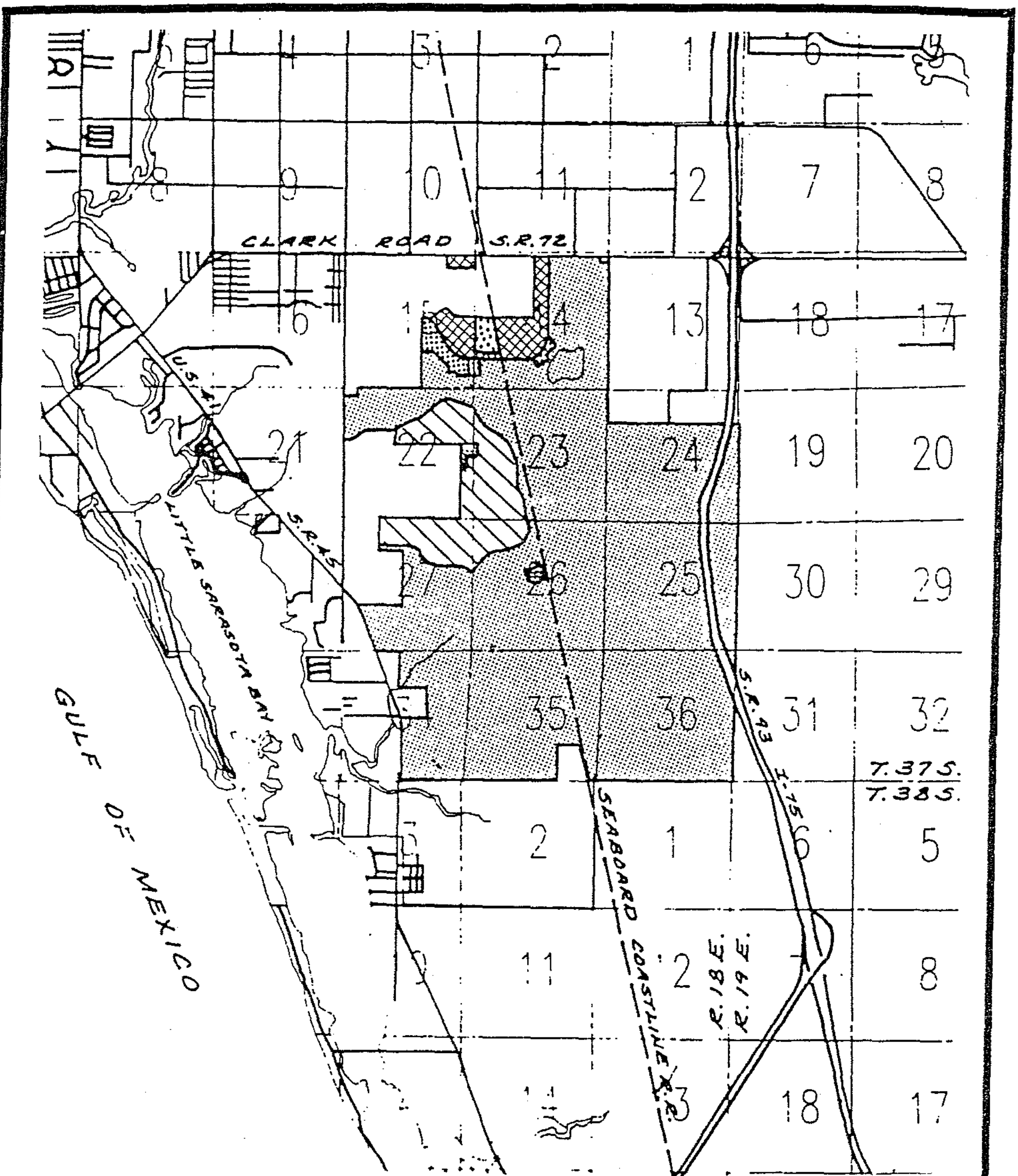


FIGURE 1.1

GENERAL SITE LOCATION

380.06(14) and (16), Florida Statutes, Chapter 9B-16.25, Florida Administrative Code, and procedures established by the Southwest Florida Regional Planning Council.

The primary purpose of the required "Continuing Surface Water Quality Monitoring Program" is to provide a continual assessment of the surface water quality conditions prior to and during the construction activities on the North Tract of the Palmer Ranch.

The monitoring program which was initiated in May 1984 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 workscope entailed a 13 station network with a quarterly sampling frequency for the parameters monitored during the first year except trace elements and organochlorine pesticides which would receive annual audits (refer to correspondence of Mr. T. W. Goodell to Mr. Russ Klier of July 24, 1986).

Palmer Venture contracted Conservation Consultants, Inc. (CCI) to carry out the Continuing Surface Water Quality Monitoring Program beginning during the second year of the monitoring program. CCI began monitoring on September 16, 1985, pursuant to the instructions provided by Mr. T. W. Goodell. The first year of the monitoring program was performed by GeoScience, Inc.

The observed water quality conditions recorded during the third monitoring year of April 1986 - March 1987 are reported herein. The report includes a discussion of the results with respect to applicable water quality criteria, observed spatial and temporal trends, and correlations between parameters.

2.0 GENERAL ENVIRONMENTAL SETTING

2.1 Climate

Prevailing climatic conditions in west-central Florida are sub-tropical, 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 Monthly Average Temperatures
(National Weather Service - Tampa, Florida)

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

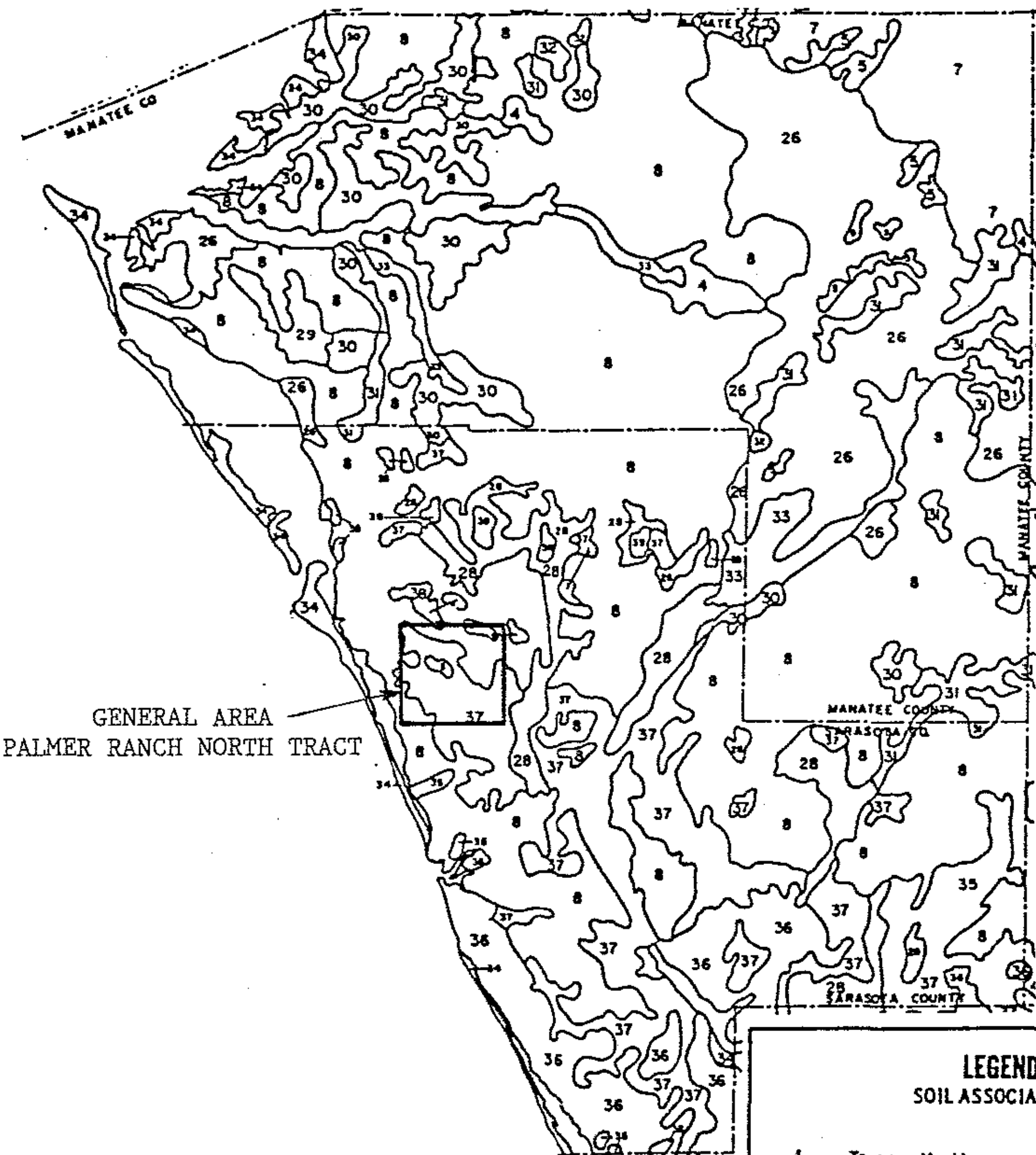
2.2 Soils

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. 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.

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 just 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 wastewater treatment facilities and associated spray effluent fields and land disposal of sludge.



LEGEND

SOIL ASSOCIATIONS

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

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

FIGURE 2.1

SOIL ASSOCIATIONS IN REGION

N

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 a 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.
	35	Pomello-Paola-St. Lucie association: Nearly level to sloping, moderately well drained sandy soils with weakly cemented sandy 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.

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	28	Pompano-Charlotte-Delray association: Nearly level, poorly drained soils, sandy throughout, and very poorly drained soils with thick sandy layers over loamy subsoil.
	31	Placid-Bassinger association: Nearly level, very poorly and poorly drained soils, sandy throughout.
	32	Delray-Manatee-Pompano association: Nearly level, very poorly drained soils with thick, sandy layers over loamy subsoil; very poorly drained sandy soils, with loamy subsoil and poorly drained soils, sandy throughout.
	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.

During the second monitoring year, the land application of sludge wastes on the Palmer Ranch was discontinued. Additionally, the construction of the Central County Utilities Regional Treatment Plant and an adjacent golf course was completed during the second year of the monitoring program.

Land uses adjacent to the ranch which 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 and light industry.

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

2.4 Drainage

The North Tract of the Palmer Ranch is divided into six primary drainage basins which ultimately discharge into Little Sarasota Bay. Two basins, the Catfish Creek-Trunk Ditch Basin and the South Creek Basin, drain the majority of the North Tract. As shown in Figure 2.2, approximately 2,590 acres of the Catfish Creek-Trunk Ditch Basin which has a total drainage area of 3,700 acres and approximately 1,770 acres of the South Creek Basin which has a total drainage area of approximately 12,000 acres are located on the North Tract. Four minor basins also drain portions of the property. These include Matheny Creek Basin (40 acres), Elligraw Bayou Basin (180 acres), North Creek Basin (460

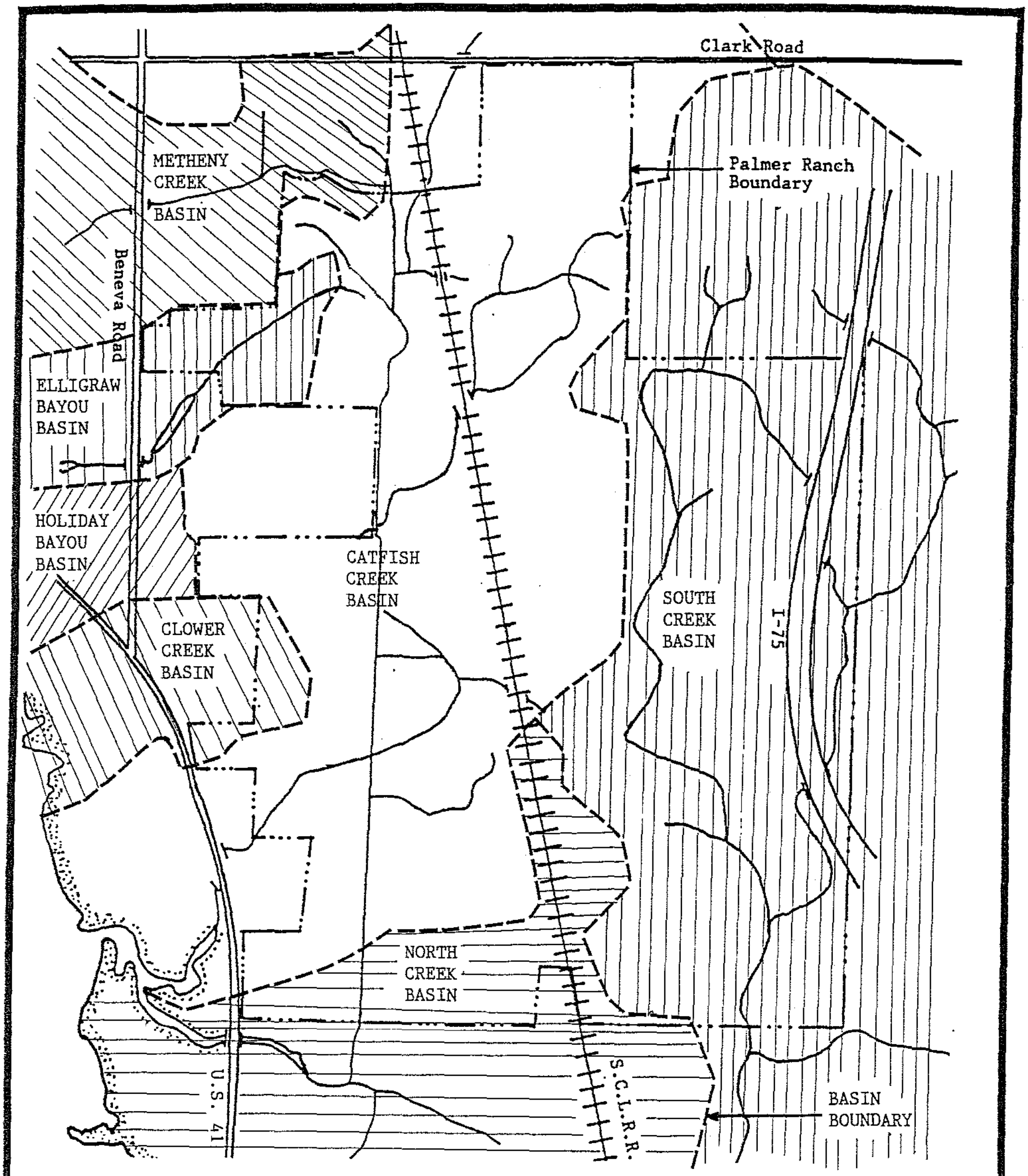


FIGURE 2.2

PALMER RANCH DRAINAGE BASINS

acres), and Clower Creek Basin (80 acres). The major streams of these basins are generally described in the following sections.

2.4.1 Catfish Creek

Catfish Creek is a meandering stream that flows southwest to the southern boundary of the property, intersecting Trunk Ditch, a straight man-made canal, at five locations. The upper reach 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.

On the Palmer Ranch, Catfish Creek receives drainage from an effluent disposal spray field of Palmer Utilities and a spray field and golf course irrigation system operated by the Central County Regional Utilities Wastewater Treatment Plant. The remainder of drainage into Catfish Creek originates in wetlands, pine flatwoods and improved pasture. At the end of the third monitoring year, i.e. February 1987, an upper segment of Catfish Creek underwent realignment.

Downstream of the Palmer Ranch, Catfish Creek receives drainage from residential areas and runoff from U.S. Highway 41. Further downstream, Catfish Creek is subject to the tidal influences of Little Sarasota Bay.

2.4.2 Trunk Ditch

Trunk Ditch is a straight canal that was constructed by Sarasota County to improve drainage. During early 1986, Trunk Ditch was realigned in association with the Prestancia golf course construction. In the realigned segment, Trunk Ditch exhibits an enlarged channel and two weirs which result in lentic conditions during the dry season. Upstream and downstream, however, Trunk Ditch exhibits steep banks showing evidence of erosion. Vegetation in Trunk Ditch is dominated by hydrilla, Elodea, cattail and other aquatic weeds except in the realigned segment which was generally void of macrophytic vegetation during the third monitoring year.

Trunk Ditch originates near the northern end of the property and flows south where it becomes contiguous with a dredged tributary to North Creek. As previously mentioned, Trunk Ditch intersects Catfish Creek 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 the Prestancia golf course, the Country Club of Sarasota and the contiguous residential area, as well as pine flatwoods, improved pastures, and wetlands of the Palmer Ranch.

In addition to two weirs in the realigned segment of Trunk Ditch, a sill (elevated streambed) exists between the last confluence with Catfish Creek and its juncture with the North Creek Basin. During dry periods when water levels are low, Trunk Ditch only flows into Catfish Creek resulting in stagnation in its southernmost segment at its juncture with the North Creek Basin. During periods of high water, however, Trunk Ditch flows into Catfish

Creek and over the aforementioned shallow sill into the North Creek Basin via a dredged tributary to North Creek.

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, weeds, and trees resulting in a partially overhanging canopy. Most of the drainage into this dredged tributary originates in improved pasture, idle agricultural land, and a marsh/slough system. 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 is a meandering stream that has been partially channelized. 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 from a golf course, mobile home park, I-75, and a large dairy. Drainage within the ranch enters South Creek primarily from improved pastures and pine flatwoods but to a lesser extent from a portion of the CCU spray field. Downstream of the ranch, South Creek flows through the Oscar Scherer State Recreational Area and subsequently into the tidal waters of Little Sarasota Bay.

2.4.5 Elligraw Bayou

Elligraw Bayou is a channelized stream that flows southwesterly to Little Sarasota Bay. The banks of Elligraw Bayou are moderately sloped and vegetated with grasses and trees. On the ranch, Elligraw Bayou receives drainage from marshes, sloughs, open areas and Prestancia. Downstream of the Palmer Ranch, Elligraw Bayou flows through Ballantrae and several other residential areas before entering Little Sarasota Bay.

2.4.6 Matheny Creek

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

2.5 Water Quality Classification

The segments of the streams traversing the North Tract of the Palmer Ranch are non-tidal freshwater systems which have been designated by the State as Class III waters. Downstream, these streams flow into a predominantly marine tidal system (Little Sarasota Bay) which is classified as an Outstanding Florida Water (OFW). In addition, the segment of South Creek which 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. predominantly fresh waters, are listed in Table 2.3.

Table 2.3 Applicable Water Quality Criteria

Parameter	State of Florida FAC 17-3	Sarasota County Ord. No. 72-37
Arsenic	Not > 0.05 mg/l	Not > 0.01 mg/l
BOD-5	Not to be increased in a manner that would depress Dissolved Oxygen levels below criteria.	Same as FAC 17-3
Cadmium	Not >0.0008 mg/l in predominantly fresh waters with a hardness of less than 150 mg/l of $CaCO_3$. Not to exceed 0.0012 mg/l in harder waters.	Not >0.01 mg/l
Chromium	Not > 0.05 mg/l in predominantly fresh waters	Not > 0.02 mg/l
Coliform, Fecal	Not > 800/100 ml	----
Coliform, Total	Not > 2,400/100 ml	Not > 2,400/100 ml
Conductivity	Shall not be increased more than 50% above background or to 1275 umhos/cm, whichever is greater, in predominantly fresh waters.	+100% above background, or to max. of 500 umhos/cm in fresh water streams.
Copper	Not > 0.03 mg/l	Not > 0.01 mg/l
Dissolved Oxygen	Not < 5 mg/l	Not < 4 mg/l
Lead	Not > 0.03 mg/l	Not > 0.01 mg/l
Mercury	Not > 0.0002 mg/l	Not > 0.01 mg/l
Nickel	Not > 0.1 mg/l	Not > 0.1 mg/l
Nutrients	Concentrations in a body of water shall not be altered in such a manner as to cause an imbalance in natural populations of aquatic flora or fauna.	-----
Nitrogen, Ammonia (ionic plus non-ionic)	See Nutrients	Only applies to non-ionic Ammonia
Nitrogen, Nitrite	See Nutrients	-----

Table 2.3 (continued) Applicable Water Quality Criteria

Parameter	State of Florida FAC 17-3	Sarasota County Ord. No. 72-37
Nitrogen, Nitrate	See Nutrients	-----
Nitrogen, Total	See Nutrients	-----
Nitrogen, Organic	See Nutrients	-----
Oil and Greases	Not > 5 mg/l	Not > 15 mg/l
Aldrin plus Dieldrin	Not > 0.003 ug/l	-----
alpha - BHC	-----	-----
beta - BHC	-----	-----
delta - BHC	-----	-----
gamma - BHC (Lindane)	Not > 0.01 ug/l	-----
Chlordane	Not > 0.01 ug/l	-----
4,4' DDD	-----	-----
4,4'-DDE	-----	-----
4,4'-DDT	Not > 0.001 ug/l	-----
Endosulfan	Not > 0.003 ug/l	-----
Endrin	Not > 0.004 ug/l	-----
Heptachlor	Not > 0.001 ug/l	-----
Toxaphene	Not > 0.005 ug/l	-----
Polychlorinated Biphenyls	Not > 0.001 ug/l	-----

Table 2.3 (continued) Applicable Water Quality Criteria

Parameter	State of Florida FAC 17-3	Sarasota County Ord. No. 72-37
Phosphate, Ortho	See Nutrients	-----
Phosphate, Total	See Nutrients	-----
pH	6 - 8.5	6 - 8.5
Solids, Total Suspended	-----	-----
Turbidity	Not > 29 NTU above background	Not > 25 JTU above background
Zinc, as Zn	Not > 0.03 mg/l	Not > 0.01 mg/l

3.0 FIELD AND LABORATORY PROCEDURES

3.1 Station Locations and General Descriptions

The Continuing Surface Water Quality Monitoring Program employed a network of 13 sampling stations (Figure 3.1) located at various sites along South Creek, Catfish Creek, Elligraw Bayou, Trunk Ditch and North Creek during the third year of monitoring, i.e. April 1986 - March 1987. Table 3.1 describes the general characteristics of the 13 sampling stations.

South Creek was monitored at five locations. These included two points of inflow (SC-3 and SC-7) as well as one point of outflow (SC-2) from the North Tract. Station SC-7 is located downstream of I-75 and a dairy farm and Station SC-3 is located downstream of a mobile home park and golf course. South Creek was also monitored within, i.e. Stations SC-4 and SC-1, and downstream of the North Tract, i.e. Station SC-8.

In Catfish Creek, inflow into the North Tract was monitored at Station CC-1 while outflow was monitored at Station CC-5. Station CC-1 receives drainage from Clark Road and commercial/industrial developments. Two tributaries of Catfish Creek were also monitored near their confluences with the main channel of Catfish Creek (Stations CC-2 and CC-3).

Trunk Ditch was monitored within its realigned segment adjacent to the Country Club of Sarasota and Prestancia, i.e. Station CC-4, as well as at its juncture with the North Creek Basin, i.e. Station NC-6.

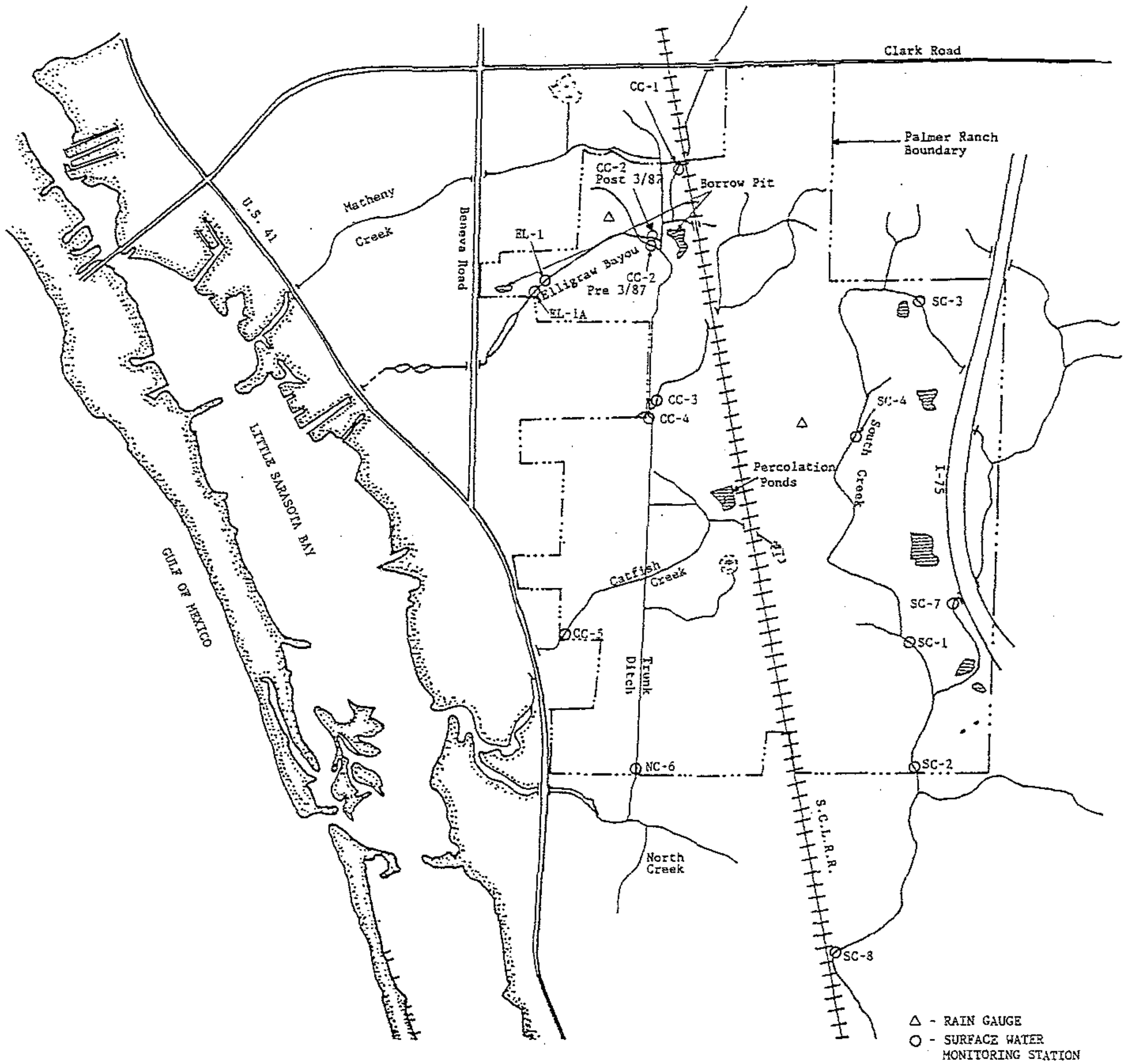


FIGURE 3.1

LOCATIONS OF MONITORING STATIONS AND RAIN GAUGES

Table 3.1. General Descriptive Characteristics of Each Surface Water Quality Sampling Station.

