Characterization of Port Charlotte Water Quality and Comparison to other Southwest Florida Canal Systems

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TABLE OF CONTENTS

BACKGROUND.. 1
Study Context 1
Study Area Description 1

STUDYDESIGN 6
Determination of Current Conditions 6
Sampling Site Selection 6
Sampling Design 6
Continuous Recorders 8
Comparisons with Existing Data Sets 8
Data Sources 8
Water Quality and Trophic State Indices 16
Power and Trend Analyses 18

RESULTS.. 20
Results - Current Water Quality Conditions 20
Dissolved Oxygen 20
Temperature 26
Conductivity/Salinity 26
Color.. 28
Biochemical Oxygen Demand (5 Day) 28
Chlorophyll-a 28
Nutrients 29
Bacteriology 31
Water Quality Index and Trophic State Index 32
Continuous Monitors 35
Results - Comparisons with Existing Data Sets 45
Power Analysis 55
Trend Analysis 55

SUMMARY AND CONCLUSIONS 57

REFERENCES 59

FIGURES AND TABLES

Figure 1. Port Charlotte water quality study area. 2
Figure 2. Existing and proposed wastewater service areas, Port Charlotte, Florida, 1994. . . . . :. 5
Figure 3. Monitor station locations and numbers. Mote Marine Laboratory Port Charlotte Water Quality Monitoring, 1994. 7

%Figure 4. Geographic coverage. Station locations for all data excluding MML/Port Charlotte. 10
Figure 5. Rainfall during the Port Charlotte water quality monitoring. Blue - rainfall, Red - sampling dates. Source: Charlotte County landfill. 25
Figure 6. WQI vs. median salinity, MML/Port Charlotte data. Numbers are station identification numbers. The line represents the least squares regression, p = 0 . 0 2 34
Figure 7. WQI vs. log of the estimated number of dwelling units affecting that station. The line represents the least squares regression, p =0.14. 36
Figure 8. WQI vs. log of the number of canal adjacent septic systems above each station. The line represents the least squares regression, p = 0.13. 37
Figure 9. WQI vs. log of dwelling units plus log of septic systems. The line represents the least squares regression, p =0.04. 38
Figure 10. TSI vs. median salinity, MML/Port Charlotte data. Numbers are station identification numbers. The line represents the least squares regression p=0.09. 39
Figure 11. WQI and TSI vs. time, with rain (in.) and temperature (C) at Port Charlotte. WQI and TSI are the from the median values for all fresh and saline stations, respectively. The rain has been accumulated over the 96 hours prior to the date identified. 40
Figure 12. Continuous data recorded at Station 1. 41
Figure 13. Continuous data recorded at Station 2. 42
Figure 14. Continuous data recorded at Station 29. 43
Figure 15. Continuous data recorded at Station 17. 44
Figure 16. WQI vs. median salinity for Port Charlotte and other regional datasets with similar trend. 51
Figure 17. WQI vs. median salinity for regional datasets with trend opposite to Port Charlotte data. 52
Figure 18. TSI vs. median salinity for Port Charlotte and STORET data. 53
Figure 19. TSI vs. median salinity for regional datasets with trend opposite to Port Charlotte data. 54

Table 1. Soil characteristics for the Port Charlotte Utility Unit Study Area (from Henderson, 1984). 4
Table 2. *In situ* parameters; Port Charlotte dry season water quality screening. . . .
Table 3. Laboratory parameters; Port Charlotte dry season water quality

Table 4. STORET Stations Retrieved. 11
Table 5. STORET Water Quality Parameters Queried. 13
Table 6. City of Cape Coral monitoring program sampling station descriptions. . . 15
Table 7. Estimated number of septic systems and dwelling units “upstream” of each station. 17
Table 8. Index parameters available in datasets used. 19

Table 9. Range and average values for fresh water stations, all sampling events. Port Charlotte dry season water quality screening. 21
Table 10. Range and average values for bacteria, freshwater stations, all sampling events. Port Charlotte dry season water quality screening. 22
Table 11. Range and average values for salt water stations, all sampling events. Port Charlotte dry season water quality screening. 23
Table 12. Range and average values for bacteria, salt water stations, all sampling events. Port Charlotte dry season water quality screening. 24
Table 13. Dissolved oxygen stress. Port Charlotte dry season water quality screening. 26
Table 14. Times and heights of predicted tides during the Port Charlotte dry season water quality screening. As listed for St. Petersburg and corrected to Punta Gorda, Florida. 27
Table 15. Nitrogen: Phosphorus Ratios. Port Charlotte dry season water quality. . . . 31
Table 16. WQI, TSI and median parameter values for MML/Port Charlotte data. Separated into fresh and estuarine groups, ordered by decreasing water quality. 33
Table 17. Myakka and Peace Rivers water quality average values compared to Port Charlotte fresh water average values. 46
Table 18. Charlotte Harbor water quality ranges compared to Port Charlotte salt water ranges. 46
Table 19. WQI, TSI and median parameter values for STORET data. Separated into fresh and estuarine groups, ordered by decreasing water quality. 48
Table 20. WQI, TSI and median parameter values for Cape Coral data. Separated into fresh and estuarine groups, ordered by decreasing water quality. . . . 49
Table 21. WQI and median parameter values for North Port data. Ordered by decreasing water quality. 49
Table 22. WQI and median parameter values for Pellam Waterway data. Ordered by decreasing water quality. 50
Table 23. TSI and median parameter values for South Gulf Cove data. Ordered by decreasing water quality. 50
Table 24. Results of power analysis on selected STORET data. 56

BACKGROUND

Study Context

As the population growth and development continues throughout the Charlotte Harbor area, environmental stresses also continue to grow. Future nitrogen loading to Charlotte Harbor due to increased runoff from urban areas and increased wastewater production in 2020 have been estimated at 2.5