Station	General Location	Water Depth (ft)[a]	Channel Width (ft)	Habitat
CC-1	Catfish Creek Site entry	0.5-1.3	10	75-100% Canopy of Salix, Rooted Emergents Incised Banks
CC-2[b]	Catfish Creek near Elligraw Confluence	0.0-2.5	12	Aquatic Vegetation Shallow sloped Banks.(post 2/87 excavated channel void of vegetation dry
CC-3	Catfish Creek Upstream of Trunk Ditch	0.2-1.4	6	Aquatic Vegetation Incised Banks
CC-4[c]	Trunk Ditch Downstream of Catfish Creek confluence	1.2-2.0	50	Sodded banks, Rooted Emergents
CC-5	Catfish Creek Outfall from Site	0.5-0.9	11	Shading in A.M. and P.M. by Willow, Wax Myrtle, Filamentous Green Algae, Rooted Emergents
NC-6	Trunk Ditch Downstream of Catfish Creek	1.2-2.7	12	Aquatic Vegetation
El-1	Elligraw Bayou near Site exit	0.0-0.7	6	Aquatic Vegetation
SC-1	South Creek mid-property	0.4-0.9	12	Sand covered with organic
SC-2	South Creek at Site exit	0.0-0.9	17	Rooted Emergents, Fllating Aquatics, Palm Trees Shade Channel in A.M.
SC-3	South Creek outfall from large wetland	0.0-0.4	10	Shallow banks Aquatic Vegetation
SC-4	South Creek near Honore Avenue	0.2-0.6	8	Rooted Emergents Cover 33% of Channel, Canopy of Pine
SC-7	South Creek near I-75 downstream of Dairy	0.0-2.5	9	50% Cover of Rooted Emergents, 75% Upstream Coverage by Floating Aquatics. Willow and Pepper Trees Line Banks
SC-8	South Creek upstream of Oscar-Scherer Recreational Area	1.2-3.5	10	Aquatic Vegetation Incised Banks

[a]Range in Depth recorded during monitoring period of June, 1986 - March, 1987.
[b]Due to realignment in 2/87, Station CC-2 was relocated to new segment of Catfish Creek (See Figure 3.1)
[c]Depths reported are depths at sampling location - total depth at site averages 8.0 feet.

Elligraw Bayou was monitored near its point of outflow from the North Tract, i.e. Station EL-1A. Matheny Creek was not monitored during the third year of the program.

3.2 Parameters and Sampling Frequency

Quarterly sampling was attempted at all 13 stations during June 1986, September 1986, December 1986 and March 1987. Due to dry conditions, however, sampling was not possible at Stations EL-1A, SC-2, SC-3 and SC-7 during the quarterly event in June or at Station CC-2 during the quarterly event in March. An annual sampling event was performed at all 13 stations during September 1986. Sampling at Station SC-3 was performed on September 16 rather than on the regularly scheduled event of September 4. The dates and times of all sample collections are given in Table 3.2.

The monitoring program acquired water quality data by: (1) *in situ* measurements and (2) grab sampling and laboratory analyses. A digital readout Hydrolab Series 4000 was used for *in situ* measurements of dissolved oxygen, pH, specific conductance and water temperature. Prior to deployment in the field, the Hydrolab was calibrated according to the manufacturer's recommended procedures. All *in situ* measurements were taken at approximate mid-depth at each station except Station CC-4 which was monitored at a depth of approximately 1 foot.

Grab samples were collected at each station during each event, preserved and analyzed in the laboratory within the recommended hold times for the parameters listed in Table 3.3. All para

Table 3.2 Date and Time of Sampling for Third Annual Monitoring Period of April, 1986 - March, 1987.

Event No.	Date of Sampling	EL-1	CC-1	CC-2	CC-3	CC-4	CC-5	NC-6	SC-1	SC-2	SC-3	SC-4	SC-7	SC-8
1	06/16/86	Dry	1300	1219	1137	1042	0958	0935						
	06/17/86								1102	Dry	Dry	1139	Dry	0953
2	09/03/86	1325	1420	1400	1245	1225	1150	1130						
	09/04/86								1500	1100	1206[a]	1735	1342	1154
3	12/03/86	1355	1306	1340	1145	1120	1040	1020						
	12/04/86								1240	1135	1342	1319	1202	1030
4	03/04/87	1010	1035	Dry	1048	1115	1204	1240						
	03/05/87								1113	1057	1237	1211	1143	0951

[a] Collected 9/16/86

Table 3.3 Collection and Analytical Methods

Parameter	Collection	Field Handling	Hold Time	Laboratory Handling	Analytical Method	Method Reference
Bacteria, Fecal Coliform	Grab	Stored on Ice	6 Hours	Immediate Analysis	Membrane Filter	APHA 909C
Bacteria, Total Coliform	Grab	Stored on Ice	6 Hours	Immediate Analysis	Membrane Filter	APHA 909A
Biochemical Oxygen Demand (BOD-5 Day)	Grab	Stored on Ice	6 Hours	Immediate Analysis	Titration - Modified Winkler	APHA 507
Conductivity	In situ	---	---	---	Hydrolab	APHA 205
Oxygen, Dissolved	In situ	---	---	---	Hydrolab	APHA 421 F
Nitrogen, Ammonia	Grab	Acidified to pH <2, Stored on Ice	7 Days	Stored at $4^{\circ}C$	Distillation, Colorimetric - Nesslerization	APHA 417A,B
Nitrogen, Nitrate	Grab	Stored on Ice	48 Hours	Immediate Analysis	Colorimetric - Brucine	EPA 352.1
Nitrogen, Nitrite	Grab	Stored on Ice	48 Hours	Immediate Analysis	Colorimetric - Diazotization	EPA 354.1
Nitrogen, Total Kjeldahl	Grab	Acidified to pH <2, Stored on Ice	14 Days	Stored at $4^{\circ}C$	Digestion/ Distillation, Colorimetric - Nesslerization	APHA 420A
Nitrogen, Total	Grab	Acidified to pH <2, Stored on Ice	14 Days	Stored at $4^{\circ}C$	Calculation	APHA 416
Oil And Grease	Grab	Acidified to pH <2, Stored On Ice	28 Days	Stored at $4^{\circ}C$	Gravimetric	EPA 413.1

Table 3.3 (continued) Collection and Analytical Methods

Parameter	Collection	Field Handling	Hold Time	Laboratory Handling	Analytical Method	Method Reference
pH	In situ	---	---	---	Hydrolab	APHA 423
Phosphate, Reactive	Grab	Stored on Ice	48 Hours	Immediate Analysis	0.45u Filtration, Colorimetric - Ascorbic Acid	EPA 365.2
Phosphate, Total	Grab	Acidified to pH <2, Stored on Ice	28 Days	Stored at $4^{\circ}C$	Persulfate Digestion, Colorimetric - Ascorbic Acid	EPA 365.2
Solids, Total Suspended (TSS)	Grab	Stored on Ice	7 Days	Stored at $4^{\circ}C$	Glass Fiber Filtration, Dried at $105^{\circ}C$	APHA 209C
Temperature	In situ	---	---	---	Hydrolab	APHA 212
Turbidity (NTU)	Grab	Stored on Ice	48 Hours	Immediate	Nephelometric	APHA 214A
Arsenic, Total	Grab	Acidified to pH <2, Stored on ice	6 Months	Stored at $4^{\circ}C$	Digestion, Furnace Technique Atomic Absorption	EPA 206.2
Cadmium, Total	Grab	Acidified to pH <2, Stored on Ice	6 Months	Stored at $4^{\circ}C$	Digestion/ PDCA Extraction, Atomic Absorption	EPA 213.1
Chromium, Total	Grab	Acidified to pH <2, Stored on Ice	6 Months	Stored at $4^{\circ}C$	Digestion/ PDCA Extraction, Atomic Absorption	EPA 218.1

Table 3.3 (continued) Collection and Analytical Methods

Parameter	Collection	Field Handling	Hold Time	Laboratory Handling	Analytical Method	Method Reference
Copper, Total	Grab	Acidified to pH <2, Stored on Ice	6 Months	Stored at 4°C	Digestion, Atomic Absorption	EPA 220.1
Lead, Total	Grab	Acidified to pH <2, Stored on Ice	6 Months	Stored at 4°C	Digestion/ PDCA Extraction, Atomic Absorption	EPA 239.1
Mercury, Total	Grab	Acidified to pH <2, Stored On Ice	28 Days	Stored at 4°C	Digestion, Cold Vapor Method	EPA 245.1
Nickel, Total	Grab	Acidified to pH <2, Stored on Ice	6 Months	Stored at 4°C	Digestion, Atomic Absorption	EPA 249.1
Zinc, Total	Grab	Acidified to pH <2, Stored on Ice	6 Months	Stored at 4°C	Digestion, Atomic Absorption	EPA 289.1
Pesticides, Organochlorine	Grab	Stored On Ice	7 Days	Stored at 4°C	Gas Chromatograph	EPA 608

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

APHA - American Public Health Association, American Water Works Association and Water Pollution Control Federation, 1985. Standard Methods for the Examination of Water and Wastewater, 16th Edition. American Public Health Association.

meters were tested on a quarterly basis except organochlorine pesticides and trace metals which were tested on an annual basis.

All laboratory analyses were performed in accordance with the procedures described in the sixteenth edition of Standard Methods (APHA, 1985) or the Methods for Chemical Analysis of Water and Wastes (USEPA, 1983). Laboratory analyses were performed by the CCI laboratory except for pesticide scans, oils and greases, arsenic and mercury which were performed by an outside laboratory. Copies of the data reports provided by the outside laboratory are given in Appendix B.

Two additional parameters were monitored as an aid in evaluating the water quality data although not part of the Continuing Surface Water Quality Monitoring Program. These were stream flow and stream depth which were monitored at each sampling point concurrently with water quality monitoring. Stream flow was measured by the use of the salt dilution method described by USGS (1982) and stream depth was measured at each point of water quality sampling by the use of a fiberglass tape.

4.0 RESULTS AND DISCUSSION

The results of the Continuing Surface Water Quality Monitoring program for the third year of monitoring (April 1986 - March 1987) are tabulated in Appendix A. Results of the analyses performed by the subcontract laboratory are also provided in Appendix B. The acquired data given in Appendix A are organized by parameter according to sampling location, sampling episode, mean, range, standard deviation, and number of observations (N). Applicable water quality criteria are footnoted below each table.

4.1 Rainfall and Hydrology

4.1.1 Rainfall

The third year of monitoring occurred during a normal period of rainfall in which 52 inches was recorded on the North Tract of the Palmer Ranch. As discussed in Section 2.1 Climate, this amount is only 4 inches less than the average rainfall of 56 inches/year based on a 30-year period of record (NOAA, 1977). Figure 4.1 provides a comparison of the monthly distribution of rainfall measured on the Palmer Ranch during the third year of monitoring to the monthly distribution of historical rainfall for the 30-year period of record.

As given in Table 4.1, the seasonal amounts of rainfall recorded on-site during the first and second quarters were 10.22 and 16.40 inches, respectively. During the third and fourth quarters, 9.85 and 15.04 inches were recorded, respectively. This temporal trend follows the normal wet season pattern which typically occurs during the second quarter (July, August and September)

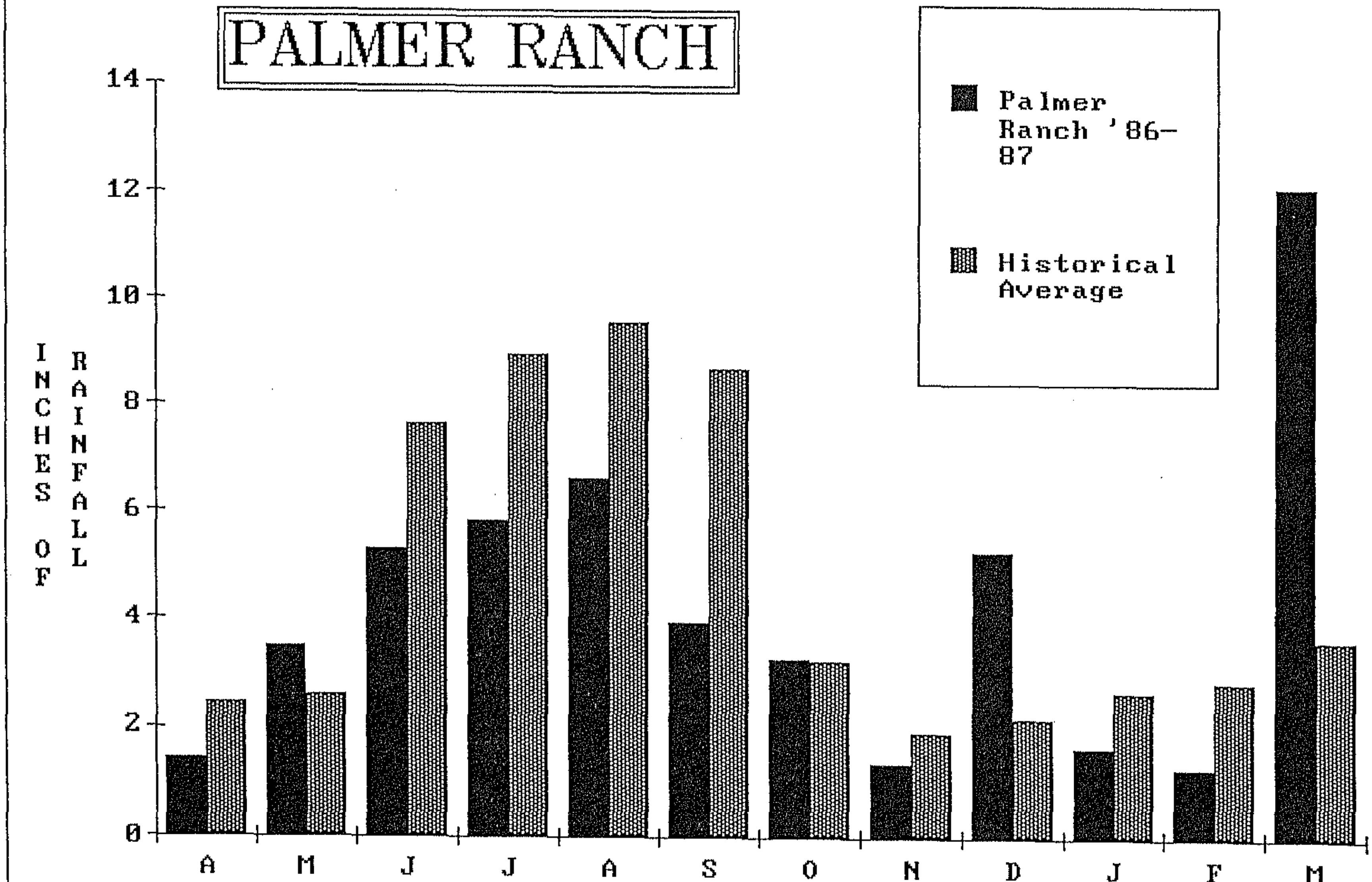


Figure 4.1 Historical vs. Rainfall Recorded on the Palmer Ranch 1986-1987

Table 4.1 Rainfall Recorded on the Palmer Ranch during the Period of April 1986 - March 1987.

	Rainfall (inches)				
Date	Monthly	Seasonal[a]	Pre-event Rainfall		
			2 Mo.	2 Week	2 Day
April, 1986	1.44				
May, 1986	3.48				
June, 1986	5.30		5.89	1.91	0.56
Spring		10.22			
July, 1986	5.84				
August, 1986	6.63				
September, 1986	3.93		12.57	3.26	0.11
Summer (wet season)		16.40			
October, 1986	3.27				
November, 1986	1.33				
December, 1986	5.25		4.30	1.13	0.01
Fall (dry season)		9.85			
January, 1987	1.66				
February, 1987	1.29				
March, 1987	12.09		3.05	0.46	0.00
Winter		15.04			
Year		51.51			

[a]Primary Wet Season (June - September) - 21.70
Primary Dry Season (October - January) - 11.51
Secondary Wet Season (February - March) - 13.38
Secondary Dry Season (April - May) - 4.92

followed by the normal dry season pattern which typically occurs during the third quarter (October, November and December).

Antecedent rainfall accumulations during a 2-week period prior to each quarterly event as well as 2-month and 2-day antecedent accumulations are given in Table 4.1. Prior to the first, second and third quarterly events (June, September and December), 1.91, 3.26 and 1.13 inches of rainfall were recorded on the Palmer Ranch, respectively. However, only 0.46 inches of rainfall was recorded during the 2-week period prior to the fourth quarterly event (March) even though this period is subject to being wet.

4.1.2 Stream Stage

Quarterly measurements of water depth at each sampling station are tabulated in Appendix Table A-1. Maximum stream depths were recorded in South Creek at its lowermost station, Station SC-8 (3.5 feet), followed by Station NC-6 (2.7 feet) in the North Creek Basin. Although Trunk Ditch exhibits the deepest waters of any stream on the ranch, e.g. approximately 8 feet near its center, Station CC-4, which is in the littoral zone, exhibited an average depth of 1.5 feet. Minimum stream depths were recorded in the upper reaches of South Creek at Stations SC-1 and SC-4 and in Elligraw Bayou at Station EL-1A.

During the first quarterly event, low water conditions prevailed as four stations were dry (Stations EL-1A, SC-2, SC-3, and SC-7). During the second quarterly event, which occurred near the end of the wet season, all sampling stations were inundated as maximum depths were observed. As evidenced by the results given in

Appendix Table A-1, stream stage declined during the third quarter in association with low rainfall during the dry season and subsequently increased during March.

4.1.3 Stream Flow

As shown in Appendix Table A-2, measurable flows were recorded in 34 of the 52 total observations (65 percent) during the third year of monitoring as compared with only 12 of the 26 total observations (46 percent) during the second year of monitoring. Although flow was not measured during the first or second quarters of the second year, 8 more observations of flow were observed during the second half of the third year than during the same period of the second year. Of significance, dry stream beds prevailed during the first quarter of the second year precluding sampling (T. Goodell, personal communication). The higher frequency of observed flow during the third year is attributed to a normal amount of annual rainfall, i.e. 52 inches, as compared with drought conditions in which only 33 inches were recorded on the Palmer Ranch during the second year (CCI, 1986).

As evidenced by the results given in Appendix Table A-2, stream flows during the first quarterly survey were the lowest recorded whereas those observed during the second quarterly survey were the highest recorded during the third year. As expected, such seasonal trends should be expected since they reflect the typical seasonal patterns in rainfall. During the wet season, more runoff occurred resulting in increased stream flow. During the dry season, less runoff occurred resulting in decreased stream flow.

As observed during both the second and third year, it is apparent that shallow sills, weirs and other impediments to flow have caused stagnant or non-flowing conditions in various stream segments of the ranch. Such conditions were frequently observed at the southern-most end of Trunk Ditch (Station NC-6) as well as in its realigned segment (Station CC-4). As previously discussed, the two weirs located in the realigned segment of Trunk Ditch have caused lentic conditions in the vicinity of Station CC-4 and a shallow sill near Station NC-6 has resulted in stagnant conditions at the juncture with the North Creek Basin. Such low-flow conditions are exacerbated by droughts and low water levels. Other stream segments were found to exhibit little or no flow during the third monitoring year. These included Elligraw Bayou (Station EL-1A), the uppermost tributary to Trunk Ditch (Station CC-2), and the eastern branch of South Creek (Station SC-3).

During the third year, recorded stream flows in Catfish Creek ranged 0 - 513 gpm in its upper reaches (CC-1 and CC-2), 0 - 108 gpm in its mid reach (CC-3 and CC-4), and 8 - 187 gpm at the point of outflow from the North Tract. During this same period, South Creek exhibited a range of 0 - 1000 gpm in its upper reaches and 0 - 1400 gpm in its mid reach. Minimal flows were observed in Elligraw Bayou and at the juncture of Trunk Ditch with the North Creek Basin as evidenced in their ranges of 0 - 36 gpm and 0 - 44 gpm, respectively.

4.2 Physical Water Quality Parameters

4.2.1 Water Temperature

Appendix Table A-3 presents the temperature measurements acquired during the third year of monitoring. Results showed that the streams of the North Tract ranged from 17.3 to 33.5°C, slightly higher than the range of 17.7 to 28.5°C recorded during the second year of monitoring.

As expected, the lowest water temperatures were recorded in the streams of the North Tract during the quarterly events performed on December 3-4 and March 4-5 and the highest water temperatures were recorded during the quarterly event performed on September 3-4. During the first event, temperatures averaged 27.3°C while during the second event, a slightly higher average of 28.9°C was observed. Average temperatures declined to 20.4 and 19.1°C during the third and fourth quarterly events, respectively.

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

4.2.2 Specific Conductance

As evidenced in Appendix Table A-4, the streams of the North Tract exhibited a range in specific conductance of 422 - 1,406 micromhos per centimeter (umhos/cm) as compared with a higher range of 413 - 1,809 umhos/cm during the previous year. The general decline in conductivity during the third year is attributed to an increase in the annual rainfall from 33 inches during the second year to 52 inches during the third year. During the second year, which was an extremely dry year, runoff of low conductivity stormwater was minimal. However, runoff increased during the third year resulting in a general decline in the conductivity of the receiving streams.

Seasonally lower conductivities, as noted in the range of 532 - 1,138 umhos/cm, were recorded during the second quarterly survey of the third year. These lower conductivities most likely resulted from the cumulative effects of increased surface runoff of low conductivity stormwater during the summer wet season.

In a comparison of streams within the Palmer Ranch, South Creek exhibited higher conductivities than the other three streams during the third year of monitoring. Likewise, South Creek exhibited higher conductivities than the other streams during the first and second years of monitoring (Palmer Venture, 1986 and CCI, 1986). During the third year, conductivities averaged 978 umhos/cm in South Creek while conductivities in Catfish Creek and Trunk Ditch averaged 730 umhos/cm. An average conductivity of 747 umhos/cm was recorded at the Trunk Ditch juncture with the North Creek Basin while conductivity in Elligraw Bayou averaged 765 umhos/cm.

Within the two major basins of the North Tract, there were no apparent spatial trends observed in conductivity during the third year (Appendix Table A-4). In Catfish Creek and Trunk Ditch, conductivities in the upper reaches averaged 632 umhos/cm, slightly less than in the mid and lower reaches which averaged 811 and 730 umhos/cm, respectively. In the South Creek Basin, upstream conductivities in the western branch averaged 1,163 umhos/cm as compared to lower mid-reach conductivities which averaged 879 umhos/cm. Similarly, conductivities in the eastern branch averaged 846 umhos/cm.

In comparing and evaluating background levels with respect to the applicable State criteria, it is important to note that the threshold level of 1,275 umhos/cm was exceeded on several occasions during the third year. The specific conductance criteria applicable to the streams of the Palmer Ranch allows an increase of not more than 50 percent above background levels to a maximum level of 1,275 umhos/cm. In the South Creek Basin at Station SC-1, observations of conductivity exceeded this threshold in two of the four measurements. Other stations in the South Creek Basin including SC-2 and SC-4 approached the threshold on several occasions.

The Sarasota County criteria for specific conductance (Ordinance No. 72-37) is similar but more stringent than the State criteria in that it allows up to a 100 percent increase above background but to a maximum level of 500 umhos/cm in freshwater streams. Therefore, the streams of the Palmer Ranch were generally out of compliance with the County criteria during the third year since they are considered to be freshwater.

4.2.3 Total Suspended Solids

During the third year of monitoring, the streams of the Palmer Ranch exhibited a range in total suspended solids (TSS) of 1 - 57 mg/l and a yearly average of approximately 15 mg/l (Appendix Table A-5). The highest TSS levels were recorded in the mid-reach of Catfish Creek (CC-3 and CC-4), the juncture of the North Creek Basin and Trunk Ditch (NC-6), and Elligraw Bayou (EL-1A). The lowest TSS levels were recorded in the uppermost reach of Catfish Creek (CC-1) and in the South Creek Basin with the exception of Station SC-1.

Also during the third year of monitoring, TSS exhibited a general declining trend. During the first quarterly event (June 1986), the highest TSS levels of the year averaging 26 mg/l were observed. These elevated levels were particularly evident in the middle segments of the basins and might have resulted from high rates of runoff and import of particulates associated with a recent storm event, i.e. 0.56 inches during a 2-day period prior to sampling. It is possible that this storm event transported particulate matter from pastures and construction sites into the mid-segments of the streams. During the second quarterly event (September 1986), TSS averaged 15 mg/l, approximately 40 percent lower than during the first quarterly event. Approximately 0.11 inches of antecedent rainfall was recorded during a 2-day period prior to the second quarterly event. Even lower averages of 10 mg/l (each) were observed during the third and fourth quarterly events as rainfall accumulations during 2-day antecedent periods prior to the third and fourth quarterly events were insignificant, i.e. 0.01 inches or less.

During the second year of monitoring (CCI, 1986), the streams of the Palmer Ranch exhibited a much wider range in TSS (1 - 207 mg/l) and a higher yearly average (24 mg/l). Additionally, the highest TSS levels were recorded in the vicinity of the Prestancia construction site, i.e. Catfish Creek (CC-3), Trunk Ditch (CC-4), and Elligraw Bayou (EL-1A). These elevated TSS levels were attributed to Prestancia construction activities and the associated excavation in Trunk Ditch during the fourth quarter.

During the first year of monitoring, TSS was reported by Palmer Venture (1986) to be much lower than observed during the past two years of the monitoring program, perhaps as a result of low mass transport rates associated with drought conditions. Overall, the ranch showed a range of approximately 1 - 12 mg/l during the first year of monitoring.

4.2.4 Turbidity

Stream turbidities also followed a declining trend similar to that of TSS during the third year of monitoring. This declining trend was evidenced by a decrease from an average of 14.7 NTU during June 1986 to an average of 7.1 NTU during March 1987 (Appendix Table A-6). In September and December, intermediate averages of 9.8 and 8.3 NTU were observed. As previously discussed, there appears to be a direct correlation of turbidity with 2-day antecedent rainfall as well as a strong correlation with TSS (R = 0.85).

Overall, the streams traversing the North Tract exhibited a range in turbidity of approximately 1.2 to 36 NTU with an average of 9.6 NTU during the third year of the monitoring program (Appendix Table A-6). In comparison, Palmer Venture (1986) reported much lower turbidities (less than 6 NTU) during the first year of monitoring and CCI (1986) reported higher turbidities (1 to 61 NTU) during the second year of monitoring. Differences between the first and second year have been attributed to the drought and to the initiation of construction.

The General Criteria for all surface waters (F.A.C. 17-3) specifies that turbidity shall not exceed 29 NTU above natural background. Based on turbidity measurements taken during the monitoring program, natural background turbidity levels are expected to be less than 10 NTU although higher background turbidities might occur as a result of natural processes, e.g. organic decay and import of particulate matter via stormwater runoff. The high range in turbidity observed at Stations NC-6 (4 - 30 NTU), EL-1A (13 - 30 NTU), and CC-3 (15 - 36 NTU) during the third year, therefore, could be attributed to the import and decay of organic and particulate matter. However, since construction activities may have facilitated an increase in mass loading rates in the vicinity of Prestancia, it is possible that turbidities observed at Stations EL-1A and CC-3 approached the maximum allowable levels. Even so, there were no measurements during the third year of monitoring which are considered definite turbidity violations.

Sarasota County Ordinance (No. 72-37) allows a maximum increase of 25 Jackson units above background. Analysis of turbidity samples, however, were performed in accordance with F.A.C. 17-3 criteria which is based on the Nephelometric procedure. Therefore, a comparison of the turbidity results to the County criteria was not performed.

4.3 Oxygen Demand and Related Parameters

4.3.1 Biochemical Oxygen Demand

As shown in Appendix Table A-7, the 5-day biochemical oxygen demand (BOD) recorded in the streams of the North Tract averaged approximately 3.1 mg/l during the third year of the monitoring program. The two largest streams, South Creek and Catfish Creek, exhibited similar BOD levels. South Creek exhibited an average level of approximately 2.7 mg/l with a range of 0.4 - 7.1 mg/l and Catfish Creek exhibited an average level of approximately 2.8 mg/l with a range of 1.2 - 10.5 mg/l. In comparison, higher BODs were observed in Elligraw Bayou and at the Trunk Ditch juncture with the North Creek Basin as they averaged approximately 6.9 and 4.1 mg/l, respectively. According to Hynes (1966), a BOD of 3 mg/l is indicative of "fairly clean" water while a BOD of 5 mg/l is indicative of "doubtful" quality water. Therefore, South Creek and Catfish Creek generally exhibited fairly clean water but Elligraw Bayou exhibited doubtful water quality with respect to the BOD results.

During the second year of monitoring, a slightly higher average, 4 mg/l, was determined (CCI, 1986). Similar to the third year, South Creek and Catfish Creek exhibited BOD levels of approximately 3.5 mg/l whereas higher BODs of approximately 8 mg/l were observed in Elligraw Bayou and at the Trunk Ditch juncture with the North Creek Basin.

During the first year of monitoring, Palmer Venture (1986) reported an overall range in BOD of 1.2 - 8.9 mg/l. Catfish Creek and Trunk Ditch exhibited a range of 1.2 - 6.5 mg/l, and South Creek exhibited a range of 1.4 - 8.9 mg/l. In Elligraw Bayou and at the Trunk Ditch-North Creek juncture, BOD was reported to range 2 - 6 mg/l.

The General Criteria for BOD in all surface waters as designated by the F.A.C. 17-3, Rules and Regulations of the Department of Environmental Regulation, as well as Sarasota County Ordinance No. 72-37, specifies that BOD shall not be increased to levels that would result in violations of dissolved oxygen. BODs recorded in the streams traversing the North Tract occasionally exceeded 5 mg/l, a threshold level which Hynes (1966) considered to be "doubtful" or between "fairly clean" and "bad" water quality. During the third year of monitoring, 9 of the 47 BOD measurements exceeded 5 mg/l. Furthermore, it is possible that BODs in excess of 5 mg/l during periods of low flow and stagnation caused a significant lowering of dissolved oxygen levels, perhaps to non-compliance levels. Such non-compliance conditions are suspected to have prevailed at Stations CC-2, EL-1 and NC-6 during the third year of monitoring, and therefore, might be considered out of compliance with the General Criteria for BOD.

4.3.2 Dissolved Oxygen

Appendix Table A-8 gives the results of dissolved oxygen measurements acquired during the third year of monitoring. Overall, dissolved oxygen was found to average 6.1 mg/l with a range of 0.4 - 16 mg/l. Highest seasonal levels were recorded during early spring (March 1987), as dissolved oxygen averaged 8.4 mg/l. Lowest seasonal levels were recorded during late summer (September 1986) as dissolved oxygen averaged 4.7 mg/l.

Dissolved oxygen measurements acquired during the second year of monitoring were lower as evident in the ranchwide average of 4.0 mg/l and the overall range of 0.4 - 12.4 mg/l. Still, even lower dissolved oxygen levels were observed during the first year of monitoring (Palmer Venture, 1986) as 22 of the 38 measurements were less than 4 mg/l.

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

The oxygen regime in the streams of the North Tract ranged well below the 5 mg/l threshold specified by F.A.C. 17-3 and the 4 mg/l threshold specified by Sarasota County Ordinance 72-37 for predominantly freshwaters. Additionally, these criteria specify that normal daily and seasonal fluctuations be maintained as depicted by the diurnal surveys (CCI, 1987). Consequently, the North Tract streams were frequently out of compliance with both State and County criteria for dissolved oxygen. Non-compliance was particularly evident at Stations CC-1, CC-2, NC-6 and SC-7.

4.3.3 pH

Results of pH monitoring are given in Appendix Table A-9. During the third year, the streams of the Palmer Ranch exhibited pH levels in the range of 6.7 - 9.8. Ranchwide, the lowest pH levels were observed at the juncture between Trunk Ditch and the North Creek Basin (NC-6) whereas the highest pH levels were recorded in South Creek (SC-1) and Elligraw Bayou (EL-1A). Seasonally, pH was found to be highest during the first quarterly event (June 1986) and lowest during the fourth quarterly event (March 1987). These differences are attributed to spatial and seasonal differences in community metabolism.

Differences or changes in pH are indicative of the effects of net community metabolism on the level of carbon dioxide and pH. During periods of net community respiration, carbon dioxide is produced faster than it is assimilated by the primary producers, thereby depressing pH as a result of its reaction with water to form carbonic acid. In contrast, carbon dioxide is consumed faster than it is produced during periods of net community primary production, thereby increasing pH. Therefore, pH typically exhibits a diel trend of increases during the day and decreases during the night. The amplitude of the cycle depends on the rates of production and consumption and to a lesser extent the buffering capacity of the water (alkalinity) and atmospheric exchange of carbon dioxide.

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

During the first and second years of monitoring, Palmer Venture (1986) and CCI (1986) reported ranges in pH of 6.3 - 8.4 and 6.0 - 8.1, lower than the range of 6.7 - 9.8 recorded during the third year. Evidently, net primary productivity attained highest rates during the third year of monitoring.

As specified in the General Criteria for all surface waters (F.A.C. 17-3) and in the Sarasota County Ordinance No. 72-37, the allowable variation in pH is 1.0 unit above or below the normal pH provided that the pH is not lowered or elevated outside the range of 6 to 8.5. Additionally, if natural background is less than 6, 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 third year of monitoring, the observed range in pH (6.7 - 9.8) partially fell outside the allowable range of 6.0 - 8.5. As previously mentioned, the high pH observations occurred at Stations SC-1 and EL-1A, and are attributed to sustained or high rates of net primary production in which carbon dioxide is depressed to low concentrations. All other measurements taken during the third year were found to be within the established criteria for pH.

4.4 Macronutrients

4.4.1 Total Nitrogen

Appendix Table A-10 provides the results of total nitrogen measurements acquired during the third year of monitoring. Similar to the results of the second year, Elligraw Bayou and the eastern branch of South Creek exhibited higher total nitrogen levels than observed in the other streams or stream segments of the North Tract. In Elligraw Bayou and in the eastern branch of South Creek, total nitrogen levels averaged 3.25 and 4.03 mg/l, respectively, while lower averages were observed in the western branch of South Creek (2.01 mg/l), Catfish Creek (1.29 mg/l), and at the Trunk Ditch juncture with the North Creek Basin (2.05 mg/l). Overall, total nitrogen levels averaged 1.9 mg/l as compared with a higher average of 2.6 mg/l during the previous year of monitoring.

The largest fraction of total nitrogen observed during the third year of monitoring occurred in the form of organic nitrogen.

Organic nitrogen represented approximately 82 percent of the total and averaged 1.56 mg/l (as N). The second most abundant form of nitrogen was ammoniacal nitrogen (ionized plus non-ionized ammonia) which represented approximately 13 percent of the total with an average level of 0.25 mg/l (as N). Nitrate represented approximately 4 percent of the total with an average level of 0.07 mg/l (as N). As expected, the smallest fraction of total nitrogen was found to be nitrite which represented < 1 percent of the total.

In comparison, CCI (1986) reported a comparable breakdown of total nitrogen during the second year of the monitoring program. The largest fraction of total nitrogen observed during the second year of monitoring occurred in the form of organic nitrogen. Organic nitrogen represented approximately 85 percent of the total and averaged 2.2 mg/l (as N). The second most abundant form of nitrogen was ammoniacal nitrogen which represented approximately 11.5 percent of the total with an average level of 0.3 mg/l (as N). Nitrate represented approximately 3 percent of the total with an average level of 0.06 mg/l (as N). As during the third year, the smallest fraction of total nitrogen was found to be nitrite which represented < 1 percent of the total.

During the first year monitoring, however, Palmer Venture (1986) reported a significantly different breakdown and a substantially lower total nitrogen (0.8 mg/l) than during the second and third years of monitoring (2.6 and 1.9 mg/l). During the first year, total nitrogen averaged 69 percent organic nitrogen, 8 percent ammonia-nitrogen, 23 percent nitrate-nitrogen, and < 1 percent nitrite-nitrogen. The lower total nitrogen during the first year versus the second and third years can not be explained based on the available information. Also, it is not completely understood why nitrate levels exceeded ammonia levels during the first year since nitrate is normally assimilated by denitrifying bacteria under conditions of depressed oxygen levels, a condition which prevailed during the first year.

As specified in F.A.C. 17-3, nutrients including total nitrogen shall not be elevated to levels causing an imbalance in the natural flora and fauna, a condition characteristic of eutrophic streams. In this respect, there were some implications in the data acquired during the second and third monitoring years which linked the observed total nitrogen levels to eutrophic conditions. Results showed that total nitrogen generally exceeded the threshold concentration defined by FDER (1983) to be characteristic of eutrophic conditions, i.e. greater than 1.2 mg/l. As previously discussed, violations in dissolved oxygen perhaps resulted from the growth and decay of excessive amounts of vegetation associated with the readily available nutrients.

4.4.2 Nitrite

Nitrite levels observed in the streams of the Palmer Ranch during the third year of monitoring are provided in Appendix Table A-11. As expected, nitrite concentrations throughout the streams traversing the North Tract were much lower than the other nitrogen constituents, and too low to be a significant nutrient source. Overall, nitrite observations averaged 0.01 mg/l (as N) with a range of < 0.01 - 0.10 mg/l (as N) as compared with the previous year in which nitrite averaged 0.02 mg/l (as N) and ranged < 0.01 - 0.13 mg/l (as N).

Although there were no apparent temporal trends, South Creek exhibited a noteworthy trend as evidenced by its slightly higher nitrite levels as compared to other streams of the North Tract. This was particularly evident in the eastern tributary of South Creek (Station SC-7) and downstream below its confluence with the main channel of South Creek (Station SC-2) as nitrite averaged 0.04 and 0.05 mg/l, respectively. A similar condition of elevated nitrites was observed at these two stations during the second year of monitoring and is attributed to a source of nitrite upstream of the ranch, perhaps the dairy.

During the first year of monitoring (Palmer Venture, 1986), nitrite was reported to range < 0.01 - 0.05 mg/l (as N), similar to the results observed during the second year of monitoring.

As a nutrient, nitrite is considered to be a water quality standard (F.A.C. 17-3). Due to the observed low concentrations, however, nitrite was found to be of little importance as a nutrient in the streams of the Palmer Ranch. For all practical purposes, therefore, nitrite is considered to meet desired standards.

4.4.3 Nitrate

As shown in the results provided in Appendix Table A-12, nitrate levels observed in the streams traversing the North Tract exhibited a yearly average of 0.07 mg/l with a range of < 0.01 - 0.54 mg/l (as N). These results are similar to the previous year in which nitrate averaged 0.06 mg/l and ranged < 0.01 - 0.42 mg/l. In contrast to the previous year, the lowest nitrate levels, averaging 0.01 mg/l (as N), were recorded at the end of the growing season (September 1986) followed by an average of 0.03 mg/l during June 1986. During the fall quarterly survey (December 1986), nitrate peaked at an average level of 0.13 mg/l (as N) and declined slightly in March 1987 to an average of 0.11 mg/l (as N). This temporal trend is attributed to higher rates of nitrate assimilation by the primary producers during the summer growing season (June - September) than during the fall and winter seasons.

Ranchwide, the eastern branch of South Creek and its downstream receiving waters exhibited the highest nitrate levels during the third monitoring year, averaging 0.31 mg/l (as N) at Station SC-7 and 0.14 and 0.12 mg/l at Stations SC-2 and SC-8, respectively. The western branch of South Creek and all stations except the uppermost station in the Catfish Creek/Trunk Ditch Basin exhibited much lower nitrate levels, i.e. approximately 0.03 mg/l (as N). The uppermost station on Catfish Creek (CC-1) was moderately high as it averaged 0.20 mg/l.

Low nitrate levels were also recorded at the juncture of Trunk Ditch and the North Creek Basin as evidenced by the yearly average of 0.03 mg/l. This juncture is normally stagnant and anaerobic, consequently, nitrate import is expected to be low. Furthermore, nitrate reduction and denitrification are expected to prevail under the observed conditions of depressed oxygen levels, thereby reducing nitrate concentrations to minimal levels. The eastern branch of South Creek, on the other hand, receives drainage from a potential nitrate source, i.e. dairy farm.

The effect of the nitrate sources in the eastern branch of South Creek and in the headwaters of the Catfish Creek/Trunk Ditch Basin was also observed during the second monitoring year (CCI, 1986).

As a nutrient, nitrate is designated as a general water quality standard, and is a potentially limiting nutrient in the streams of the Palmer Ranch. Therefore, increases in its availability are subject to accelerate production rates of aquatic plants and, in turn, result in an imbalance in the flora and fauna.

4.4.4 Ammoniacal Nitrogen

Appendix Table A-13 provides the results of ammoniacal nitrogen measurements (ionized plus non-ionized ammonia) recorded during the third year of monitoring. Relative to the observed concentrations of nitrate, ammoniacal nitrogen concentrations were higher indicating that it is a potentially important nutrient source in the streams of the Palmer Ranch but perhaps preferred less than nitrate. This is evidenced by the high annual average of 0.25 mg/l (as N). Overall, ammoniacal nitrogen exhibited a wide range of 0.04 - 3.32 mg/l (as N) as compared to nitrate which ranged < 0.01 - 0.54 mg/l (as N).

Ammoniacal nitrogen levels recorded in the streams of the North Tract during the third year were similar except for those recorded in the eastern tributary of South Creek (Appendix Table A-13). Catfish Creek, the juncture of Trunk Ditch and the North Creek Basin, and Elligraw Bayou all exhibited similar averages of 0.12, 0.16, and 0.16 mg/l (as N), respectively. In South Creek, however, a much higher average of 0.41 mg/l (as N) was found primarily as a result of the higher ammoniacal nitrogen levels observed in the eastern tributary. The eastern tributary of South Creek, as previously discussed, receives dairy farm drainage which is a potential source of ammoniacal nitrogen. The effect of the ammonia source was observed downstream as a level of 0.48 mg/l (as N) was recorded at the downstream boundary of the North Tract (SC-2) in comparison to the average level of 1.81 mg/l (as N) at its point of inflow into the North Tract. However, the effects were not evident further downstream (SC-8) as an average concentration of 0.08 mg/l (as N) was observed at Station SC-8. During the first and second years of monitoring (Palmer Venture, 1986 and CCI, 1986)), maximum levels of ammoniacal nitrogen were also found in the eastern tributary of the South Creek Basin.

Ammoniacal nitrogen is a nutrient, and therefore, considered by F.A.C. 17-3 as a criteria of surface water quality. As in the case of nitrate, increases in ammonia have the potential to accelerate eutrophication, and, in turn, result in an imbalance in the flora and fauna of the streams traversing the Palmer Ranch. Since the non-ionized fraction of ammoniacal nitrogen was not evaluated independently, comparisons to County and State criteria for non-ionized ammonia were not performed.

4.4.5 Organic Nitrogen

Concentrations of organic nitrogen (total Kjeldahl nitrogen less ammoniacal nitrogen) in the streams traversing the Palmer Ranch (Appendix Table A-14) increased to maximal levels during the summer then declined steadily during the fall and winter. During June 1986, ranchwide organic nitrogen levels averaged 1.59 mg/l and increased to 1.77 mg/l during September 1986. In December 1986, organic nitrogen declined to an average of 1.47 mg/l and further declined to an average of 1.42 mg/l during March 1987. It is possible that the peak concentration in September was associated with the peak standing crop of aquatic vegetation as well as maximal stormwater loadings of organic detritus. This is supported by the positive correlation of organic nitrogen and total suspended solids (R = 0.52) and the positive correlation of organic nitrogen and BOD (R = 0.58). During the fall and winter, stormwater loadings and standing crops of vegetation declined possibly resulting in concomitant declines in organic nitrogen.

Overall, organic nitrogen exhibited an annual average of 1.56 mg/l as compared with a higher average of 2.21 mg/l during the second year of the monitoring program.

During the first year of monitoring, organic nitrogen was reported to average 0.6 mg/l, somewhat less than observed during the second and third years of monitoring (Palmer Venture, 1986).

Organic nitrogen may be considered a nutrient standard (F.A.C. 17-3) since it is assimilated by microbial heterotrophs, used as an energy source as well as a source of nitrogen, and potentially recycled as an inorganic nutrient to be assimilated by vegetation and other autotrophs. In comparison of the third year average to FDER's eutrophication threshold of 1.2 mg/l (1983), it is apparent that the streams of the Palmer Ranch are indicative of eutrophic conditions with respect to organic nitrogen.

4.4.6 Total Phosphate

Total phosphate in the streams of the Palmer Ranch exhibited a yearly average of 0.47 mg/l (as P) and a range of 0.07 - 2.86 mg/l (as P) during the third year of the monitoring program (Appendix Table A-15). An annual peak was recorded during September 1986 as total phosphate averaged 0.60 mg/l. During December 1986 and March 1987, total phosphate gradually declined to average levels of 0.55 and 0.37 mg/l (as P). The lowest seasonal levels were recorded during the first quarterly survey (June 1986) as total phosphate averaged 0.31 mg/l (as P).

Ranchwide, the highest total phosphate levels were recorded in the South Creek Basin, apparently originating from an upstream source. The eastern tributary of South Creek, which received drainage from a dairy farm, exhibited the highest total phosphate levels averaging 1.72 mg/l (as P). Downstream, total phosphate averaged 1.19 mg/l (as P) at the point of outflow from the North Tract, and 0.51 mg/l (as P) further downstream of the North Tract. The effects of this phosphate source were most pronounced during December 1986 as the inflowing concentration was 2.86 mg/l (as P).

High total phosphate levels were also observed in Elligraw Bayou as evidenced by the yearly average of 1.13 mg/l (as P). Correspondingly high levels of total nitrogen, organic nitrogen, BOD, turbidity, and total suspended solids were also observed in Elligraw Bayou. Such conditions of high phosphate levels as well as other related parameters are attributed to the combined effects of stormwater loadings, low flows and the decay of vegetation.

During the second year of the monitoring program, Total Phosphate in Palmer Ranch's streams were higher as evidenced by the average of 1.0 mg/l (as P) and by the wider range of 0.08 - 6.4 mg/l (as P). As observed during the third year of monitoring, high total phosphate levels were recorded in Elligraw Bayou concurrently with high levels of total nitrogen, organic nitrogen, BOD, turbidity and total suspended solids. Likewise, high total phosphate levels were recorded in the eastern branch of South Creek.

Similarly, Palmer Venture (1986) reported a range in total phosphate of 0.1 - 4.7 mg/l (as P) during the first year, and the eastern tributary of South Creek was found to exhibit the highest total phosphate levels. This upstream source of phosphate exhibited its effects as far downstream in South Creek as Station SC-8.

As a nutrient, phosphate is required by algae and other autotrophic organisms for the primary production of organic matter and, therefore, as specified in F.A.C. 17-3, shall not be elevated to levels which will cause an imbalance in the natural flora and fauna. By definition, the results of the third year of monitoring shows that the observed total phosphate levels in the streams of the Palmer Ranch exceeded the FDER threshold of 0.05 mg/l and, therefore, are indicative of eutrophic conditions and an imbalance in the flora and fauna (FDER, 1983).

In many cases such levels are normal in west-central Florida because of the widespread deposits of naturally occurring phosphate. Of significance, well drillers logs show that phosphates exist in shallow deposits on the Palmer Ranch (Patton and Associates, 1984). In addition, Palmer Venture (1986) noted that the phosphate levels in the streams of the Palmer Ranch were significantly influenced by phosphate enriched groundwater during periods when stream flow was augmented by groundwater exfiltration, i.e., low flow conditions. Consequently, the high levels of phosphate which have resulted from the naturally occurring deposits within or upstream of the Palmer Ranch should not be considered violations.

4.4.7 Orthophosphate

As evidenced in Appendix Table A-16, orthophosphate was found to average 0.29 mg/l (as P), representing approximately 62 percent of the total phosphate during the third year of monitoring. Overall, orthophosphate exhibited a range of < 0.01 - 2.86 mg/l (as P) as compared to higher ranges of 0.1 - 4.3 mg/l (as P) during the first year of monitoring (Palmer Venture, 1986) and < 0.02 - 5.5 mg/l (as P) during the second year of monitoring (CCI, 1986).

During the third year of monitoring, an apparent spatial trend in orthophosphate showed that there is a significant source of phosphate in the headwaters of the South Creek Basin. This upstream nutrient source affects the eastern tributary of South Creek as orthophosphate was found to average 1.61 mg/l (as P) at the point of inflow into the North Tract, i.e. Station SC-7. Downstream, South Creek exhibited the effects of this source of phosphates as averages of 1.12 and 0.34 mg/l (as P) were found at Stations SC-2 and SC-8, respectively. This general decline is attributed to a combination of dilution and phosphate uptake by biological and physicochemical processes. During the first and second years of monitoring, Palmer Venture (1986) and CCI (1986) also evidenced this upstream orthophosphate source in South Creek.

As a nutrient, orthophosphate is designated by F.A.C. 17-3 as a general water quality criteria. This criteria specifies that the discharge of nutrients, such as orthophosphate, shall be limited to prevent an imbalance in the natural populations of aquatic flora and fauna. Although the observed levels are indicative of eutrophic conditions as defined by FDER (1983), orthophosphate has been found to occur naturally on the North Tract. Consequently, other factors are probably more growth limiting than phosphate and any further increase in its availability is less likely to cause an imbalance in the aquatic flora and fauna.

4.4.8 Nutrient Ratios

Nitrate and phosphate are required in proportions of approximately 16:1 (N:P) as illustrated (Odum, 1959) in the following equation:

Inorganic Constituents			Algal Protoplasm
106 CO_2	Light	Heat	106 C
90 H_2O			180 H
16 NO_3	Production Decomposition		46 O
1 PO_4			16 N
Mineral Elements	Heat	Chemical energy	154 O_2

In these proportions, they are assimilated by the primary producers (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.

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.

Results of the third year of monitoring were used to determine the atomic ratios of nitrogen to phosphorus in the streams of the Palmer Ranch. Total nitrogen to total phosphorus ratios ($N_t:P_t$) are provided in Appendix Table A-17 and ratios of inorganic nitrogen (ammonia, nitrite, and nitrate as N) to orthophosphorus ($N_i:P_i$) are provided in Appendix Table A-18. Estimates of the $N_i:P_i$ ratios were generally low and found to average 10:1, indicative of conditions in which fixed inorganic nitrogen would generally limit plant growth before orthophosphate. In comparison, $N_t:P_t$ ratios were found to average 15:1, approaching a balanced ratio of 16:1, indicative of organic detritus. The lower $N_i:P_i$ ratio is attributed to the naturally high levels of orthophosphate, as well as its high percentage of total phosphorus (62 percent of total phosphorus). The nearly balanced $N_t:P_t$ ratio is expected under conditions in which organic nitrogen, i.e. plant protoplasm, is the predominant form of total nitrogen. As previously noted, organic nitrogen was found to average 82 percent of the total nitrogen in the streams of the Palmer Ranch.

The more 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 third year of monitoring, seasonal averages of the $N_i:P_i$ ratio approached balanced conditions during June and March but not during September and December. During September and December, $N_i:P_i$ ratios averaged approximately 5.5:1; however, during June and March, they averaged approximately 13.5:1. Ranchwide, the Catfish Creek/Trunk Ditch Basin exhibited a balanced yearly average of 16:1 whereas the South Creek Basin was low, averaging 4:1. Perhaps the balanced ratio observed in the Catfish Creek/Trunk Ditch Basin resulted from the runoff of fertilizers from the adjacent golf courses.

4.5 Trace Elements

4.5.1 Arsenic

Arsenic levels in the streams traversing the Palmer Ranch (Appendix Table A-19) occurred at levels below the analytical detection limit of 0.005 mg/l during September 1986 showing that the Palmer Ranch streams were in compliance with the applicable F.A.C. 17-3 General Criteria of 0.05 mg/l and in compliance with the more stringent County criteria of 0.01 mg/l.

During the previous year of monitoring (CCI, 1986), arsenic levels in the streams of the Palmer Ranch ranged at higher concentrations of < 0.005 - 0.012 mg/l. Still, only one observation was found to be out of compliance with the more stringent County criteria of 0.01 mg/l and all observations were well within the State criteria of 0.05 mg/l.

4.5.2 Cadmium

Cadmium was found to range < 0.0008 mg/l - 0.0023 mg/l in the streams of the Palmer Ranch during September 1986 (Appendix Table A-19). These results are similar to the range of <0.0008 - 0.0034 mg/l reported by CCI (1986) during the second year of monitoring. During the third monitoring year, exceedences of the State criteria of 0.0012 mg/l were recorded upstream in South Creek near a point of inflow into the North Tract (Station SC-3) and downstream in Catfish Creek at the point of outflow from the North Tract (Station CC-5). A level of 0.0023 mg/l was recorded at Station CC-5 which receives drainage from Clark Road and its adjacent commercial/light industrial developments as well as two golf courses. The other non-compliance observation of 0.0018 mg/l was recorded at Station SC-3 which receives upstream drainage from a golf course and mobile home park. With respect to the less stringent County criteria, all cadmium observations were found to be in compliance with the maximum allowable level of 0.01 mg/l.

During the previous monitoring year, cadmium ranged < 0.0008 mg/l - 0.0034 mg/l in the streams of the Palmer Ranch (CCI, 1986). Non-compliance levels with respect to State criteria were recorded in South Creek at points of inflow into the North Tract, i.e. Stations SC-3 and SC-7.

4.5.3 Chromium

The applicable State water quality criteria for total chromium (F.A.C. 17-3) allows a maximum concentration of 0.05 mg/l while Sarasota County Ordinance No. 72-37 allows a maximum of 0.02 mg/l. As evidenced in Appendix Table A-19, the North Tract streams were not found to be out of compliance with either criteria during September 1986, as all observations of total chromium were less than the detection limit of the analytical procedure, i.e., 0.05 mg/l. CCI (1986) reported the same results for the second year of the monitoring program.

4.5.4 Copper

As shown in Appendix Table A-19, the streams of the Palmer Ranch exhibited concentrations of copper below the analytical detection limit of 0.01 mg/l during September 1986 and all 13 measurements were in compliance with the State criteria of 0.03 mg/l (F.A.C. 17-3). Additionally, all 13 measurements complied with the County criteria of 0.01 mg/l. During the second monitoring year, CCI (1986) reported that copper exceeded the County criteria.

4.5.5 Lead

The streams of the Palmer Ranch were found to be in compliance with the State criteria of 0.03 mg/l for lead as all 13 analyses performed during September 1986 showed less than detectable concentrations of 0.02 mg/l (Appendix Table A-19).

During the second year of the monitoring program, lead in the streams of the Palmer Ranch was found to be in compliance except in the headwaters of South Creek where a lead concentration of 0.05 mg/l was recorded (CCI, 1986). The headwaters of the South Creek Basin receive drainage from two possible sources of lead, a mobile home park and a golf course located upstream of the North Tract.

During the first year of the monitoring program when lead was monitored more frequently than during the past two years, i.e. bimonthly versus annually, a total of 38 measurements were made of which 12 exceeded the State criteria of 0.03 mg/l (Palmer Venture, 1986).

4.5.6 Mercury

As shown in Appendix Table A-19, the streams of the Palmer Ranch were found to exhibit mercury concentrations below the detection limit of 0.0001 mg/l at 12 of the 13 sampling sites and a barely detectable concentration of 0.0001 mg/l at the upstream boundary on Catfish Creek (Station CC-1). All 13 measurements complied with the appropriate water quality criteria.

During the second monitoring year, 3 of the 13 sampling sites on the Palmer Ranch were found to exhibit mercury concentrations in excess of the State standard of 0.0002 mg/l (CCI, 1986). The exceedences were recorded in Catfish Creek at Station CC-1, in Elligraw Bayou at Station EL-1, and in North Creek at Station NC-6 where levels of up to 0.0004 mg/l were reported. These exceedences were attributed to possible sources of mercury on and adjacent to the Palmer Ranch including rain and dust fallout, commercial and industrial drainage along Clark Road, golf course drainage, and drainage from sludge waste disposal sites.

4.5.7 Nickel

The streams of the Palmer Ranch exhibited nickel levels of 0.031 mg/l or less during September 1986 as compared to the maximum allowable level of 0.1 mg/l (Appendix Table A-19). Therefore, all 13 observations were found to be in compliance with both State and County standards for nickel.

Likewise, the streams of the Palmer Ranch exhibited nickel levels in compliance with the State and County standards during September 1985 (CCI, 1986) as evident in the reported range of < 0.01 - 0.02 mg/l.

4.5.8 Zinc

The streams of the Palmer Ranch exhibited a range in zinc of < 0.005 mg/l to 0.014 mg/l during September 1986 (Appendix Table A-19). As shown in the results, one of the 13 measurements barely exceeded the County standard of 0.01 mg/l but none exceeded the less stringent State standard of 0.03 mg/l. This observation (0.014 mg/l) was recorded at the upstream property boundary on Catfish Creek (Station CC-1) and is attributed to non-point sources along Clark Road, e.g. roadside drainage from the adjacent commercial and light industrial developments.

During the second monitoring year, the streams of the Palmer Ranch exhibited a range in zinc of less than 0.005 mg/l to 0.036

mg/l as one of the 13 measurements exceeded the State standard of 0.03 mg/l and five of the 13 measurements exceeded the more stringent County standard of 0.01 mg/l. These exceedences were attributed to rain and dust fallout and drainage from sewage sludge disposal sites.

4.6 Organic Constituents

4.6.1 Oils and Greases

As given in Appendix Table A-20, oils and greases in the streams of the Palmer Ranch were found to range from below the analytical detection limit of 1 mg/l up to a maximum of 17 mg/l. Three of the 47 measurements during the past year of monitoring exceeded the State standard of 5 mg/l and one exceeded the County standard of 15 mg/l. These exceedences were observed at Stations CC-1, CC-2 and CC-3 in the upper reaches of the Catfish Creek/Trunk Ditch Basin during June 1986 where levels of 13, 10 and 17 mg/l were recorded, respectively. All other measurements during the third year of monitoring were found to comply with State and County criteria as exhibited in their range of < 1 - 3 mg/l.

The three exceedences of State standards including the single exceedence of the County standard during the third year are attributed to sources of oils and greases upstream of the Palmer Ranch and possibly to sources on the ranch. Of significance, 0.56 inches of rainfall occurred during a two-day period immediately prior to the June sampling event when all three exceedences were recorded. Runoff, therefore, could have contributed to the elevated oils and greases in the upper reaches of the basin. Of possible significance, June is the beginning of the wet season when greater rates of stormwater loadings might be expected due to accumulations of oils and greases in the watershed, e.g. on paved surfaces such as Clark Road and adjacent parking/loading areas in the upper parts of the Catfish Creek/Trunk Ditch Drainage Basin. Therefore, it is possible that runoff from Clark Road as well as runoff from the immediate surroundings contributed to these elevated concentrations. Weirs located along the realigned segment of Trunk Ditch, however, may have prevented the increased transport of oils and greases downstream to Stations CC-4 and CC-5.

The concentrations of oils and greases reported in the streams of the Palmer Ranch during the first and second years of the monitoring program (Palmer Venture, 1986, and CCI, 1986), ranged from less than 1 mg/l to 15 mg/l. Most of the observations (71 of 74) were found to be less than the maximum allowable State criteria of 5 mg/l and none were found to be greater than the maximum allowable County criteria of 15 mg/l.

4.6.2 Organochlorine Pesticides

Results of the 13 organochlorine pesticide scans (including polychlorinated biphenyls, i.e., PCBs) which were performed during September 1986, are provided in Appendix Table A-21. These results show that the streams traversing the Palmer Ranch were less than the EPA recommended detection limits for all parameters except Endosulfan which was found to exceed the State Class III water quality criteria of 0.003 ug/l at four of the 13 monitoring stations on the Palmer Ranch. Of possible significance, these four stations (CC-2, NC-6, SC-4, and SC-8) are located in three different drainage basins which would indicate that the source of contamination was ubiquitous, i.e. aerial spraying. (Endosulfan is a miticide and insecticide used on various types of plants including ornamentals, citrus, tomatoes, strawberries, beans and forestry trees).

In an effort to identify possible sources, Sarasota County Mosquito Control was contacted (Dr. Ray Parsons, personal communication) to determine if they had used Endosulfan recently in the area of the Palmer Ranch. However, it was learned that Endosulfan had not been used by Mosquito Control.

Subsequently, Sarasota County Agricultural Extension Service was contacted (Mr. Bob Meyer, Ms. Jo Duranceau and Mr. Luther Rozar, personal communication) although they had no specific knowledge of any recent use of Endosulfan in Sarasota County.

In reviewing an aerial map of the immediate surroundings, it is evident that numerous citrus groves exist to the north and northeast of the Palmer Ranch. Normally, citrus groves are sprayed several times during the year including the summer season. Furthermore, Endosulfan (sold under the trademark or generic names as Thiodan, Chlorthiepin, Malix, Thionex and Cyclodan) is readily available and sold locally even though it might be restricted. Therefore, it is possible that Endosulfan originated from aerial spraying of one or more of these groves during the summer of 1986.

Of further significance, Endosulfan is insoluble in water and is oxidized by UV light to Endosulfandiol and CO_2. Its decomposition rate in river water at an initial concentration of 10 ug/l is as follows: after 1 hour -100 percent present, after 1 week - 30 percent present, after 2 weeks - 5 percent present, and after 4 weeks - 0 percent present. Therefore, the presence of the Endosulfan in the streams of the Palmer Ranch most likely decomposed after approximately one month.

In soil with active fungi, Endosulfan is transformed to Endosulfan Sulfate. However, Endosulfan Sulfate did not occur at detectable levels in any of the 13 samples. Neither did Endosulfan Beta show up at detectable levels. Either Endosulfan Beta and Endosulfan Sulfate would have confirmed the validity of the analysis, however, neither were shown to be present at detectable levels. The analysis was performed by a DHRS certified laboratory and they confirmed that the results were valid (Appendix B).

4.7 Bacteriological Parameters

4.7.1 <u>Total Coliform</u>

As evidenced in Appendix Table A-22, the streams traversing the Palmer Ranch were found to exhibit frequent exceedences of the State and County standards for Total Coliform during the third year of monitoring. Both the State and County standards which allow up to 2,400 counts/100 ml were exceeded in 20 out of a total of 47 samples. Highest counts were observed in the upper reaches of the Catfish Creek/Trunk Ditch Basin (Stations CC-1, CC-2 and CC-3) and in the adjacent basin of Elligraw Bayou

(Station EL-1A). Lower coliform counts were found in the downstream reach of Catfish Creek (CC-4 and CC-5) and in the eastern branch of South Creek (SC-7).

Total coliform counts recorded during the third monitoring year were highest during the wet season and lowest during the dry season. During June 1986, total coliform counts ranged 300 - 32,000 counts/100 ml, exceeding the allowable limit at five stations. During September 1986 (end of wet season), six stations were out of compliance as a range of 500 - 40,000 counts/100 ml was recorded. During December 1986 (dry season), bacterial counts declined to a lower range of 300 - 13,400 counts/100 ml in association with less rainfall and runoff. Still, five stations were out of compliance. Total coliform counts increased during March 1987 to a range of 100 - 33,000 counts/100 ml and five stations were out of compliance with State and County standards of 2,400 counts/100 ml.

Even higher total coliform counts and a higher frequency of violations were observed during the previous two years of monitoring. During the first year of monitoring, Palmer Venture (1986) reported non-compliance conditions in 27 of 38 total coliform counts. During the second year, CCI (1986) reported non-compliance in 25 of the 37 total coliform counts. The highest counts were observed during the wet season, ranging up to 1,000,000 counts/100 ml as rainfall and runoff peaked.

Several sources of coliform bacteria exist on and upstream of the Palmer Ranch. The primary source is expected to be the naturally occurring coliform bacteria of the soils and vegetation. A secondary source is represented by the warm blooded animals inhabiting the watershed. These include birds, cattle, feral hogs, deer, rodents and other small mammals. The primary mode of transport of the coliform bacteria to the streams traversing the ranch is expected to be surface runoff, consequently resulting in a seasonal trend in association with rainfall.

4.7.2 Fecal Coliform

During the third year of monitoring, the streams of the Palmer Ranch exhibited fecal coliform densities in the range of < 10 - 10,200 counts/100 ml (Appendix Table A-23). Of the 47 samples which were collected, 13 exceeded the Class III standard of 800/100 ml as compared to fewer exceedences but a wider range during the previous year of monitoring (CCI, 1986).

The highest fecal coliform counts and greatest number of exceedences during the third year occurred during the fall and winter seasons, perhaps in association with a greater attraction of warm blooded animals to the stream communities during drier periods of the year. Similar to the previous year of monitoring, a higher occurrence of non-compliance conditions was also observed in the interior of the Palmer Ranch, e.g. Stations CC-3 and SC-4, suggesting that the primary sources of fecal contamination originated within the ranch, i.e. birds and cattle. The highest count of 10,200/100 ml was recorded in Elligraw Bayou (Station EL-1A). Since its watershed was not used to graze cattle, this elevated count is attributed primarily to birds.

Throughout the first year of monitoring, the streams of the Palmer Ranch exhibited fecal coliform densities which frequently exceeded allowable limits (Palmer Venture, 1986). Of the 38 observations, 22 exceeded the allowable limit of 800/100 ml. Only two of these exceedences were recorded at points of inflow into the ranch, consequently, the source of fecal coliform was attributed birds and cattle on the ranch.

5.0 SUMMARY

The third year of the "Continuing Surface Water Quality Monitoring Program" was performed quarterly at the 13 stations located in the streams of the Palmer Ranch during the period of April 1986 through March 1987. Monitoring during the previous two years was performed at the same 13 stations. However, monitoring was performed bimonthly during the first year and subsequently changed to a quarterly frequency at the beginning of the second year of monitoring. The results of the first two years of monitoring may be reviewed in the annual reports prepared by Palmer Venture (1986) and CCI (1986).

Monitoring of the Palmer Ranch streams entailed quarterly measurements of conductivity, water temperature, suspended solids, turbidity, dissolved oxygen, pH, biochemical oxygen demand, macronutrients, oils and greases, and bacteriological quality. Additionally, organochlorine pesticide scans and measurements of trace elements including arsenic, cadmium, copper, chromium, lead, mercury, nickel and zinc were performed during an annual sampling event at the end of the wet season (September). The results of the third year of monitoring are summarized in Table 5.1. A complete tabulation of the results is provided in Appendix A.

As evident in the results, the third year of monitoring exhibited a normal amount of rainfall as 52 inches occurred on the Palmer Ranch. However, the third year was preceded by a drought in which only 33 inches of rainfall was recorded. The historical

Table 5.1

Summary of Results - Palmer Ranch Surface Water Quality Monitoring Program

April 1986 - March 1987

Parameter	CC-1 Mean	CC-2 Mean	CC-3 Mean	CC-4 Mean	CC-5 Mean	EI-1A Mean	NC-6 Mean	SC-1 Mean	Applicable Criteria
PHYSICAL									
Depth (Ft.)	0.90	1.09	0.70	1.49	0.69	0.40	1.96	0.73	----
Flow (GPM)	182	None	54	15	119	16	11	57	----
Temperature (C) (Field)	23.4	25.6	24.8	25.8	25.4	24.6	22.2	24.6	NA
Conductivity (umhos/cm, Field)	726	507	805	816	738	765	747	1,256	+50%, +100%[a]
Solids, Total Suspended (mg/l)	7	13	24	17	12	34	30	19	----
Turbidity (NTU)	4.5	8.8	26.8	11.0	5.4	22.3	15.9	9.1	+29, +25[b]
OXYGEN DEMAND AND RELATED PARAMETERS									
BOD, 5-day (mg/l)	1.4	6.3	2.2	3.3	1.9	6.9	4.1	3.1	----
Dissolved Oxygen (mg/l, Field)	4.4	3.1	5.3	7.7	10.0	6.9	0.93	10.3	>5, >4[c]
pH (Field)	7.5	7.6	7.3	7.7	7.8	8.0	7.0	8.4	6.0-8.5
MACRONUTRIENTS									
Nitrogen, Total	1.24	1.83	1.22	1.29	1.02	3.25	2.05	2.44	----
Nitrogen, Nitrite (mg/l as N)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	----
Nitrogen, Nitrate (mg/l as N)	0.20	0.03	0.03	0.03	0.04	0.04	0.03	0.02	----
Nitrogen, Ammonia[d] (mg/l as N)	0.22	0.12	0.14	0.07	0.07	0.16	0.16	0.15	----[e]
Nitrogen, Organic (mg/l)	0.83	1.68	1.06	1.20	0.92	3.05	1.86	2.28	----
Phosphate, Total (mg/l as P)	0.24	0.27	0.22	0.15	0.12	1.13	0.42	0.27	----
Phosphate, Ortho (mg/l as P)	0.12	0.10	0.02	0.02	0.05	0.38	0.11	0.11	----
TRACE ELEMENTS									
Arsenic, Total (mg/l)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.05, 0.01[c]
Cadmium, Total (mg/l)	<0.0008	0.0008	<0.0008	<0.0008	0.0023	<0.0008	<0.0008	<0.0008	0.0008, 0.0012, or 0.01[c]
Chromium, Total (mg/l)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05, 0.02[c]
Copper, Total (mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.03, 0.01[c]
Lead, Total (mg/l)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.03, 0.01[c]
Mercury, Total, (mg/l)	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0002, 0.01[c]
Nickel, Total (mg/l)	<0.01	<0.01	<0.01	<0.01	0.016	<0.01	0.012	<0.01	0.1
Zinc, Total (mg/l)	0.014	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.03, 0.01[c]
ORGANIC CONSTITUENTS									
Oils and Greases (mg/l)	4.8	5.3	5.3	<1	<1	1.3	<1	<1	5, 15[c]
Aldrin (ug/l)	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	0.003[f]
alpha - BHC (ug/l)	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	----
beta - BHC (ug/l)	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	----
delta - BHC (ug/l)	<0.009	<0.009	<0.009	<0.009	<0.009	<0.009	<0.009	<0.009	----
gamma - BHC (ug/l) (Lindane)	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	0.01
Chlordane (ug/l)	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	0.01
4 - 4' DDD (ug/l)	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	----
4 - 4' DDE (ug/l)	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	----
4 - 4' DDT (ug/l)	<0.012	<0.012	<0.012	<0.012	<0.012	<0.012	<0.012	<0.012	0.001
Dieldrin (ug/l)	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.003[f]
Endosulfan Alpha (ug/l)	<0.014	5.2	<0.014	<0.014	<0.014	<0.014	16.5	<0.014	0.003[g]
Endosulfan Beta (ug/l)	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	0.003[g]
Endosulfan Sulfate (ug/l)	<0.066	<0.066	<0.066	<0.066	<0.066	<0.066	<0.066	<0.066	----
Endrin (ug/l)	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	0.004
Endrin Aldehyde (ug/l)	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	----
Heptachlor (ug/l)	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	0.001
Heptachlor Epoxide (ug/l)	<0.083	<0.083	<0.083	<0.083	<0.083	<0.083	<0.083	<0.083	----
Toxaphene (ug/l)	<0.024	<0.024	<0.024	<0.024	<0.024	<0.024	<0.024	<0.024	0.005
Polychlorinated Biphenyls (ug/l)	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	0.001
BIOLOGICAL									
Coliform, Total (per 100 ml)	9,475	25,100	7,075	925	1,325	11,550	1,575	5,125	800
Coliform, Fecal (per 100 ml)	925	590	2,235	230	178	3,460	183	570	2,400

[a] State General Criteria allows 50% increase above background to 1,275 umhos/cm and County Ordinance 72-37 allows 100% increase above background to 500 umhos/cm.

[b] State General Criteria allows a maximum increase of 29 NTU above background and County Ordinance allows a 25 JTU maximum increase.

[c] State and County Criteria, respectively.

[d] Ionized plus non-ionized ammonia.

[e] State (0.02 mg/l unionized), County (0.2-2 mg/l non-ionic ammonia depending on pH).

Table 5.1

(Continued)

Parameter	SC-2 Mean	SC-3 Mean	SC-4 Mean	SC-7 Mean	SC-8 Mean	All Stations Mean	All Stations N	All Stations Min.	All Stations Max.	Applicable Criteria
PHYSICAL										
Depth (Ft.)	0.50	0.30	0.40	0.90	2.21	1.00	52	0.00	3.50	----
Flow (GPM)	219	10	189	319	69	145	52	0	1,400	----
Temperature (C) (Field)	20.9	23.5	24.4	20.9	22.1	23.8	47	17.3	33.5	----
Conductivity (umhos/cm, Field)	977	794	1,071	897	805	844	47	422	1,406	+50%, 100%[a]
Solids, Total Suspended (mg/l)	2	5	10	3	9	15	47	1	57	----
Turbidity (NTU)	1.8	1.6	7.9	2.7	4.5	9.6	47	1.2	36.0	+29, +25[b]
OXYGEN DEMAND AND RELATED PARAMETERS										
BOD, 5-day (mg/l)	2.4	3.6	2.7	2.8	1.7	3.1	47	0.4	11.1	----
Dissolved Oxygen (mg/l, Field)	3.1	4.5	9.3	3.1	5.7	6.1	47	0.4	16.0	>4, >5[c]
pH (Field)	7.2	7.1	7.5	7.3	7.5	7.5	47	6.7	9.8	6.0-8.5
MACRONUTRIENTS										
Nitrogen, Total	2.46	1.65	1.58	4.03	1.53	1.90	47	0.75	6.16	----
Nitrogen, Nitrite (mg/l as N)	0.05	<0.01	<0.01	0.04	<0.01	0.01	47	<0.01	0.10	----
Nitrogen, Nitrate (mg/l as N)	0.14	0.01	0.02	0.31	0.12	0.07	47	<0.01	0.54	----
Nitrogen, Ammonia[d] (mg/l as N)	0.48	0.10	0.12	1.81	0.08	0.25	47	<0.01	3.32	----[e]
Nitrogen, Organic (mg/l)	1.79	1.54	1.45	1.87	1.33	1.56	47	0.55	4.82	----
Phosphate, Total (mg/l as P)	1.19	0.17	0.26	1.72	0.51	0.47	47	0.07	2.86	----
Phosphate, Ortho (mg/l as P)	1.12	0.11	0.10	1.61	0.34	0.29	47	0.01	2.86	----
TRACE ELEMENTS										
Arsenic, Total (mg/l)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	13	<0.005	<0.005	0.05, 0.01[c]
Cadmium, Total (mg/l)	<0.0008	0.0008	<0.0008	<0.0008	0.0023	<0.0008	13	<0.0008	0.0023	0.0008, 0.0012, or 0.01[c]
Chromium, Total (mg/l)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	13	<0.05	<0.05	0.05, 0.02[c]
Copper, Total (mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	13	<0.01	<0.01	0.03, 0.01[c]
Lead, Total (mg/l)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	13	<0.02	<0.02	0.03, 0.01[c]
Mercury, Total (mg/l)	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	13	<0.0001	0.0001	0.0002, 0.01[c]
Nickel, Total (mg/l)	0.031	<0.01	0.023	<0.01	<0.01	0.01	13	<0.01	0.031	0.1
Zinc, Total (mg/l)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	13	<0.005	0.014	0.03, 0.01[c]
ORGANIC CONSTITUENTS										
Oils and Greases (mg/l)	1.3	<1	1.3	1.3	1.3	2.06	47	<1	17.0	5, 15[c]
Aldrin (ug/l)	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	13	<0.004	<0.004	0.003[f]
alpha - BHC (ug/l)	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	13	<0.003	<0.003	----
beta - BHC (ug/l)	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	13	<0.006	<0.006	----
delta - BHC (ug/l)	<0.009	<0.009	<0.009	<0.009	<0.009	<0.009	13	<0.009	<0.009	----
gamma - BHC (ug/l) (Lindane)	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	13	<0.004	<0.004	0.01
Chlordane (ug/l)	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	13	<0.014	<0.014	0.01
4 - 4' DDD (ug/l)	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	13	<0.011	<0.011	----
4 - 4' DDE (ug/l)	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	13	<0.004	<0.004	----
4 - 4' DDT (ug/l)	<0.012	<0.012	<0.012	<0.012	<0.012	<0.012	13	<0.012	<0.012	0.001
Dieldrin (ug/l)	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	13	<0.002	<0.002	0.003[f]
Endosulfan Alpha (ug/l)	<0.014	<0.014	1.7	<0.014	3.8	2.09	13	<0.014	16.5	0.003[g]
Endosulfan Beta (ug/l)	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	13	<0.004	<0.004	0.003[g]
Endosulfan Sulfate (ug/l)	<0.066	<0.066	<0.066	<0.066	<0.066	<0.066	13	<0.066	<0.066	----
Endrin (ug/l)	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	13	<0.006	<0.006	0.004
Endrin Aldehyde (ug/l)	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	13	<0.023	<0.023	----
Heptachlor (ug/l)	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	13	<0.003	<0.003	0.001
Heptachlor Epoxide (ug/l)	<0.083	<0.083	<0.083	<0.083	<0.083	<0.083	13	<0.083	<0.083	----
Toxaphene (ug/l)	<0.024	<0.024	<0.024	<0.024	<0.024	<0.024	13	<0.024	<0.024	0.005
Polychlorinated Biphenyls (ug/l)	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	13	<0.065	<0.065	0.001
BIOLOGICAL										
Coliform, Total (per 100 ml)	1,267	3,083	5,950	1,000	2,350	5,562	47	100	40,000	800
Coliform, Fecal (per 100 ml)	105	333	1,363	65	468	857	47	10	10,200	2,400

[f]Aldrin + Dieldrin

[g]Endosulfan a+b

amount of rainfall for the region based on a 30-year record is 56 inches per year (NOAA, 1978). Consequently, the streams of the Palmer Ranch gradually returned to normal flows following the year of drought.

A general water quality effect of the change from the drought to normal rainfall conditions during the third year of monitoring was evidenced by the change in conductivity. During the second year, conductivities were abnormally high as evidenced in their range of 413 - 1,809 umhos/cm. During the third year, however, conductivities declined to a lower range of 422 - 1,406 umhos/cm. This change is attributed to an increase in runoff of low conductivity stormwater.

Groundwater seepage effects during the second year were more pronounced since groundwater exfiltration represented a larger percentage of the annual water budgets relative to surface runoff contributions. As a result, dissolved constituents including electrolytes transported into the streams via groundwater exfiltration exhibited greater effects on conductivity and the concentration of dissolved solids. During the third year of monitoring, stormwater runoff, which normally exhibits lower conductivities than groundwater, increased with increased rainfall amounts. Therefore, the concentration of dissolved constituents and levels of conductivities in the receiving waters declined.

Seasonal trends related to rainfall were also observed in the streams of the Palmer Ranch. The influence of rainfall was evident in the inverse relationship with conductivity. By the end of the summer wet season, i.e. September, conductivities averaged 820 umhos/cm. However, during the dry season, i.e. December, conductivities increased to an average level of 868 umhos/cm. Conductivities remained at a comparatively high average of 918 umhos/cm during the winter quarter in association with minor amounts of rainfall.

As during the second year of monitoring, the streams exhibited a direct correlation between seasonal rainfall and total suspended solids as total suspended solids averaged 26 mg/l at the beginning of the summer wet season and declined to an average level of 10 mg/l during the fall dry season. Total suspended solids remained low through the winter season as reflected in its average of 10 mg/l. As expected, turbidity was positively correlated with total suspended solids (R = 0.85).

Biochemical oxygen demands (BOD) were found to average 2.7 mg/l in South Creek and 2.8 mg/l in Catfish Creek, representing a general decrease of approximately 1 mg/l in comparison to average BODs. These declines are indicative of a general improvement in water quality during the third year of monitoring. As observed during the second year, however, higher BODs indicative of poor water quality were recorded in Elligraw Bayou and at the southern end of Trunk Ditch where stagnant conditions prevailed.

Dissolved oxygen and pH also reflected a general improvement in water quality during the third monitoring year as pH averaged 7.5 in comparison to 7.1 during the second year. Similarly, dissolved oxygen which averaged 4.1 mg/l during the second year increased to an average of 6.1 mg/l during the third year of monitoring, perhaps in association with the general decline in BOD. Even so, the streams of the Palmer Ranch exhibited generally heterotrophic conditions as evidenced by the marginal levels of dissolved oxygen, pH and BOD.

Although there was a general decrease in nutrient concentrations, high levels of nutrients were found in the streams of the Palmer Ranch as total nitrogen and total phosphorus exceeded threshold levels characteristic of eutrophic conditions (FDER, 1983). During the third year, the streams of the Palmer Ranch exhibited annual averages in total nitrogen and total phosphorus of 1.9 mg/l and 0.47 mg/l as compared to even higher averages of 2.6 mg/l and 1.0 mg/l during the second year, respectively. These averages significantly exceeded the FDER nutrient thresholds for total nitrogen and total phosphorus of 1.2 and 0.05 mg/l, respectively.

The inorganic fractions which are required by plants during the process of photosynthesis were also found to be readily available as orthophosphorus represented 62 percent of total phosphorus and inorganic nitrogen represented 12 percent of total nitrogen. Although the availability of inorganic nitrogen was found to be substantial, its low molecular ratio to orthophosphate implies that nitrogen should be more limiting to primary producers in the streams of the ranch. Ratios of inorganic nitrogen to inorganic phosphorus were found to average 10:1 as compared to algal protoplasm which is 16:1 (Odum, 1959). These results were comparable to previous monitoring results as orthophosphorus represented 66 percent of total phosphorus, inorganic nitrogen represented 15 percent of the total nitrogen, and the ratio of inorganic nitrogen to inorganic phosphorus averaged 4:1 during the second year of monitoring (CCI, 1986).

Potential sources of nutrients upstream of the Palmer Ranch include a dairy farm, golf course and mobile home park located in the South Creek Basin, the commercial-industrial strip development along Clark Road in the northern part of the Catfish Creek-Trunk Ditch Basin, and the country club development located in the western part of the Catfish Creek-Trunk Ditch Basin. Within the ranch, potential nutrient sources include Prestancia (new golf course and residential development), spray irrigation fields (Palmer Utilities and Central County Regional Utilities), and active pastures. Additionally, rainfall and surficial phosphate deposits represent two potentially ubiquitous sources of phosphate and fixed nitrogen throughout the basins of the ranch.

The streams of the Palmer Ranch were found to be out of compliance with the State water quality criteria for cadmium at two sites and out of compliance with the County criteria for zinc at one site during September 1986. Cadmium was found to be out of compliance at an inflowing station in the South Creek Basin (Station SC-3) and an outflowing station in the Catfish Creek Basin (Station CC-5). Zinc was found to exceed the County water quality standard at the inflowing station in the Catfish Creek Basin (Station CC-1). Several potential sources of zinc and cadmium exist upstream of the ranch including the commercial-industrial strip development along Clark Road which drains unmitigated into Catfish Creek and Trunk Ditch. Additionally, the mobile home park and golf course which is located upstream of the ranch drains into the South Creek. Drainage from various land uses within the ranch might also affect the cadmium content of Catfish Creek. These land uses include golf courses and once used sludge disposal sites. Additionally, rain and dust fallout are potentially ubiquitous sources of zinc and cadmium which could affect the zinc and cadmium content of the surface waters throughout these two basins.

Organochlorine pesticide scans performed during September 1986 showed no evidence of any measurable amounts or exceedences of the State Class III standards for aldrin, dieldrin, lindane, chlordane, DDT, endosulfan-beta, endrin, heptachlor, toxaphene, or PCBs in the streams of the Palmer Ranch. Endosulfan-alpha, however, was found in excess concentrations in the Catfish Creek-Trunk Ditch Basin (Station CC-2), in the South Creek Basin (Stations SC-4 and SC-8), and in the North Creek Basin (Station NC-6). The occurrence of endosulfan-alpha in these basins might be attributed to the spraying of pesticides in a citrus grove or some other agricultural land use.

Oils and greases which were monitored quarterly exceeded the maximum allowed by the State, i.e., 5.0 mg/l, at three sites in the upper portions of the Catfish Creek-Trunk Ditch Basin during June 1986. One of the three sites, i.e. Station CC-3, exceeded the maximum allowed by the County, i.e., 15 mg/l. All other measurements were found to be in compliance with State and County standards. Candidate sources of oils and greases include road runoff (e.g. Clark Road), construction activities on the Prestancia site and decaying vegetation.

The bacteriological quality of the streams of the Palmer Ranch was found to be poor as total coliform and fecal coliform counts were frequently out of compliance with applicable standards. Of the 47 total coliform counts taken during the third year, 20 exceeded the maximum allowable limit of 2,400/100 ml. Similarly, 13 of the 47 fecal coliform counts were found to exceed the maximum allowable limit of 800/100 ml. The frequency of exceedences as well as total coliform densities were found to be directly related to the amount of rainfall. In contrast, fecal coliform counts were inversely related to the amount of rainfall. The primary sources of coliform bacteria within the Palmer Ranch include the fecal bacteria of cattle and birds as well as the naturally occurring soil bacteria. During storm events which frequently occur during the summer wet season, it is likely that more of the 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 the drier periods of the year, it is likely that birds, cattle, and other warm blooded animals, which are the sources of fecal coliform bacteria, are attracted to the streams to water and feed, thereby resulting in an increase in fecal coliform counts.

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APPENDIX A. WATER QUALITY DATA

Appendix Table A - 1

Continuing Surface Water Quality Monitoring Program

Stream Stage (ft.) [a]

April 1986 - March 1987

Sampling Date[b]	Catfish Creek/ Trunk Ditch						Elligraw	North	South Creek							All Stations				
	CC-1	CC-2[c]	CC-3	CC-4	CC-5	Mean	EL-1A	NC-6	SC-1	SC-2	SC-3	SC-4	SC-7	SC-8	Mean	Mean	SD	Min	Max	N
June 16-17, 1986	1.3	1.1	1.0	1.2	0.9	1.1	0.0	1.2	0.4	0.0	0.0	0.6	0.0	2.2	0.5	0.8	0.65	0.0	2.2	13
September 3-4, 1986	0.5	2.5	0.3	2.0	0.7	1.2	0.5	2.7	0.7	0.9	0.6	0.4	2.5	3.5	1.4	1.4	1.06	0.3	3.5	13
December 3-4, 1986	1.0	0.8	0.2	1.3	0.6	0.8	0.7	1.9	0.9	0.7	0.2	0.2	0.5	1.2	0.6	0.8	0.47	0.2	1.9	13
March 4-5, 1987	0.8	0.01	1.4	1.5	0.5	0.8	0.4	2.0	0.9	0.6	0.4	0.3	0.7	2.0	0.8	0.9	0.62	0.01	2.0	13
Mean	0.9	1.1	0.7	1.5	0.7		0.4	2.0	0.7	0.5	0.3	0.4	0.9	2.2						
Minimum	0.5	0.01	0.2	1.2	0.5		0.0	1.2	0.4	0.0	0.00	0.2	0.00	1.2						
Maximum	1.3	2.5	1.4	2.0	0.9		0.7	2.7	0.9	0.9	0.6	0.6	2.5	3.5						
Std. Deviation	0.29	0.90	0.50	0.31	0.15		0.29	0.61	0.20	0.34	0.22	0.15	0.94	0.83						
N	4	4	4	4	4		4	4	4	4	4	4	4	4						

Stations	Mean	SD	Min	Max	N
CC-1, CC-2 (upper reach)	1.0	0.68	0.01	2.5	8
CC-3, CC-4 (mid reach)	1.1	0.60	0.2	2.0	8
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	1.0	0.59	0.01	2.5	20
SC-4, SC-1 (upper reach - west)	0.6	0.25	0.2	0.9	8
SC-3, SC-7 (upper reach - east)	0.6	0.75	0.0	2.5	8
SC-2, SC-8 (mid reach)	1.4	1.05	0.0	3.5	8
SC-1, SC-2, SC-3, SC-4, SC-7, SC-8 (entire basin)	0.9	0.85	0.0	3.5	24
All 13 Stations	1.0	0.77	0.0	3.5	52

SD - standard deviation

N - number of observations

[a] Maximum stream depths at each station except at Station CC-4. Stream stage at Station CC-4 is the water depth at the sampling site which is less than the maximum depth. 0.0 = Station Dry.

[b] Catfish Creek/Trunk Ditch, Elligraw Bayou and North Creek stations sampled on first day of each event, South Creek stations sampled on second day of each event.

[c] Station CC-2 was relocated to the new tributary of Catfish Creek just before the sampling event during March.

Appendix Table A - 2

Continuing Surface Water Quality Monitoring Program

Stream Flow (GPM)

April 1986 - March 1987

Sampling Date[a]	Catfish Creek/ Trunk Ditch						Elligraw	North	South Creek							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	EL-1A	NC-6	SC-1	SC-2	SC-3	SC-4	SC-7	SC-8	Mean	Mean	SD	Min	Max	N
June 16-17, 1986	98	0	10	0	8	23	0	0	0	0	0	93	0	1400	249	124	385	0	1400	13
September 3-4, 1986	0	0	38	0	173	42	36	0	99	220	22	465	1000	278	347	179	284	0	1000	13
December 3-4, 1986	513	0	108	0	109	146	0	0	128	375	7	166	109	281	178	138	162	0	513	13
March 4-5, 1987	116	0	60	59	187	84	28	44	0	282	9	33	168	814	218	139	220	0	814	13
Mean	182	0	54	15	119		16	11	57	219	10	189	319	693						
Minimum	0	0	10	0	8		0	0	0	0	0	33	0	278						
Maximum	513	0	108	59	187		36	44	128	375	22	465	1000	1400						
Std. Deviation	227	0	41	30	82		19	22	67	159	9	192	459	534						
N	4	4	4	4	4		4	4	4	4	4	4	4	4						

Stations	Mean	SD	Min	Max	N
CC-1, CC-2 (upper reach)	91	177	0	513	8
CC-3, CC-4 (mid reach)	34	39	0	108	8
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	74	120	0	513	20
SC-4, SC-1 (upper reach - west)	123	151	0	465	8
SC-3, SC-7 (upper reach - east)	164	343	0	1000	8
SC-2, SC-8 (mid reach)	456	444	0	1400	8
SC-1, SC-2, SC-3, SC-4, SC-7, SC-8 (entire basin)	248	355	0	1400	24
All 13 Stations	145	268	0	1400	52

SD - standard deviation

N - number of observations

[a] Catfish Creek/Trunk Ditch, Elligraw Bayou and North Creek stations sampled on first day of event, South Creek stations on second day.

Appendix Table A - 3

Continuing Surface Water Quality Monitoring Program

Water Temperature (°C)

April 1986 - March 1987

Sampling Date[a]	Catfish Creek/ Trunk Ditch						Elligraw	North	South Creek							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	EL-1A	NC-6	SC-1	SC-2	SC-3	SC-4	SC-7	SC-8	Mean	Mean	SD	Min	Max	N
June 16-17, 1986	25.9	27.7	29.0	29.1	27.1	27.8	Dry	24.4	28.8	Dry	Dry	27.8	Dry	26.1	27.6	27.3	1.6	24.4	29.1	9
September 3-4, 1986	28.1	27.4	27.5	30.0	29.9	28.6	31.1	25.1	33.5	27.3	30.1	31.6	27.1	27.3	29.5	28.9	2.3	25.1	33.5	13
December 3-4, 1986	21.7	21.7	22.6	23.1	22.2	22.3	23.2	20.9	17.9	17.8	20.3	19.1	17.7	17.3	18.4	20.4	2.2	17.3	23.2	13
March 4-5, 1987	18.0	Dry	20.0	21.0	22.5	20.4	19.5	18.5	18.0	17.5	20.0	19.0	18.0	17.5	18.3	19.1	1.5	17.5	22.5	12
Mean	23.4	25.6	25.8	25.8	25.4		24.6	22.2	24.6	20.9	23.5	24.4	20.9	22.1						
Minimum	18.0	21.7	20.0	21.0	22.2		19.5	18.5	17.9	17.5	20.0	19.0	17.7	17.3						
Maximum	28.1	27.7	29.0	30.0	29.9		31.1	25.1	33.5	27.3	30.1	31.6	27.1	27.3						
Std. Deviation	4.5	3.4	4.2	4.4	3.7		5.9	3.1	7.9	5.6	5.8	6.3	5.3	5.4						
N	4	3	4	4	4		3	4	4	3	3	4	3	4						

Stations	Mean	SD	Min	Max	N
CC-1, CC-2 (upper reach)	24.4	3.9	18.0	28.1	7
CC-3, CC-4 (mid reach)	25.3	4.0	20.0	30.0	8
8C-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	25.0	3.7	18.0	30.0	19
SC-4, SC-1 (upper reach - west)	24.5	6.6	17.9	33.5	8
SC-3, SC-7 (upper reach - east)	22.2	5.2	17.7	30.1	6
SC-2, SC-8 (mid reach)	21.5	5.0	17.3	27.3	7
SC-1, SC-2, SC-3, SC-4, SC-7, SC-8 (entire basin)	22.8	5.6	17.3	33.5	21
All 13 Stations	23.8	4.7	17.3	33.5	47

SD - standard deviation

N - number of observations

[a] Catfish Creek/Trunk Ditch, Elligraw Bayou and North Creek stations sampled on first day of event, South Creek stations on second day.

Appendix Table A - 4

Continuing Surface Water Quality Monitoring Program

Specific Conductance (umhos/cm)[a]

April 1986 - March 1987

Sampling Date[b]	Catfish Creek/ Trunk Ditch						Elligraw	North	South Creek							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	EL-1A	NC-6	SC-1	SC-2	SC-3	SC-4	SC-7	SC-8	Mean	Mean	SD	Min	Max	N
June 16-17, 1986	653	422	713	729	525	608	Dry	703	1,406	Dry	Dry	941	Dry	630	992	747	286	422	1,406	9
September 3-4, 1986	700	553	816	767	756	718	725	796	1,138	1,001	532	1,129	966	785	925	820	191	532	1,138	13
December 3-4, 1986	732	545	790	859	750	735	741	738	1,178	1,101	860	995	1,046	945	1,021	868	178	545	1,178	13
March 4-5, 1987	820	Dry	900	910	920	888	830	750	1,300	830	990	1,220	680	860	980	918	180	680	1,300	12
Mean	726	507	805	816	738		765	747	1,255	977	794	1,071	897	805						
Minimum	653	422	713	729	525		725	703	1,138	830	532	941	680	630						
Maximum	820	553	900	910	920		830	796	1,406	1,101	990	1,220	1,046	945						
Std. Deviation	70	73	77	83	162		57	38	122	137	236	127	192	134						
N	4	3	4	4	4		3	4	4	3	3	4	3	4						

Stations	Mean	SD	Min	Max	N
CC-1, CC-2 (upper reach)	632	134	422	820	7
CC-3, CC-4 (mid reach)	811	74	713	910	8
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	730	138	422	920	19
SC-4, SC-1 (upper reach - west)	1,163	152	941	1,406	8
SC-3, SC-7 (upper reach - east)	846	201	532	1,046	6
SC-2, SC-8 (mid reach)	879	154	630	1,101	7
SC-1, SC-2, SC-3, SC-4, SC-7, SC-8 (entire basin)	978	218	532	1,406	21
All 13 Stations	844	208	422	1,406	47

SD - standard deviation

N - number of observations

[a] Applicable surface water quality criteria: State - allows a maximum increase of 50% to 1,275 umhos/cm; County - allows a maximum increase of 50% to 500 umhos/cm above background.

[b] Catfish Creek/Trunk Ditch, Elligraw Bayou and North Creek stations sampled on first day of event, South Creek stations on second day.

Appendix Table A - 5

Continuing Surface Water Quality Monitoring Program

Total Suspended Solids (mg/l)

April 1986 - March 1987

Sampling Date[a]	Catfish Creek/ Trunk Ditch						Elligraw	North	South Creek							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	EL-1A	NC-6	SC-1	SC-2	SC-3	SC-4	SC-7	SC-8	Mean	Mean	SD	Min	Max	N
June 16-17, 1986	3	9	38	32	28	22	Dry	57	50	Dry	Dry	7	Dry	6	21	26	20	3	57	9
September 3-4, 1986	7	15	22	17	6	13	50	22	19	2	4	22	4	10	10	15	13	2	50	13
December 3-4, 1986	12	15	27	11	4	14	21	30	2	1	2	4	1	2	2	10	10	1	30	13
March 4-5, 1987	5	Dry	10	7	8	8	31	10	6	4	10	7	4	16	8	10	7	4	31	12
Mean	7	13	24	17	12		34	30	19	2	5	10	30	9						
Minimum	3	9	10	7	4		21	10	2	1	2	4	1	2						
Maximum	12	15	38	32	28		50	57	50	4	10	22	4	16						
Std. Deviation	4	4	12	11	11		15	20	22	2	4	8	2	6						
N	4	3	4	4	4		3	4	4	3	3	4	3	4						

Stations	Mean	SD	Min	Max	N
CC-1, CC-2 (upper reach)	9	5	3	15	7
CC-3, CC-4 (mid reach)	21	11	7	38	8
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	15	10	3	38	19
SC-4, SC-1 (upper reach - west)	4	3	1	10	6
SC-3, SC-7 (upper reach - east)	15	16	2	50	8
SC-2, SC-8 (mid reach)	6	5	1	16	7
SC-1, SC-2, SC-3, SC-4, SC-7, SC-8 (entire basin)	9	11	1	50	21
All 13 Stations	15	14	1	57	47

SD - standard deviation

N - number of observations

[a] Catfish Creek/Trunk Ditch, Elligraw Bayou and North Creek stations sampled on first day of event, South Creek stations on second day.

Appendix Table A - 6

Continuing Surface Water Quality Monitoring Program

Turbidity (NTU)[a]

April 1986 - March 1987

Sampling Date[b]	Catfish Creek/ Trunk Ditch						Elligraw	North	South Creek							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	EL-1A	NC-6	SC-1	SC-2	SC-3	SC-4	SC-7	SC-8	Mean	Mean	SD	Min	Max	N
June 16-17, 1986	2.8	12.0	36.0	22.0	5.0	15.6	Dry	30.0	18.0	Dry	Dry	4.5	Dry	2.0	8.2	14.7	12.6	2.0	36.0	9
September 3-4, 1986	4.0	7.0	27.0	7.6	4.0	9.9	30.0	9.0	12.0	1.9	1.2	16.0	4.0	3.2	6.4	9.8	9.3	1.2	30.0	13
December 3-4, 1986	8.3	7.3	29.0	9.3	5.3	11.8	13.0	20.0	1.7	1.4	2.0	4.1	2.1	4.2	2.6	8.3	8.2	1.4	29.0	13
March 4-5, 1987	2.9	Dry	15.0	5.2	7.4	7.6	24.0	4.4	4.8	2.0	1.6	6.9	2.0	8.6	4.3	7.1	6.5	1.6	24.0	12

	CC-1	CC-2	CC-3	CC-4	CC-5	EL-1A	NC-6	SC-1	SC-2	SC-3	SC-4	SC-7	SC-8
Mean	4.5	8.8	26.8	11.0	5.4	22.3	15.9	9.1	1.8	1.6	7.9	2.7	4.5
Minimum	2.8	7.0	15.0	5.2	4.0	13.0	4.4	1.7	1.4	1.2	4.1	2.0	2.0
Maximum	8.3	12.0	36.0	22.0	7.4	30.0	30.0	18.0	2.0	2.0	16.0	4.0	8.6
Std. Deviation	2.6	2.8	8.7	7.5	1.4	8.6	11.5	7.3	0.3	0.4	5.6	1.1	2.9
N	4	3	4	4	4	3	4	4	3	3	4	3	4

Stations	Mean	SD	Min	Max	N
CC-1, CC-2 (upper reach)	6.3	3.3	2.8	12.0	7
CC-3, CC-4 (mid reach)	18.9	11.3	5.2	36.0	8
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	11.4	9.8	2.8	36.0	19
SC-4, SC-1 (upper reach - west)	2.2	1.0	1.2	4.0	6
SC-3, SC-7 (upper reach - east)	8.5	6.1	1.7	18.0	8
SC-2, SC-8 (mid reach)	3.3	2.5	1.4	8.6	7
SC-1, SC-2, SC-3, SC-4, SC-7, SC-8 (entire basin)	5.0	4.8	1.2	18.0	21
All 13 Stations	9.6	9.2	1.2	36.0	47

SD - standard deviation

N - number of observations

[a] Applicable surface water quality criteria: State - allows a maximum increase of 29 NTU; County - allows a maximum increase of 25 JTU above background.

[b] Catfish Creek/Trunk Ditch, Elligraw Bayou and North Creek stations sampled on first day of event, South Creek stations on second day.

Appendix Table A - 7

Continuing Surface Water Quality Monitoring Program

5 - Day Biochemical Oxygen Demand (mg/l)

April 1986 - March 1987

Sampling Date[a]	Catfish Creek/ Trunk Ditch						Elligraw	North	South Creek							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	EL-1A	NC-6	SC-1	SC-2	SC-3	SC-4	SC-7	SC-8	Mean	Mean	SD	Min	Max	N
June 16-17, 1986	1.2	2.4	1.7	2.5	1.9	1.9	Dry	2.6	4.3	Dry	Dry	5.4	Dry	0.8	3.5	2.5	1.5	0.8	5.4	9
September 3-4, 1986	1.8	6.1	3.1	5.2	2.5	3.7	5.5	5.3	4.0	2.8	7.1	2.4	3.3	2.2	3.6	4.0	1.7	1.8	7.1	13
December 3-4, 1986	1.2	10.5	1.8	2.3	1.8	3.5	4.1	5.9	1.7	1.0	0.6	1.4	2.7	0.4	1.3	2.7	2.8	0.4	10.5	13
March 4-5, 1987	1.5	Dry	2.0	3.0	1.4	2.0	11.1	2.7	2.3	3.3	3.1	1.7	2.3	3.4	2.7	3.2	2.6	1.4	11.1	12
Mean	1.4	6.3	2.2	3.3	1.9		6.9	4.1	3.1	2.4	3.6	2.7	2.8	1.7						
Minimum	1.2	2.4	1.7	2.3	1.4		4.1	2.6	1.7	1.0	0.6	1.4	2.3	0.4						
Maximum	1.8	10.5	3.1	5.2	2.5		11.1	5.9	4.3	3.3	7.1	5.4	3.3	3.4						
Std. Deviation	0.3	4.1	0.7	1.3	0.5		3.7	1.7	1.3	1.2	3.3	1.8	0.5	1.4						
N	4	3	4	4	4		3	4	4	3	3	4	3	4						

Stations	Mean	SD	Min	Max	N
CC-1, CC-2 (upper reach)	3.5	3.5	1.2	10.5	7
CC-3, CC-4 (mid reach)	2.7	1.1	1.7	5.2	8
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	2.8	2.3	1.2	10.5	19
SC-4, SC-1 (upper reach - west)	2.9	1.5	1.4	5.4	8
SC-3, SC-7 (upper reach - east)	3.2	2.2	0.6	7.1	6
SC-2, SC-8 (mid reach)	2.0	1.2	0.4	3.4	7
SC-1, SC-2, SC-3, SC-4, SC-7, SC-8 (entire basin)	2.7	1.6	0.4	7.1	21
All 13 Stations	3.1	2.3	0.4	11.1	47

SD - standard deviation

N - number of observations

[a] Catfish Creek/Trunk Ditch, Elligraw Bayou and North Creek stations sampled on first day of event, South Creek stations on second day.

Appendix Table A - 8

Continuing Surface Water Quality Monitoring Program

Dissolved Oxygen (mg/l) [a]

April 1986 - March 1987

Sampling Date[b]	Catfish Creek/ Trunk Ditch						Elligraw	North	South Creek							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	EL-1A	NC-6	SC-1	SC-2	SC-3	SC-4	SC-7	SC-8	Mean	Mean	SD	Min	Max	N
June 16-17, 1986	3.2	2.7	6.9	11.5	12.0	7.3	Dry	1.5	9.6	Dry	Dry	6.6	Dry	3.9	6.7	6.4	3.9	1.5	12.0	9
September 3-4, 1986	3.2	1.1	4.9	5.0	5.8	4.0	2.8	0.9	15.6	2.4	4.9	5.3	4.1	4.4	6.1	4.7	3.7	0.9	15.6	13
December 3-4, 1986	5.3	5.4	4.1	6.6	7.7	5.8	6.0	0.9	6.0	5.5	4.9	9.3	1.5	5.4	5.4	5.3	2.2	0.9	9.3	13
March 4-5, 1987	5.8	Dry	5.2	7.7	14.5	8.3	11.9	0.4	10.0	5.7	10.9	16.0	3.6	9.1	9.2	8.4	4.6	0.4	16.0	12
Mean	4.4	3.1	5.3	7.7	10.0		6.9	1.0	10.3	3.1	4.5	9.3	3.1	5.7						
Minimum	3.2	1.4	4.1	5.0	5.8		2.8	0.4	6.0	1.1	2.4	5.3	1.5	3.9						
Maximum	5.8	5.4	6.9	11.5	14.5		11.9	1.5	15.6	5.4	5.7	16.0	4.1	9.1						
Std. Deviation	1.4	2.2	1.2	2.8	4.0		4.6	0.5	4.0	2.2	1.9	4.8	1.4	2.4						
N	4	3	4	4	4		3	4	4	3	3	4	3	4						

Stations	Mean	SD	Min	Max	N
CC-1, CC-2 (upper reach)	3.8	1.7	1.1	5.8	7
CC-3, CC-4 (mid reach)	6.5	2.4	4.1	11.5	8
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	6.2	3.4	1.1	14.5	19
SC-4, SC-1 (upper reach - west)	9.8	4.1	5.3	16.0	8
SC-3, SC-7 (upper reach - east)	5.0	3.2	1.5	10.9	6
SC-2, SC-8 (mid reach)	5.2	2.1	2.4	9.1	7
SC-1, SC-2, SC-3, SC-4, SC-7, SC-8 (entire basin)	6.9	3.9	1.5	16.0	21
All 13 Stations	6.1	3.8	0.4	16.0	47

SD - standard deviation

N - number of observations

[a] Applicable surface water quality criteria: State - minimum allowable of 5 mg/l; County - minimum allowable of 4 mg/l.

[b] Catfish Creek/Trunk Ditch, Elligraw Bayou and North Creek stations sampled on first day of event, South Creek stations on second day.

Appendix Table A - 9

Continuing Surface Water Quality Monitoring Program

pH (-log[H^+])[a]

April 1986 - March 1987

Sampling Date[b]	Catfish Creek/ Trunk Ditch						Elligraw	North	South Creek							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	EL-1A	NC-6	SC-1	SC-2	SC-3	SC-4	SC-7	SC-8	Mean	Mean	SD	Min	Max	N
June 16-17, 1986	7.6	7.7	7.8	8.3	7.8	7.8	Dry	7.3	8.6	Dry	Dry	7.8	Dry	7.8	8.1	7.9	0.4	7.3	8.6	9
September 3-4, 1986	7.7	7.6	7.0	7.2	7.5	7.4	7.5	6.7	9.8	7.0	6.8	7.2	7.7	7.4	7.7	7.5	0.8	6.7	9.8	13
December 3-4, 1986	7.3	7.4	7.1	7.4	7.7	7.4	7.8	6.9	7.5	7.3	7.3	7.5	7.2	7.4	7.4	7.4	0.2	6.9	7.8	13
March 4-5, 1987	7.4	Dry	7.3	7.7	8.3	7.7	8.7	7.0	7.6	7.2	7.2	7.5	7.0	7.5	7.3	7.5	0.5	7.0	8.7	12
Mean	7.5	7.6	7.3	7.7	7.8		8.0	7.0	8.4	7.2	7.1	7.5	7.3	7.5						
Minimum	7.3	7.4	7.0	7.2	7.5		7.5	6.7	7.5	7.0	6.8	7.2	7.0	7.4						
Maximum	7.7	7.7	7.8	8.3	8.3		8.7	7.3	9.8	7.3	7.3	7.8	7.7	7.8						
Std. Deviation	0.2	0.2	0.4	0.5	0.3		0.6	0.3	1.1	0.2	0.3	0.2	0.4	0.2						
N	4	3	4	4	4		3	4	4	3	3	4	3	4						

Stations	Mean	SD	Min	Max	N
CC-1, CC-2 (upper reach)	7.5	0.2	7.3	7.7	7
CC-3, CC-4 (mid reach)	7.5	0.4	7.0	8.3	8
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	7.6	0.4	7.0	8.3	19
SC-4, SC-1 (upper reach - west)	7.9	0.9	7.2	9.8	8
SC-3, SC-7 (upper reach - east)	7.2	0.3	6.8	7.7	6
SC-2, SC-8 (mid reach)	7.4	0.3	7.0	7.8	7
SC-1, SC-2, SC-3, SC-4, SC-7, SC-8 (entire basin)	7.5	0.6	6.8	9.8	21
All 13 Stations	7.5	0.5	6.7	9.8	47

SD - standard deviation

N - number of observations

[a] Applicable surface water quality criteria: State and County - allowable range of 6.0-8.5.

[b] Catfish Creek/Trunk Ditch, Elligraw Bayou and North Creek stations sampled on first day of event, South Creek stations on second day.

Appendix Table A - 10

Continuing Surface Water Quality Monitoring Program

Total Nitrogen (mg/l)

April 1986 - March 1987

Sampling Date[a]	Catfish Creek/ Trunk Ditch						Elligraw	North	South Creek							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	EL-1	NC-6	SC-1	SC-2	SC-3	SC-4	SC-7	SC-8	Mean	Mean	SD	Min	Max	N
June 16-17, 1986	0.90	0.82	1.41	1.42	0.75	1.06	Dry	1.95	4.95	Dry	Dry	1.58	Dry	1.48	2.67	1.70	1.28	0.75	4.95	9
September 3-4, 1986	1.83	1.83	1.25	1.41	1.33	1.53	3.92	1.96	1.74	3.01	1.51	1.92	4.06	1.80	2.34	2.12	0.94	1.25	4.06	13
December 3-4, 1986	1.28	2.83	1.17	1.04	0.97	1.46	2.11	2.24	1.30	2.67	1.80	1.28	6.16	1.27	2.41	2.01	1.39	0.97	6.16	13
March 4-5, 1987	0.95	Dry	1.04	1.29	1.02	1.08	3.73	2.04	1.77	1.70	1.64	1.55	1.87	1.55	1.68	1.68	0.74	0.95	3.73	12
Mean	1.24	1.83	1.22	1.29	1.02		3.25	2.05	2.44	2.46	1.65	1.58	4.03	1.53						
Minimum	0.90	0.82	1.04	1.04	0.75		2.11	1.95	1.30	1.70	1.51	1.28	1.87	1.27						
Maximum	1.83	2.83	1.41	1.42	1.33		3.92	2.24	4.95	3.01	1.80	1.92	6.16	1.80						
Std. Deviation	0.43	1.00	0.15	0.18	0.24		0.99	0.14	1.69	0.68	0.15	0.26	2.15	0.22						
N	4	3	4	4	4		3	4	4	3	3	4	3	4						

Stations	Mean	SD	Min	Max	N
CC-1, CC-2 (upper reach)	1.49	0.73	0.82	2.83	7
CC-3, CC-4 (mid reach)	1.25	0.16	1.04	1.42	8
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	1.29	0.48	0.75	2.83	19
SC-4, SC-1 (upper reach - west)	2.01	1.21	1.28	4.95	8
SC-3, SC-7 (upper reach - east)	2.84	1.88	1.51	6.16	6
SC-2, SC-8 (mid reach)	1.93	0.65	1.27	3.01	7
SC-1, SC-2, SC-3, SC-4, SC-7, SC-8 (entire basin)	2.22	1.30	1.27	6.16	21
All 13 Stations	1.90	1.09	0.75	6.16	47

SD - standard deviation

N - number of observations

[a] Catfish Creek/Trunk Ditch, Elligraw Bayou and North Creek stations sampled on first day of event, South Creek stations on second day.

Appendix Table A -11

Continuing Surface Water Quality Monitoring Program

Nitrite (mg/l as N)

April 1986 - March 1987

Sampling Date[a]	Catfish Creek/ Trunk Ditch						Elligraw	North	South Creek							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	EL-1A	NC-6	SC-1	SC-2	SC-3	SC-4	SC-7	SC-8	Mean	Mean	SD	Min	Max	N
June 16-17, 1986	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	Dry	<0.01	<0.01	Dry	Dry	<0.01	Dry	<0.01	<0.01	<0.01	NA	<0.01	0.01	9
September 3-4, 1986	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.05	<0.01	<0.01	0.03	<0.01	0.02	0.01	0.01	<0.01	0.05	13
December 3-4, 1986	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.10	<0.01	<0.01	0.08	<0.01	0.03	0.02	0.03	<0.01	0.10	13
March 4-5, 1987	<0.01	Dry	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.01	<0.01	<0.01	0.01	<0.01	0.01	<0.01	<0.01	NA	<0.01	0.01	12
Mean	<0.01	0.01	<0.01	<0.01	<0.01		<0.01	<0.01	<0.01	0.05	<0.01	<0.01	0.04	<0.01						
Minimum	<0.01	<0.01	<0.01	<0.01	<0.01		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01						
Maximum	0.01	0.01	<0.01	<0.01	<0.01		<0.01	0.01	<0.01	0.10	<0.01	0.01	0.08	0.01						
Std. Deviation	NA	NA	NA	NA	NA		NA	NA	NA	0.05	NA	NA	0.04	NA						
N	4	3	4	4	4		3	4	4	3	3	4	3	4						

Stations	Mean	SD	Min	Max	N
CC-1, CC-2 (upper reach)	<0.01	NA	<0.01	0.01	7
CC-3, CC-4 (mid reach)	<0.01	NA	<0.01	<0.01	8
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	<0.01	NA	<0.01	0.01	19
SC-4, SC-1 (upper reach - west)	<0.01	NA	<0.01	0.01	8
SC-3, SC-7 (upper reach - east)	0.02	0.03	<0.01	0.08	6
SC-2, SC-8 (mid reach)	0.03	0.04	<0.01	0.10	7
SC-1, SC-2, SC-3, SC-4, SC-7, SC-8 (entire basin)	0.02	0.03	<0.01	0.10	21
All 13 Stations	0.01	0.02	<0.01	0.10	47

SD - standard deviation

N - number of observations

[a] Catfish Creek/Trunk Ditch, Elligraw Bayou and North Creek stations sampled on first day of event, South Creek stations on second day.

Appendix Table A - 12

Continuing Surface Water Quality Monitoring Program

Nitrate (mg/l as N)

April 1986 - March 1987

Sampling Date[a]	Catfish Creek/ Trunk Ditch						Elligraw	North	South Creek							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	EL-1A	NC-6	SC-1	SC-2	SC-3	SC-4	SC-7	SC-8	Mean	Mean	SD	Min	Max	N
June 16-17, 1986	0.05	0.04	0.03	0.02	0.05	0.04	Dry	0.02	<0.01	Dry	Dry	<0.01	Dry	0.03	0.01	0.03	0.02	<0.01	0.05	9
September 3-4, 1986	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	0.02	0.08	0.02	0.01	0.02	<0.01	0.08	13
December 3-4, 1986	0.45	0.04	0.05	0.05	0.05	0.13	0.06	0.02	0.03	0.25	0.02	0.05	0.54	0.11	0.17	0.13	0.17	0.02	0.54	13
March 4-5, 1987	0.29	Dry	0.03	0.04	0.04	0.10	0.04	0.08	0.03	0.16	<0.01	0.03	0.38	0.24	0.14	0.11	0.12	<0.01	0.38	12
Mean	0.20	0.03	0.03	0.03	0.04		0.04	0.03	0.02	0.14	0.01	0.02	0.31	0.12						
Minimum	<0.01	<0.01	<0.01	<0.01	<0.01		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	0.03						
Maximum	0.45	0.04	0.05	0.05	0.05		0.06	0.08	0.03	0.25	0.02	0.05	0.54	0.24						
Std. Deviation	0.21	0.02	0.02	0.02	0.02		0.03	0.03	0.01	0.12	0.01	0.02	0.27	0.09						
N	4	3	4	4	4		3	4	4	3	3	4	3	4						

Stations	Mean	SD	Min	Max	N
CC-1, CC-2 (upper reach)	0.13	0.17	<0.01	0.45	7
CC-3, CC-4 (mid reach)	0.03	0.02	<0.01	0.05	8
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	0.07	0.11	<0.01	0.45	19
SC-4, SC-1 (upper reach - west)	0.02	0.02	<0.01	0.05	8
SC-3, SC-7 (upper reach - east)	0.16	0.24	<0.01	0.54	6
SC-2, SC-8 (mid reach)	0.13	0.10	<0.01	0.25	7
SC-1, SC-2, SC-3, SC-4, SC-7, SC-8 (entire basin)	0.10	0.14	<0.01	0.54	21
All 13 Stations	0.07	0.12	<0.01	0.54	47

SD - standard deviation

N - number of observations

[a] Catfish Creek/Trunk Ditch, Elligraw Bayou and North Creek stations sampled on first day of event, South Creek stations on second day.

Appendix Table A - 13

Continuing Surface Water Quality Monitoring Program

Ammoniacal Nitrogen (mg/l)[a]

April 1986 - March 1987

Sampling Date[b]	Catfish Creek/ Trunk Ditch						Elligraw	North	South Creek							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	EL-1A	NC-6	SC-1	SC-2	SC-3	SC-4	SC-7	SC-8	Mean	Mean	SD	Min	Max	N
June 16-17, 1986	0.06	0.08	0.08	0.07	0.04	0.07	Dry	0.10	0.13	Dry	Dry	0.06	Dry	0.07	0.09	0.08	0.03	0.04	0.13	9
September 3-4, 1986	0.61	0.08	0.05	0.06	0.06	0.17	0.25	0.16	0.07	0.74	0.08	0.22	1.93	0.10	0.52	0.34	0.53	0.05	1.93	13
December 3-4, 1986	0.08	0.20	0.28	0.04	0.08	0.14	0.12	0.10	0.08	0.60	0.10	0.08	3.32	0.05	0.71	0.40	0.89	0.04	3.32	13
March 4-5, 1987	0.11	Dry	0.13	0.10	0.08	0.11	0.12	0.27	0.30	0.11	0.13	0.10	0.18	0.09	0.15	0.14	0.07	0.08	0.30	12
Mean	0.22	0.12	0.14	0.07	0.07		0.16	0.16	0.15	0.48	0.10	0.12	1.81	0.08						
Minimum	0.06	0.08	0.05	0.04	0.04		0.12	0.10	0.07	0.11	0.08	0.06	0.18	0.05						
Maximum	0.61	0.20	0.28	0.10	0.08		0.25	0.27	0.30	0.74	0.13	0.22	3.32	0.10						
Std. Deviation	0.26	0.07	0.10	0.03	0.02		0.08	0.08	0.11	0.33	0.03	0.07	1.57	0.02						
N	4	3	4	4	4		3	4	4	3	3	4	3	4						

Stations	Mean	SD	Min	Max	N
CC-1, CC-2 (upper reach)	0.17	0.20	0.06	0.61	7
CC-3, CC-4 (mid reach)	0.10	0.08	0.04	0.28	8
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	0.12	0.13	0.04	0.61	19
SC-4, SC-1 (upper reach - west)	0.13	0.09	0.06	0.30	8
SC-3, SC-7 (upper reach - east)	0.96	1.37	0.08	3.32	6
SC-2, SC-8 (mid reach)	0.25	0.29	0.05	0.74	7
SC-1, SC-2, SC-3, SC-4, SC-7, SC-8 (entire basin)	0.41	0.79	0.05	3.32	21
All 13 Stations	0.25	0.55	0.04	3.32	47

SD - standard deviation

N - number of observations

[a] Ionized plus un-ionized ammonia (surface water quality criteria only applies to un-ionized ammonia).

[b] Catfish Creek/Trunk Ditch, Elligraw Bayou and North Creek stations sampled on first day of event, South Creek stations on second day.

Appendix Table A - 14

Continuing Surface Water Quality Monitoring Program

Organic Nitrogen (mg/l)[a]

April 1986 - March 1987

Sampling Date[b]	Catfish Creek/ Trunk Ditch						Elligraw	North	South Creek							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	EL-1A	NC-6	SC-1	SC-2	SC-3	SC-4	SC-7	SC-8	Mean	Mean	SD	Min	Max	N
June 16-17, 1986	0.79	0.69	1.30	1.33	0.66	0.95	Dry	1.83	4.82	Dry	Dry	1.52	Dry	1.38	2.57	1.59	1.28	0.66	4.82	9
September 3-4, 1986	1.22	1.75	1.20	1.35	1.27	1.36	3.66	1.80	1.67	2.22	1.42	1.70	2.08	1.62	1.79	1.77	0.65	1.20	3.66	13
December 3-4, 1986	0.74	2.59	0.84	0.95	0.83	1.19	1.93	2.12	1.19	1.72	1.68	1.15	2.22	1.11	1.51	1.47	0.61	0.74	2.59	13
March 4-5, 1987	0.55	Dry	0.88	1.15	0.90	0.87	3.57	1.68	1.44	1.43	1.51	1.41	1.31	1.21	1.39	1.42	0.75	0.55	3.57	12
Mean	0.83	1.68	1.06	1.20	0.92		3.05	1.86	2.28	1.79	1.54	1.45	1.87	1.33						
Minimum	0.55	0.69	0.84	0.95	0.66		1.93	1.68	1.19	1.43	1.42	1.15	1.31	1.11						
Maximum	1.22	2.59	1.30	1.35	1.27		3.66	2.12	4.82	2.22	1.68	1.70	2.22	1.62						
Std. Deviation	0.28	0.95	0.23	0.19	0.26		0.98	0.19	1.71	0.40	0.13	0.23	0.49	0.22						
N	4	3	4	4	4		3	4	4	3	3	4	3	4						

Stations	Mean	SD	Min	Max	N
CC-1, CC-2 (upper reach)	1.19	0.74	0.55	2.59	7
CC-3, CC-4 (mid reach)	1.13	0.21	0.84	1.35	8
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	1.10	0.47	0.55	2.59	19
SC-4, SC-1 (upper reach - west)	1.86	1.21	1.15	4.82	8
SC-3, SC-7 (upper reach - east)	1.70	0.37	1.31	2.22	6
SC-2, SC-8 (mid reach)	1.53	0.37	1.11	2.22	7
SC-1, SC-2, SC-3, SC-4, SC-7, SC-8 (entire basin)	1.71	0.78	1.11	4.82	21
All 13 Stations	1.56	0.80	0.55	4.82	47

SD - standard deviation

N - number of observations

[a]Organic Nitrogen = Total Kjeldahl Nitrogen - Ammoniacal Nitrogen

[b] Catfish Creek/Trunk Ditch, Elligraw Bayou and North Creek stations sampled on first day of event, South Creek stations on second day.

Appendix Table A - 15

Continuing Surface Water Quality Monitoring Program

Total Phosphate (mg/l as P)

April 1986 - March 1987

Sampling Date[a]	Catfish Creek/ Trunk Ditch						Elligraw	North	South Creek							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	EL-1A	NC-6	SC-1	SC-2	SC-3	SC-4	SC-7	SC-8	Mean	Mean	SD	Min	Max	N
June 16-17, 1986	0.23	0.32	0.44	0.26	0.07	0.26	Dry	0.56	0.36	Dry	Dry	0.22	Dry	0.33	0.30	0.31	0.14	0.07	0.56	9
September 3-4, 1986	0.43	0.11	0.13	0.18	0.19	0.21	2.51	0.39	0.27	1.11	0.07	0.30	1.51	0.58	0.64	0.60	0.71	0.07	2.51	13
December 3-4, 1986	0.16	0.38	0.21	0.10	0.12	0.19	0.47	0.49	0.12	1.37	0.10	0.29	2.86	0.44	0.86	0.55	0.77	0.10	2.86	13
March 4-5, 1987	0.14	Dry	0.10	0.07	0.09	0.10	0.42	0.23	0.32	1.10	0.33	0.22	0.78	0.69	0.57	0.37	0.32	0.07	1.10	12
Mean	0.24	0.27	0.22	0.15	0.12		1.13	0.42	0.27	1.19	0.17	0.26	1.72	0.51						
Minimum	0.14	0.11	0.10	0.07	0.07		0.42	0.23	0.12	1.10	0.07	0.22	0.78	0.33						
Maximum	0.43	0.38	0.44	0.26	0.19		2.51	0.56	0.36	1.37	0.33	0.30	2.86	0.69						
Std. Deviation	0.13	0.14	0.15	0.09	0.05		1.19	0.14	0.11	0.15	0.14	0.04	1.06	0.16						
N	4	3	4	4	4		3	4	4	3	3	4	3	4						

Stations	Mean	SD	Min	Max	N
CC-1, CC-2 (upper reach)	0.25	0.13	0.11	0.43	7
CC-3, CC-4 (mid reach)	0.19	0.12	0.07	0.44	8
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	0.20	0.12	0.07	0.44	19
SC-4, SC-1 (upper reach - west)	0.26	0.08	0.12	0.36	8
SC-3, SC-7 (upper reach - east)	0.94	1.08	0.07	2.86	6
SC-2, SC-8 (mid reach)	0.80	0.39	0.33	1.37	7
SC-1, SC-2, SC-3, SC-4, SC-7, SC-8 (entire basin)	0.64	0.66	0.07	2.86	21
All 13 Stations	0.47	0.58	0.07	2.86	47

SD - standard deviation

N - number of observations

[a] Catfish Creek/Trunk Ditch, Elligraw Bayou and North Creek stations sampled on first day of event, South Creek stations on second day.

Appendix Table A - 16

Continuing Surface Water Quality Monitoring Program

Orthophosphate (mg/1 as P)

April 1986 - March 1987

Sampling Date[a]	Catfish Creek/ Trunk Ditch						Elligraw	North	South Creek							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	EL-1A	NC-6	SC-1	SC-2	SC-3	SC-4	SC-7	SC-8	Mean	Mean	SD	Min	Max	N
June 16-17, 1986	0.14	0.13	<0.01	<0.01	0.04	0.07	Dry	0.09	0.02	Dry	Dry	0.12	Dry	0.30	0.15	0.10	0.09	<0.01	0.30	9
September 3-4, 1986	0.14	0.03	0.02	0.03	0.08	0.06	1.00	0.11	0.08	1.10	0.02	0.06	1.20	0.40	0.48	0.33	0.45	0.02	1.20	13
December 3-4, 1986	0.12	0.15	0.04	0.04	0.04	0.08	0.11	0.10	0.08	1.23	0.04	0.15	2 86	0.27	0.77	0.40	0.80	0.04	2.86	13
March 4-5, 1987	0.06	Dry	<0.01	0.01	0.03	0.03	0.03	0.13	0.24	1.04	0.26	0.06	0.77	0.40	0.46	0.25	0.33	<0.01	1.04	12
Mean	0.12	0.10	0.02	0.02	0.05		0.38	0.11	0.11	1.12	0.11	0.10	1.61	0.34						
Minimum	0.06	0.03	<0.01	<0.01	0.03		0.03	0.09	0.02	1.04	0.02	0.06	0.77	0.27						
Maximum	0.14	0.15	0.04	0.04	0.08		1.00	0.13	0.24	1.23	0.26	0.15	2.86	0.40						
Std. Deviation	0.04	0.06	0.01	0.02	0.02		0.54	0.02	0.09	0.10	0.13	0.05	1.10	0.07						
N	4	3	4	4	4		3	4	4	3	3	4	3	4						

Stations	Mean	SD	Min	Max	N
CC-1, CC-2 (upper reach)	0.11	0.05	0.03	0.15	7
CC-3, CC-4 (mid reach)	0.02	0.01	<0.01	0.04	8
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	0.06	0.05	<0.01	0.15	19
SC-4, SC-1 (upper reach - west)	0.10	0.07	0.02	0.24	8
SC-3, SC-7 (upper reach - east)	0.86	1.08	0.02	2.86	6
SC-2, SC-8 (mid reach)	0.68	0.42	0.27	1.23	7
SC-1, SC-2, SC-3, SC-4, SC-7, SC-8 (entire basin)	0.51	0.68	0.02	2.86	21
All 13 Stations	0.29	0.51	<0.01	2.86	47

SD - standard deviation

N - number of observations

[a] Catfish Creek/Trunk Ditch, Elligraw Bayou and North Creek stations sampled on first day of event, South Creek stations on second day.

Appendix Table A - 17

Continuing Surface Water Quality Monitoring Program

Total N to Total P Ratios (N_t:P_t)[a]

April 1986 - March 1987

Sampling Date[b]	Catfish Creek/ Trunk Ditch					Elligraw	North	South Creek						All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	EL-1A	NC-6	SC-1	SC-2	SC-3	SC-4	SC-7	SC-8	Mean	SD	Min	Max	N
June 16-17, 1986	9	6	7	12	24	Dry	8	31	Dry	Dry	16	Dry	10	14	9	6	31	9
September 3-4, 1986	9	36	21	17	16	4	11	14	6	48	14	6	7	16	13	4	48	13
December 3-4, 1986	18	17	12	23	18	10	10	24	4	40	10	5	6	15	10	4	40	13
March 4-5, 1987	15	Dry	23	41	23	20	20	12	3	11	16	5	5	16	11	3	41	12
Mean	13	20	16	23	20	11	12	20	4	33	14	5	7					
Minimum	9	6	7	12	16	1	8	12	3	11	10	5	5					
Maximum	15	36	23	41	24	27	20	31	6	48	16	6	10					
Std. Deviation	5	15	8	13	4	8	5	9	2	20	3	1	2					
N	4	3	4	4	4	3	4	4	3	3	4	3	4					

Stations	Mean	SD	Min	Max	N
CC-1, CC-2 (upper reach)	16	10	6	36	7
CC-3, CC-4 (mid reach)	20	11	7	41	8
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	18	9	6	41	19
SC-4, SC-1 (upper reach - west)	17	7	10	31	8
SC-3, SC-7 (upper reach - east)	19	20	5	48	6
SC-2, SC-8 (mid reach)	6	2	3	10	7
SC-1, SC-2, SC-3, SC-4, SC-7, SC-8 (entire basin)	14	12	3	48	21

SD - standard deviation

N - number of observations

[a] Atomic ratios

[b] Catfish Creek/Trunk Ditch, Elligraw Bayou and North Creek stations sampled on first day of event, South Creek stations on second day.

Appendix Table A - 18

Continuing Surface Water Quality Monitoring Program

Inorganic N to Inorganic P Ratios ($N_i:P_i$)[a]

April 1986 - March 1987

Sampling Date[b]	Catfish Creek/ Trunk Ditch					Elligraw	North	South Creek						All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	EL-1	NC-6	SC-1	SC-2	SC-3	SC-4	SC-7	SC-8	Mean	SD	Min	Max	N
June 16-17, 1986	2	2	51	42	5	Dry	3	16	Dry	Dry	1	Dry	1	14	19	1	51	9
September 3-4, 1986	10	7	7	5	2	1	3	2	2	11	9	4	1	5	4	1	11	13
December 3-4, 1986	10	4	19	5	10	4	2	3	2	7	2	3	1	6	5	1	19	13
March 4-5, 1987	15	Dry	73	32	9	12	6	3	1	1	5	2	2	13	21	1	73	12
Mean	9	4	38	21	7	6	4	6	1.7	6.3	4	3	1.3					
Minimum	2	2	7	5	2	1	2	2	1	1	1	2	1					
Maximum	15	7	73	42	10	12	6	16	2	11	9	4	2					
Std. Deviation	5	3	30	19	4	6	2	7	0.6	5	4	1	0.5					
N	4	3	4	4	4	3	4	4	3	3	4	3	4					

Stations	Mean	SD	Min	Max	N
CC-1, CC-2 (upper reach)	7	5	2	15	7
CC-3, CC-4 (mid reach)	30	25	5	73	8
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	16	20	2	73	19
SC-4, SC-1 (upper reach - west)	5	5	1	16	8
SC-3, SC-7 (upper reach - east)	5	4	1	11	6
SC-2, SC-8 (mid reach)	1.4	0.5	1	2	7
SC-1, SC-2, SC-3, SC-4, SC-7, SC-8 (entire basin)	4	4	1	16	21

SD - standard deviation

N - number of observations

a Atomic ratios of NO_2-N, NO_3-N, and NH_3-N to Ortho PO_4-P.

b Catfish Creek/Trunk Ditch, Elligraw Bayou and North Creek stations sampled on first day of event, South Creek stations on second day.

Appendix Table A - 19

Continuing Surface Water Quality Monitoring Program
Trace Elements (mg/l)
September 3-4, 1986[a]

Parameter	Catfish Creek/ Trunk Ditch						Elligraw	North	South Creek							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	EL-1A	NC-6	SC-1	SC-2	SC-3	SC-4	SC-7	SC-8	Mean	Mean	SD	Min	Max	N
Arsenic, Total	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NA	<0.005	<0.005	13
Cadmium, Total	<0.0008	<0.0008	<0.0008	<0.0008	0.0023[b]	0.0008	<0.0008	<0.0008	<0.0008	<0.0008	0.0018[b]	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	0.0006	<0.0008	0.0023	13
Copper, Total	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01	<0.01	13
Chromium, Total	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NA	<0.05	<0.05	13
Lead, Total	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	NA	<0.02	<0.02	13
Mercury, Total	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	NA	<0.0001	0.0001	13
Nickel, Total	<0.01	<0.01	<0.01	<0.01	0.016	<0.01	<0.01	0.02	<0.01	0.031	<0.01	0.023	<0.01	<0.01	0.01	0.01	0.009	<0.01	0.031	13
Zinc, Total	0.014[c]	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.003	<0.005	0.014	13

SD - standard deviation

N - number of observations

[a] Catfish Creek/Trunk Ditch, Elligraw Bayou and North Creek stations sampled on first day of event, South Creek stations on second day.

[b] Out of compliance with State standards.

[c] Out of compliance with County standards.

Applicable surface water quality criteria (State/County in units of mg/l): As (0.05/0.01); Cd (0.0008-0.0012/0.01); Cu (0.03/0.01); Cr (0.05/0.02); Pb (0.03/0.01); Hg (0.0002/0.01); Ni (0.1/0.1); and Zn (0.03/0.01).

Appendix Table A - 20

Continuing Surface Water Quality Monitoring Program

Oils and Greases (mg/l) [a]

April 1986 - March 1987

Sampling Date[b]	Catfish Creek/ Trunk Ditch						Elligraw	North	South Creek							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	EL-1A	NC-6	SC-1	SC-2	SC-3	SC-4	SC-7	SC-8	Mean	Mean	SD	Min	Max	N
June 16-17, 1986	13	10	17	<1	<1	1.4	Dry	<1	<1	Dry	Dry	<1	Dry	<1	<1	5.1	6.4	<1	17.0	9
September 3-4, 1986	3	3	<1	<1	<1	1.8	<1	<1	<1	2	<1	<1	2	2	1.5	1.5	0.8	<1	3	13
December 3-4, 1986	<1	3	<1	<1	<1	1.4	1	<1	1	<1	<1	2	<1	<1	1.2	1.2	0.6	<1	3	13
March 4-5, 1987	2	Dry	2	<1	<1	1.5	2	<1	<1	<1	<1	<1	<1	<1	<1	1.3	0.5	<1	2	12
Mean	5	5.3	5.3	<1	<1		1.3	<1	1	1.3	<1	1.3	1.3	1.3						
Minimum	<1	3	<1	<1	<1		<1	<1	<1	<1	<1	<1	<1	<1						
Maximum	13	10	17	<1	<1		2.0	<1	1	2	<1	2	2	2						
Std. Deviation	5.6	4.0	7.9	NA	NA		0.6	NA	NA	0.6	NA	0.5	0.6	0.5						
N	4	3	4	4	4		3	4	4	3	3	4	3	4						

Stations	Mean	SD	Min	Max	N
CC-1, CC-2 (upper reach)	5	4.6	<1	13	7
CC-3, CC-4 (mid reach)	3.1	5.6	<1	17	8
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	3.4	4.6	<1	17	19
SC-4, SC-1 (upper reach - west)	1.1	0.35	<1	2	8
SC-3, SC-7 (upper reach - east)	1.2	0.41	<1	2	6
SC-2, SC-8 (mid reach)	1.3	0.5	<1	2	7
SC-1, SC-2, SC-3, SC-4, SC-7, SC-8 (entire basin)	1.2	0.4	<1	2	21
All 13 Stations	2.1	3.1	<1	17	47

SD - standard deviation

N - number of observations

[a] Applicable surface water quality criteria: State - maximum allowable of 5.0 mg/l; County - maximum allowable of 15 mg/l.

[b] Catfish Creek/Trunk Ditch, Elligraw Bayou and North Creek stations sampled on first day of event, South Creek stations on second day.

Appendix Table A -21

Continuing Surface Water Quality Monitoring Program

Organochlorine Pesticides (ug/l)

September 3-4, 1986 [a]

Parameter	Catfish Creek/ Trunk Ditch					Elligraw	North	South Creek					
	CC-1	CC-2	CC-3	CC-4	CC-5	EL-1A	NC-6	SC-1	SC-2	SC-3	SC-4	SC-7	SC-8
Aldrin	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
alpha - BHC	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
beta - BHC	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
delta - BHC	<0.009	<0.009	<0.009	<0.009	<0.009	<0.009	<0.009	<0.009	<0.009	<0.009	<0.009	<0.009	<0.009
gamma - BHC (Lindane)	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Chlordane	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014
4 - 4' DDD	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011
4 - 4' DDE	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
4 - 4' DDT	<0.012	<0.012	<0.012	<0.012	<0.012	<0.012	<0.012	<0.012	<0.012	<0.012	<0.012	<0.012	<0.012
Dieldrin	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Endosulfan Alpha	<0.014	5.2	<0.014	<0.014	<0.014	<0.014	16.5	<0.014	<0.014	<0.014	1.7	<0.014	3.8
Endosulfan Beta	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Endosulfan Sulfate	<0.066	<0.066	<0.066	<0.066	<0.066	<0.066	<0.066	<0.066	<0.066	<0.066	<0.066	<0.066	<0.066
Endrin	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
Endrin Aldehyde	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023
Heptachlor	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Heptachlor Epoxide	<0.083	<0.083	<0.083	<0.083	<0.083	<0.083	<0.083	<0.083	<0.083	<0.083	<0.083	<0.083	<0.083
Toxaphene	<0.024	<0.024	<0.024	<0.024	<0.024	<0.024	<0.024	<0.024	<0.024	<0.024	<0.024	<0.024	<0.024
Polychlorinated Biphenyls	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065	<0.065

[a] Catfish Creek/Trunk Ditch, Elligraw Bayou and North Creek stations sampled on first day of event, South Creek stations on second day.

Applicable State surface water quality criteria (ug/l): Aldrin plus Dieldrin (0.003); Lindane (0.01); Chlordane (0.01); DDT (0.001); Endosulfan (0.003); Endrin (0.004); Heptachlor (0.001); Toxaphene (0.005); and PCB (0.001).

Appendix Table A -22

Continuing Surface Water Quality Monitoring Program

Total Coliform (count/100 ml)[a]

April 1986 - March 1987

Sampling Date[b]	Catfish Creek/ Trunk Ditch					Elligraw	North	South Creek						All Stations		
	CC-1	CC-2	CC-3	CC-4	CC-5	EL-1A	NC-6	SC-1	SC-2	SC-3	SC-4	SC-7	SC-8	Min	Max	N
June 16-17, 1986	13,000	32,000	13,000	2,800	300	Dry	1,500	16,800	Dry	Dry	2,100	Dry	900	300	32,000	9
September 3-4, 1986	6,300	40,000	1,300	500	1,000	1,150	4,000	2,400	1,800	4,000	4,600	1,800	3,600	500	40,000	13
December 3-4, 1986	13,400	3,300	6,800	300	2,300	500	300	700	1,200	3,600	2,700	300	2,000	300	13,400	13
March 4-5, 1987	5,200	Dry	7,200	100	1,700	33,000	500	800	800	1,650	14,400	900	2,900	100	33,000	12
Minimum	5,200	3,300	1,300	100	300	500	300	700	800	1,650	2,100	300	900			
Maximum	13,400	40,000	13,000	2,800	2,300	33,000	4,000	16,800	1,800	4,000	14,400	1,800	3,600			
N	4	3	4	4	4	3	4	4	3	3	4	3	4			

Stations	Min	Max	N
CC-1, CC-2 (upper reach)	3,300	40,000	7
CC-3, CC-4 (mid reach)	100	13,000	8
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	100	40,000	19
SC-4, SC-1 (upper reach - west)	700	16,800	8
SC-3, SC-7 (upper reach - east)	300	4,000	6
SC-2, SC-8 (mid reach)	800	3,600	7
SC-1, SC-2, SC-3, SC-4, SC-7, SC-8 (entire basin)	300	16,800	21
All 13 Stations	100	40,000	47

N - number of observations

[a] Applicable surface water quality criteria (State and County): maximum of 2,400/100 ml.

[b] Catfish Creek/Trunk Ditch, Elligraw Bayou and North Creek stations sampled on first day of event, South Creek stations on second day.

Appendix Table A - 23

Continuing Surface Water Quality Monitoring Program

Fecal Coliform (count/100 ml)[a]

April 1986 - March 1987

Sampling Date[b]	Catfish Creek/ Trunk Ditch					Elligraw	North	South Creek						All Stations		
	CC-1	CC-2	CC-3	CC-4	CC-5	EL-1A	NC-6	SC-1	SC-2	SC-3	SC-4	SC-7	SC-8	Min	Max	N
June 16-17, 1986	300	1,600	1,800	640	50	Dry	240	1,300	Dry	Dry	310	Dry	<10	<10	1,800	9
September 3-4, 1986	720	60	520	20	130	140	320	230	20	20	1,260	<20	200	20	1,260	13
December 3-4, 1986	1,600	110	2,920	110	280	40	40	90	140	880	1,580	30	440	30	2,920	13
March 4-5, 1987	1,080	Dry	3,700	150	250	10,200	130	660	155	100	4,300	145	1,220	100	10,200	12
Minimum	300	60	520	20	50	40	40	90	20	20	310	<20	<10			
Maximum	1,600	1,600	3,700	640	280	10,200	320	1,300	155	880	4,300	145	1,220			
N	4	3	4	4	4	3	4	4	3	3	4	3	4			

Stations	Min	Max	N
CC-1, CC-2 (upper reach)	60	1,600	7
CC-3, CC-4 (mid reach)	20	3,700	8
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	20	3,700	19
SC-4, SC-1 (upper reach - west)	90	4,300	8
SC-3, SC-7 (upper reach - east)	20	880	6
SC-2, SC-8 (mid reach)	<10	1,220	7
SC-1, SC-2, SC-3, SC-4, SC-7, SC-8 (entire basin)	<10	4,300	21
All 13 Stations	<10	10,200	47

N - number of observations

[a] Applicable surface water quality criteria (State): maximum of 800/100 ml.

[b] Catfish Creek/Trunk Ditch, Elligraw Bayou and North Creek stations sampled on first day of event, South Creek stations on second day.

APPENDIX B. CONTRACT LABORATORY REPORTS

Enviropact
of Tampa Bay, Inc.
Environmental Consulting and Analysis

11181 43 Street North
Clearwater, Florida 33520

Telephone: (813) 223-5804
Telephone: (813) 577-9663

Conservation Consultants, Inc .
P.O. Box 35
Palmetto, Fl. 33561 0035

June 26, 1986
Report T3114
Lab I.D. #84271

Sample Received: 6/17/86
Sample Designation: Lab No.: 075 02451; 075 02452; 075 02453; 075 02454; 075 02455; 075 02456
Collected By: Your Rep.

REPORT OF ANALYSIS	OIL AND GREASE	UNITS
CC 1	13	mg/l
CC 2	10	mg/l
CC 3	17	mg/l
CC 4	<1	mg/l
CC 5	<1	mg/l
NC 6	<1	mg/l

Analysis made in accordance with E.P.A., A.S.T.M., Standard Methods or other approved methods.

Respectfully submitted,

Andrew R. Tintle
Laboratory Supervisor

Enviropact of Tampa Bay, Inc.
Environmental Consulting and Analysis

11181 43 Street North
Clearwater, Florida 33520

Telephone: (813) 223-5804
Telephone: (813) 577-9663

Conservation Consultants, Inc.
P.O. Box 35
Palmetto, FL. 33561 0035

July 15,1986
Report T 3115
LAB ID #84271

Sample Received: 6/17/86
Sample Designation: Project #0380 502, SC 1, SC 4, and SC 8
Collected By: Your Rep.

REPORT OF ANALYSIS	OIL AND GREASE	UNITS
SC 1	<1	mg/l
SC 4	<1	mg/l
SC 8	<1	mg/l

Analysis made in accordance with E.P.A., A.S.T.M., Standard Methods or other approved methods.

Respectfully submitted,

Francis L. Corden
Laboratory Supervisor

ENVIROPACT

Conservation Consultants, Inc.
P. O. Box 35
Palmetto, Fl. 33561-0035

July 15, 1987
Report T-3550
LAB ID# 84271
Corrected Report

Sample Received: 9/19/86
Sample Designation: Project 0380-502
Collected By: Your Rep.

REPORT OF ANALYSIS	SC3	UNITS
METALS		
Arsenic	<0.005	mg/l
Mercury	<0.0001	mg/l
Oil and Grease	<1	mg/l

REPORT OF ANALYSIS	SC3	DETECTION LIMIT	UNITS
EPA 608			
Aldrin	BDL *	0.004	ug/l
alpha - BHC	BDL	0.003	ug/l
beta - BHC	BDL	0.006	ug/l
delta - BHC	BDL	0.009	ug/l
gamma - BHC	BDL	0.004	ug/l
Chlordane	BDL	0.014	ug/l
4,4' - DDD	BDL	0.011	ug/l
4,4' - DDE	BDL	0.004	ug/l
4,4' - DDT	BDL	0.012	ug/l
Dieldrin	BDL	0.002	ug/l
Endosulfan I	BDL	0.014	ug/l
Endosulfan II	BDL	0.004	ug/l
Endosulfan Sulfate	BDL	0.066	ug/l
Endrin	BDL	0.006	ug/l
Endrin Aldehyde	BDL	0.023	ug/l
Heptachlor	BDL	0.003	ug/l
Heptachlor Epoxide	BDL	0.083	ug/l
Toxaphene	BDL	0.24	ug/l
Polychlorinated Biphenyls	BDL	0.065	ug/l

*BDL - Below Detection Limit

Analyses made in accordance with E.P.A., A.S.T.M., Standard Methods or other approved methods.

Respectfully submitted,

Michael T. Osinski

Michael T. Osinski
Laboratory Manager

ENVIROPACT SERVICES, INC.
TAMPA DIVISION
5180 113th AVENUE NORTH
CLEARWATER, FL 34620-4835
(813) 577-9663

ENVIROPACT

Conservation Consultants, Inc.
P.O. Box 35
Palmetto, FL 33561-0035

July 15, 1987
Report T-3483
LAB ID #84271
Page 1 of 2
Corrected Report

Samples Received 9/5/86
Sample Designation: Project #0380-502
Collected By: Your Rep.

REPORT OF ANALYSIS	SC 1	SC 2	SC 4	UNITS
METALS				
Arsenic	<0.005	<0.005	<0.005	mg/l
Mercury	<0.0001	<0.0001	<0.0001	mg/l
Oil and Grease	<1	2	<1	mg/l

REPORT OF ANALYSIS	SC 1	SC 2	SC 4	DETECTION LIMIT	UNITS
EPA 608					
Endrin	BDL*	BDL	BDL	0.006	ug/l
Toxaphene	BDL	BDL	BDL	0.24	ug/l
Aldrin	BDL	BDL	BDL	0.004	ug/l
Dieldrin	BDL	BDL	BDL	0.002	ug/l
Endrin Aldehyde	BDL	BDL	BDL	0.023	ug/l
Heptachlor	BDL	BDL	BDL	0.003	ug/l
Heptachlor Epoxide	BDL	BDL	BDL	0.083	ug/l
Alpha BHC	BDL	BDL	BDL	0.003	ug/l
Beta BHC	BDL	BDL	BDL	0.006	ug/l
Gamma BHC	BDL	BDL	BDL	0.004	ug/l
Delta BHC	BDL	BDL	BDL	0.009	ug/l
Endosulfan Sulfate	BDL	BDL	BDL	0.066	ug/l
Chlordane	BDL	BDL	BDL	0.014	ug/l
4,4' - DDD	BDL	BDL	BDL	0.011	ug/l
4,4' - DDT	BDL	BDL	BDL	0.012	ug/l
4,4' - DDE	BDL	BDL	BDL	0.004	ug/l
Endosulfan I	BDL	BDL	1.7	0.014	ug/l
Endosulfan II	BDL	BDL	BDL	0.004	ug/l
Polychlorinated Biphenyls	BDL	BDL	BDL	0.065	ug/l

*BDL - Below Detection Limit

ENVIROPACT SERVICES, INC.
TAMPA DIVISION
5180 113th AVENUE NORTH
CLEARWATER, FL 34620-4835
(813) 577-9663

Conservation Consultants, Inc.

Report T-3483

July 15, 1987

REPORT OF ANALYSIS	SC 7	SC 8	UNITS
METALS			
Arsenic	<0.005	<0.005	mg/l
Mercury	<0.0001	<0.0001	mg/l
Oil and Grease	2	2	mg/l

REPORT OF ANALYSIS	SC 7	SC 8	DETECTION LIMIT	UNITS
EPA 608				
Endrin	BDL*	BDL	0.006	ug/l
Toxaphene	BDL	BDL	0.24	ug/l
Aldrin	BDL	BDL	0.004	ug/l
Dieldrin	BDL	BDL	0.002	ug/l
Endrin Aldehyde	BDL	BDL	0.023	ug/l
Heptachlor	BDL	BDL	0.003	ug/l
Heptachlor Epoxide	BDL	BDL	0.083	ug/l
Alpha BHC	BDL	BDL	0.003	ug/l
Beta BHC	BDL	BDL	0.006	ug/l
Gamma BHC	BDL	BDL	0.004	ug/l
Delta BHC	BDL	BDL	0.009	ug/l
Endosulfan Sulfate	BDL	BDL	0.066	ug/l
Chlordane	BDL	BDL	0.014	ug/l
4,4' - DDD	BDL	BDL	0.011	ug/l
4,4' - DDT	BDL	BDL	0.012	ug/l
4,4' - DDE	BDL	BDL	0.004	ug/l
Endosulfan I	BDL	3.8	0.014	ug/l
Endosulfan II	BDL	BDL	0.004	ug/l
Polychlorinated Biphenyls	BDL	BDL	0.065	ug/l

*BDL - Below Detection Limit

Analyses made in accordance with E.P.A., A.S.T.M., Standard Methods or other approved methods.

Respectfully submitted,

Michael T. Osinski

Michael T. Osinski
Laboratory Manager

ENVIROPACT

Conservation Consultants, Inc.
P.O. Box 35
Palmetto, FL. 33561-0035

July 15, 1987
Report T-3482
LAB ID #84271

Corrected Report

Sample Received: 9-5-86
Sample Designation: Project #0380-502
Collected By: Your Rep.

REPORT OF ANALYSIS	CC 1	CC 2	CC 3	DETECTION LIMIT	UNITS
METALS					
Arsenic	<0.005	<0.005	<0.005	-----	mg/l
Mercury	<0.0001	<0.0001	<0.0001	-----	mg/l
Oil and Grease	3	3	<1	-----	mg/l
ORGANOCHLORINE PESTICIDES AND PCBs EPA METHOD 608					
Aldrin	BDL*	BDL	BDL	0.004	ug/l
Alpha - BHC	BDL	BDL	BDL	0.003	ug/l
Beta - BHC	BDL	BDL	BDL	0.006	ug/l
Delta - BHC	BDL	BDL	BDL	0.009	ug/l
Gamma - BHC	BDL	BDL	BDL	0.004	ug/l
Chlordane	BDL	BDL	BDL	0.014	ug/l
4,4' - DDD	BDL	BDL	BDL	0.011	ug/l
4,4' - DDE	BDL	BDL	BDL	0.004	ug/l
4,4' - DDT	BDL	BDL	BDL	0.012	ug/l
Dieldrin	BDL	BDL	BDL	0.002	ug/l
Endosulfan I	BDL	5.2	BDL	0.014	ug/l
Endosulfan II	BDL	BDL	BDL	0.004	ug/l
Endosulfan Sulfate	BDL	BDL	BDL	0.066	ug/l
Endrin	BDL	BDL	BDL	0.006	ug/l
Endrin Aldehyde	BDL	BDL	BDL	0.023	ug/l
Heptachlor	BDL	BDL	BDL	0.003	ug/l
Heptachlor Epoxide	BDL	BDL	BDL	0.083	ug/l
Toxaphene	BDL	BDL	BDL	0.24	ug/l
Polychlorinated Biphenyls	BDL	BDL	BDL	0.065	ug/l

*BDL - Below Detection Limit

ENVIROPACT SERVICES, INC.
TAMPA DIVISION
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CLEARWATER, FL 34620-4835
(813) 577-9663

Conservation Consultants, Inc.

Report T-3482

July 15, 1987

REPORT OF ANALYSIS	CC 4	CC 5	DETECTION LIMIT	UNITS
METALS				
Arsenic	<0.005	<0.005	-----	mg/l
Mercury	<0.0001	<0.0001	-----	mg/l
Oil and Grease	<1	<1	-----	mg/l
ORGANOCHLORINE PESTICIDES AND PCBs EPA METHOD 608				
Aldrin	BDL*	BDL	0.004	ug/l
Alpha - BHC	BDL	BDL	0.003	ug/l
Beta - BHC	BDL	BDL	0.006	ug/l
Delta - BHC	BDL	BDL	0.009	ug/l
Gamma - BHC	BDL	BDL	0.004	ug/l
Chlordane	BDL	BDL	0.014	ug/l
4,4' - DDD	BDL	BDL	0.011	ug/l
4,4' - DDE	BDL	BDL	0.004	ug/l
4,4' - DDT	BDL	BDL	0.012	ug/l
Dieldrin	BDL	BDL	0.002	ug/l
Endosulfan I	BDL	BDL	0.014	ug/l
Endosulfan II	BDL	BDL	0.004	ug/l
Endosulfan Sulfate	BDL	BDL	0.066	ug/l
Endrin	BDL	BDL	0.006	ug/l
Endrin Aldehyde	BDL	BDL	0.023	ug/l
Heptachlor	BDL	BDL	0.003	ug/l
Heptachlor Epoxide	BDL	BDL	0.083	ug/l
Toxaphene	BDL	BDL	0.24	ug/l
Polychlorinated Biphenyls	BDL	BDL	0.065	ug/l

*BDL - Below Detection Limit

Conservation Consultants, Inc

Report T-3482

July 15, 1987

REPORT OF ANALYSIS	ELA	NC 6	DETECTION LIMIT	UNITS
METALS				
Arsenic	<0.005	<0.005	-----	mg/l
Mercury	<0.0001	<0.0001	-----	mg/l
Oil and Grease	<1	<1	-----	mg/l
ORGANOCHLORINE PESTICIDES AND PCBs EPA METHOD 608				
Aldrin	BDL*	BDL	0.004	ug/l
Alpha - BHC	BDL	BDL	0.003	ug/l
Beta - BHC	BDL	BDL	0.006	ug/l
Delta - BHC	BDL	BDL	0.009	ug/l
Gamma - BHC	BDL	BDL	0.004	ug/l
Chlordane	BDL	BDL	0.014	ug/l
4,4' - DDD	BDL	BDL	0.011	ug/l
4,4' - DDE	BDL	BDL	0.004	ug/l
4,4' - DDT	BDL	BDL	0.012	ug/l
Dieldrin	BDL	BDL	0.002	ug/l
Endosulfan I	BDL	16.5	0.014	ug/l
Endosulfan II	BDL	BDL	0.004	ug/l
Endosulfan Sulfate	BDL	BDL	0.066	ug/l
Endrin	BDL	BDL	0.006	ug/l
Endrin Aldehyde	BDL	BDL	0.023	ug/l
Heptachlor	BDL	BDL	0.003	ug/l
Heptachlor Epoxide	BDL	BDL	0.083	ug/l
Toxaphene	BDL	BDL	0.24	ug/l
Polychlorinated Biphenyls	BDL	BDL	0.065	ug/l

*BDL - Below Detection Limit

Analyses made in accordance with E.P.A., A.S.T.M., Standard Methods or other approved methods.

Respectfully submitted,

Michael T. Osinski
Laboratory Manager

Enviropact of Tampa Bay
Environmental Consulting and Analysis

11181 43 Street North
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Telephone: (813) 223-5804
Telephone: (813) 577-9663

DEC 1986
RECEIVED
C.C.I.

Conservation Consultants, Inc.
P.O. Box 35
Palmetto, FL. 33561-0035

December 23,1986
Report T-3884
LAB ID #84271

Sample Received: 12-4-86
Sample Designation: Project #0380-502
Collected By: Your Rep.

REPORT OF ANALYSIS	OIL AND GREASE	UNITS
194-02834 CC 1	<1	mg/l
194-02825 CC 2	3	mg/l
194-02826 CC 3	<1	mg/l
194-02827 CC 4	<1	mg/l
194-02828 CC 5	<1	mg/l
194-02829 ELIA	1	mg/l
194-02830 NC 6	<1	mg/l

Analyses made in accordance with E.P.A., A.S.T.M., Standard Methods or other approved methods.

Respectfully submitted,

James G. Clayton

James G. Clayton
Laboratory Supervisor

Enviropact of Tampa Bay
Environmental Consulting and Analysis

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Conservation Consultants, Inc.
P. O. Box 35
Palmetto, FL. 33561-0035

December 19, 1986
Report T-3906
LAB # 84271

Samples Received: 12-05-86
Sample Designation: Project # 0380-501
Collected By: Your Rep.

REPORT OF ANALYSIS	SC-1	SC-2	SC-3	UNITS
Oil and Grease	1	<1	<1	mg/l
	SC-4	SC-7	SC-8	
Oil and Grease	2	<1	<1	mg/l

Analyses made in accordance with E.P.A., A.S.T.M., Standard Methods or other approved methods.

Respectfully submitted,

James G. Clayton

James G. Clayton
Laboratory Supervisor

Enviropact, Inc.
Environmental Consulting and Analysis

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Fla. Wats: (800) 432-9706

Conservation Consultants, Inc.
P.O. Box 35
Palmetto, FL 33561

March 17, 1987
Report T-4274
LAB ID #84271

Sample Received: 3-5-87
Sample Designation: Project #0380-502
Collected By: Your Rep.

REPORT OF ANALYSIS	042-02981	042-02982	042-02983	UNITS
Oil & Grease	2	2	<1	mg/l

REPORT OF ANALYSIS	042-02984	042-02985	042-02986	UNITS
Oil & Grease	<1	2	<1	mg/l

Analyses made in accordance with E.P.A., A.S.T.M., Standard Methods or other approved methods.

Respectfully submitted,

Andrew R. Tintle
Laboratory Supervisor

Enviropact, Inc.
Environmental Consulting and Analysis

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Clearwater, Florida 33520

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Conservation Consultants, Inc.
P.O. Box 35
Palmetto, FL 33561

March 23, 1987
Report T-4275
LAB ID #84271
Page 1 of 1

Sample Received: 3-5-87
Sample Designation: Project #0380-502
Collected By: Your Rep.

REPORT OF ANALYSIS	042-02987	042-02988	042-02989	UNITS
Oil & Grease	<1	<1	<1	mg/l

REPORT OF ANALYSIS	042-02990	042-02991	042-02992	UNITS
Oil & Grease	<1	<1	<1	mg/l

Analyses made in accordance with E.P.A., A.S.T.M., Standard Methods or other approved methods.

Respectfully submitted,

Andrew R. Tintle
Laboratory Supervisor

APPENDIX C. MONITORING TEAM

H. LEE DAVIS, Ph.D.
Principal Scientist

FIELDS OF COMPETENCE

Water Resource Planning and Mitigation Concepts, Design and Restoration, Toxicology and Water Chemistry, Limnology and Oceanography.

EXPERIENCE SUMMARY

Dr. H. Lee Davis has gained 20 years of applied research and environmental consulting experience in the field of water resources. Much of his applied research experience has been with evaluations of physical, chemical, and biological changes in natural systems resulting from watershed development and drainage, mining and cooling tower blowdown, point-sources and toxic waste effects, eutrophication, and dredge spoil disposal. In serving both the private and public sectors since 1971, he has employed this experience in planning and permitting studies for industry, utilities, municipalities, land developers and water management authorities. Many of these projects have involved stormwater management, wetland and stream restoration, expansion and protection of potable water supplies, harbor maintenance, and development of impoundments and marinas.

In addition, Dr. Davis has been responsible for the technical supervision and management of professional staffs of water resource scientists, engineers and chemists since 1968. Prior to joining CCI, Dr. Davis held the position of Water Resource Supervisor with Envirosphere Company, the environmental department of Ebasco Services, Inc. His experience from 1971 to 1978 was gained at Environmental Science and Engineering, Inc. where he was the Manager of the Environmental Sciences Division. During the first six years of his career, Dr. Davis was a research assistant at North Carolina State University and a research associate at the University of North Carolina. In these early positions, he supervised field and laboratory operations for studies related to phosphate mining and barrier island development.

EDUCATION

YEAR	SCHOOL
1971	North Carolina State University Ph.D., Marine Science (Marine Chemistry)
1968	North Carolina State University M.S., Zoology (Limnology)
1965	Wilmington College (University of North Carolina - Wilmington, N.C.) B.A., Chemistry and Biology

H. LEE DAVIS, Ph.D.
Principal Scientist

EMPLOYMENT HISTORY

1981 - Present	Conservation Consultants, Inc. Principal Scientist
1978 - 1981	Ebasco Services, Inc. Supervisor, Water Resources/ Envirosphere - Atlanta, Georgia
1971 - 1978	Environmental Science & Engineering, Inc. Director, Environmental Sciences Division ('75-'78) Director, Tampa Regional Office ('77-'78) Project Manager ('73-'78) Leader, Aquatic Sciences Group ('73-'75)
1970 - 1971	University of North Carolina Biology Department Wilmington, North Carolina Research Associate
1965 - 1970	North Carolina State University Pamlico Marina Laboratory Aurora, North Carolina Research Assistant

KEY PROJECTS

City of Bradenton: Principal Investigator for Water Quality Impact Assessment and Monitoring of Reservoir Expansion and Improvement Project; Bill Evers Reservoir, Manatee County, Florida.

Ramar Group Companies, Inc.: Project Manager for Water Quality Impact Assessment related to Stormwater Management Plan for 500-acre, planned residential community on the Caloosahatchee River; Lee County, Florida. Project scope included background monitoring, literature review to determine probable pollutant loadings for undeveloped and developed site, projection of mass loading impacts on water quality, and technical report.

Tara, Ltd.: Principal Investigator to prepare report characterizing background water quality on a 1,100-acre tract; performed statistical analysis of data from one-year water quality/water flow program (11 sites, monthly sampling); performed literature review and was primary author of report.

KEY PROJECTS (Continued)

Palmer Venture: Principal Investigator to monitor and to determine the stormwater pollutant loads and to evaluate the lake management plans for several incremental developments on the 5,000-acre north tract of the Palmer Ranch. Sarasota County, Florida.

Farmland Industries: Principal Investigator for an ecological assessment of the effects of high conductivity levels in the upper reaches of the North Prong Alafia River watershed. Polk County, Florida.

Southwest Florida Water Management District: Principal Investigator to characterize surface water quality of the Delaney Creek Watershed and to evaluate the proposed Stormwater Management Plan including a comprehensive evaluation of alternatives and the development of mitigative measures. Hillsborough County, Florida.

City of Bradenton: Principal Scientist to prepare a report of the existing and anticipated aquatic weed problems of the Bill Evers Reservoir and an analysis of the weed control programs. Submitted to the Evers Reservoir Management Committee, Bradenton, Florida.

Fowler, White, Gillen, Boggs, Villareal & Banker, P.A.: Principal Scientist to perform a data search, review, and analysis of annual cycles and spatial trends in dissolved oxygen and related parameters reported by past and ongoing studies performed in the tidal reach of the Manatee River. Manatee County, Florida.

American Cyanamid Company: Principal Investigator to perform a water quality impact assessment of six dragline and utility line crossings of the South Prong Alafia River during construction, operation, and reclamation phases. Subsequently served as the Senior Advisor on the construction and reclamation water quality monitoring program for the actual crossings. Hillsborough County, Florida.

American Cyanamid Company: Principal Scientist to perform a water quality baseline characterization of significant temporal and spatial trends in nutrient loads, dissolved oxygen, pH, fluoride, and other water quality parameters, for a 42-mile stretch of the South Prong Alafia River from Hookers Prairie to its confluence with the North Prong Alafia River during the period of 1965-1984. Hillsborough County, Florida.

American Cyanamid Company: Project Manager of the Supplement to the Development of Regional Impact Application related to various significant deviations from the original approved mine plan including floodplain crossings, mine expansion, and additional clay settling areas. Four Corners Mine, Hillsborough County, Florida.

KEY PROJECTS (Continued)

American Cyanamid Company: Project Manager for the baseline characterization of surface and ground water quality of three sub-basins of the South Prong Alafia River Basin as related to permit applications to mine within jurisdictional wetlands. Subsequently served as a Principal Scientist on the reclamation monitoring programs of the mined streams. Hillsborough County, Florida.

Holland and Knight: Principal Scientist for the assessment of potential adverse water quality impacts of proposed mining operations in selected wetlands and streams of the Alafia River Basin and an assessment of the feasibility to successfully reclaim mined watersheds. Hillsborough County, Florida.

AMAX Chemical Corporation: Principal Scientist for an evaluation of spatial and temporal trends of the saltwater - freshwater interface in Bishop Harbor and a contiguous tributary as related to permit renewal. Manatee County, Florida.

Agrico Chemical Company: Principal Investigator to evaluate the cause of an extreme range in pH in a chemical plant, wastewater holding pond. Subsequently developed and evaluated conceptual alternatives to control pH and related non-compliance parameters. Polk County, Florida.

Honeycomb Company of America: Project Manager to evaluate the quality of industrial wastewater from an aluminum honeycomb manufacturing facility as related to its suitability for discharge into a public sewer system. Manatee County, Florida.

Manatee County Planning and Development Department: Principal Scientist to evaluate the proposed Cooper Creek Development with respect to the possible impacts it could have on the quality of the drinking water supply of the Bill Evers Reservoir as well as its source waters. Manatee County, Florida.

Knepper & Willard, Inc.: Principal Scientist to characterize baseline water quality conditions for a 2,500-acre residential, commercial, and industrial development site and to evaluate the anticipated level of mitigation expected to be achieved through the implementation of a stormwater management plan. Saddlebrook Ranch, Pasco County, Florida.

Beker Phosphate Corporation: Principal investigator for An Evaluation of Environmental Significance of Phosphorus Levels in the discharge of clay settling pond effluent into Wingate Creek, Manatee County, Florida.

KEY PROJECTS (Continued)

Pan American Plant: Project Manager to conceptually design a source of low conductivity irrigation water for a plant nursery in lieu of high conductivity ground water sources. Manatee County, Florida.

Jacksonville Electric Authority: Project Scientist for the Evaluation of, Construction and Operation of an Ocean Going Barge Unloading Facility on Blount Island on the Water Quality and Aquatic Biology of the St. Johns River.

Carolina Power and Light: Project Investigator for the Evaluation of Cooling Water Design Alternatives including an Ocean Intake Five (5) Mile Long Pipeline Alternative to Mitigate Ecological Impacts on the Cape Fear River, 1200 MW Nuclear Power Plant. Southport, North Carolina.

Jacksonville Electric Authority: Co-principal Investigator for the preparation of a Site Certification Application and Environmental Impact Draft - Impact on Water Resources. Proposed 2-600 MW Unit Coal Fired Power Plant, Jacksonville, Florida.

Smith-Douglass Division of Borden Chemical: Project Manager for the preparation of Development of Regional Impact Application - Impact on Environment and Natural Resources. Wastewater discharge permits and baseline water quality monitoring program. Big Four Mine, Hillsborough County, Florida.

Offshore Power Systems: Principal Investigator for the pre-operational and operational assessment of a Dredge-Spoiling Operation in the St. Johns River; determination of reduced sulfur gas emissions from estuarine sediments. Jacksonville, Florida.

Mobile District, Corps of Engineers: Principal Investigator for the Development of a water quality and fishery assessment in the tailrace waters of West Point Dam, Georgia.

Texasgulf Company: Assistance in a long-term assessment of the nitrogen and phosphate budgets of the Pamlico River Estuary. Phosphate mine and fertilizer plant, Lee Creek, North Carolina.

Jacksonville Electric Authority: Principal Investigator for a two-year assessment of entrainment and impingement rates, fish return system effectiveness and thermal loading at the Northside Generating Station, a once-through cooled 1200 MW plant. St. Johns River, Jacksonville, Florida.

KEY PROJECTS (Continued)

New Orleans District, Corps of Engineers: Project Advisor for preparation of the Draft Environmental Report to perform maintenance dredging in the Gulf Intracoastal Waterway. Louisiana.

Southern States Energy Board: Co-principal Investigator; feasibility and impact assessment of a 16 Unit Nuclear Energy Park - Impact on water resources. Lake Hartwell, South Carolina.

SELECTED REPORTS

Davis, H. L. 1968. The net exchanges of phosphate by estuarine sediment in flowing waters. M.S. Thesis. North Carolina State University. 41 pages.

Davis, H. L. 1971. Evaluation and use of pCO_2 in studying community metabolism in heated experimental ecosystems. Ph.D. Dissertation. North Carolina State University. 90 pages.

Copeland, B. J. and H. L. Davis. 1972. Estuarine ecosystems and high temperatures. North Carolina State University. State College of Agriculture and Engineering. Raleigh. Water Resources Research Institute. Report No. 68. 101 pages.

Davis, H. L. and K. D. Wilson. 1975. Analysis of pollution from marine engines and effects on the environment - southern lakes. U.S.E.P.A., Report No. 71-060-003. 226 pages.

Davis, H. L. 1982. Pre-development surface water quality monitoring report. Tara Planned Unit Development Site, Manatee County, Florida. Prepared for TARA, LTD., Bradenton, Florida. 146 pages.

Davis, H. L. 1983. Bradenton reservoir improvements pre-construction water quality monitoring and water quality impact assessment report. Manatee County, Florida. Prepared for Smith and Gillespie Engineers, Inc. Jacksonville, Florida. 287 pages.

Davis, H. L. 1984. A review of dissolved oxygen and related water quality conditions for the lower Manatee River, Manatee County, Florida. Prepared for Fowler, White, et al., P.A. Tampa, Florida. 57 pages.

Davis, H. L. and W. W. Hamilton. 1984. Aquatic weeds in the Bill Evers Reservoir. Prepared for Evers Reservoir Management Committee. Bradenton, Florida. 13 pages.

SELECTED REPORTS (Continued)

Davis, H. L., J. M. Emery and L. J. Swanson. 1985. Systems characterization, Delaney Creek stormwater management master plan, Hillsborough County, Florida. Prepared for Ghioto, Singhofen and Associates, Orlando, Florida. 234 pages.

MEMBERSHIPS

American Society of Limnology and Oceanography
Southeastern Estuarine Research Society
Ecological Society of America

RICHARD W. ODELL
Staff Scientist

FIELDS OF COMPETENCE

Water Quality Monitoring, Biological Sample Collection/Processing, Automatic Instrumentation, Data Acquisition, Field Methodology/ Quality Assurance, Marine Biology, Air Quality Sampling, Visible Emissions

EXPERIENCE SUMMARY

Mr. Odell has six years of experience in environmental technical services. He has worked directly in the areas of water resources, aquatic biology, and wetlands. He has served as a coordinator, field team member, and quality assurance officer for numerous field sampling projects. He has completed all phases of surface water quality investigations including *in situ* measurements, grab samples, flow determinations, solar irradiance and light attenuation, automatic data acquisition, and composite sampling. He has monitored groundwater via well installations, water level measurements, and grab samples. He has collected and processed aquatic biological samples, participated in wetland jurisdiction determinations, and revegetated wetlands for mitigative purposes. Additionally, Mr. Odell has been active in data management and report preparation.

EDUCATION

YEAR	SCHOOL
1975	Delta State University Cleveland, Mississippi B.S. - Biology
1978	University of Southern Mississippi Hattiesburg, Mississippi 60 credit hours in Graduate Level Marine Biology, Environmental Physiology

RICHARD W. ODELL
Staff Scientist

EMPLOYMENT HISTORY

1980 - Present Conservation Consultants, Inc.

KEY PROJECTS

American Cyanamid Co.: Field Services Coordinator for background and post-reclamation monitoring of three wetland streams. Duties included project mobilization, grab and biological sample collection, automatic water quality data acquisition, data management, and report preparation.

American Cyanamid Co.: Field Technician for background assessment of wetland sources in the Little Manatee River drainage basin. Duties included stream flow measurements and grab sample collection.

American Cyanamid Co.: Field Team Leader for revegetation of wetland with native plant species. Duties included mobilization, site survey, and planting.

Applied Optics, Inc.: Field Technician for beryllium emissions evaluations during two-year period. Duties included equipment calibration and installation, in stack sampling, sample recovery, and data management.

CF Mining Corp.: Field Team Leader for background aquatic biological assessment of freshwater stream. Duties included installation and recovery of artificial substrate sampling devices and sample processing.

City of Bradenton: Field Team Leader for pre-construction and construction phase water quality monitoring of Bill Evers Reservoir. Duties included project mobilization, grab sample collection, in situ measurements, flow measurements, light attenuation and solar irradiance measurements, data management, and report preparation.

Florida Power and Light Co.: Field Technician and Field Team Leader for particulate emissions evaluations during three-year period. Duties included equipment installation, in stack sampling, and data management.

Honeycomb Co. of America: Field Technician for investigation of industrial wastewater discharge. Duties included mobilization, flow measurements, in situ water quality measurements, and preparation of flow-proportional composite sample.

KEY PROJECTS (Continued)

Loral American Beryllium: Field Technician for beryllium emissions evaluations during two-year period. Duties included equipment calibration and installation, in stack sampling, sample recovery, and data management.

Lynnette, Inc.: Field Team Leader for background biological and water quality assessment in Little Sarasota Bay. Duties included benthic biological sampling, water quality profile measurements, grab sample collection, and data management.

Manatee Canvest Corp.: Project Manager and Field Services Coordinator for post-construction water quality monitoring of a marina. Duties included automatic water quality data acquisition, grab sample collection, data management, and report preparation.

Marcove Venture: Field Technician for revegetation of mangrove ecosystem. Duties included mobilization, site survey, and planting.

Miller Trailers, Inc.: Field Technician for compliance visible emissions evaluations of industrial plant during two-year period.

Tara, Ltd.: Field Team Leader for background assessment of water quality and stream flow on 1,100-acre planned residential development site. Duties included grab sample collection, flow measurements, time-series composite sampling, data retrieval from continuous rainfall recorder, and data management.

U.S. Army, Corps of Engineers: Field Services Coordinator of daily monitoring project in association with dredge and dredge material disposal operations of the Tampa Harbor Deepening project. Served as Project Field Technician initially and as Field Services Coordinator for one year of three-year program. Participated in grab sample collection, scheduling, training, and data management.

SHERRIE ANNE LEMAN
Associate Chemist

IELDS OF COMPETENCE

Chemical Analysis of Surface and Ground Water, Drinking Water, Wastewater, Soil and Air; Bacteriological Analysis of Water and Pharmaceutical Products; Statistical Analysis of Data; Analytical Quality Control and Assurance Procedures in Both Chemistry and Microbiology.

EXPERIENCE SUMMARY

Mrs. Leman joined Conservation Consultants, Inc. in 1983. Her work includes both supervision and performance of analytical testing on surface, ground and marine waters; quality control and assurance functions; preparation of laboratory reports and computer compilation of data; preparation and calibration of equipment for field sampling events.

Prior to joining Conservation Consultants, Inc., Mrs. Leman worked at the Manatee County Utilities Water Treatment Plant Laboratory. From 1981 to 1982 she was in charge of both chemical and microbiological quality control and assurance testing of pharmaceutical products and the production area environment. Her previous experience includes positions with Bausch and Lomb, Illinois Environmental Protection Agency, Richmond Sanitary District in Richmond, Indiana, and the South Dakota State University Water Quality Laboratory in Brookings, South Dakota.

EDUCATION

YEAR	SCHOOL
1972-1977	South Dakota State University Brookings, South Dakota Bachelor Degree - Microbiology Minor - Chemistry, Public Health Science

SHERRIE ANNE LEMAN
Associate Chemist

EMPLOYMENT HISTORY

1983 - present	Conservation Consultants, Inc. Environmental Chemistry Laboratory Associate Chemist
1982 - 1983	Manatee County Utilities Department Water Treatment Plant Quality Assurance Laboratory Laboratory Technician II
1981 - 1982	Danker Laboratories Quality Assurance Microbiologist/ Chemist Sarasota, Florida
1979 - 1980	Bausch and Lomb Microbiologist Sarasota, Florida
1978 - 1979	Illinois Environmental Protection Agency Laboratory Technician Champaign, Illinois
1977 - 1978	Richmond Sanitary District Assistant Chemist Richmond, Indiana
1973 - 1977	Water Quality Laboratory South Dakota State University Assistant Laboratory Technician Brookings, South Dakota

ASSOCIATIONS

American Chemical Society
Society of Industrial Microbiologist Society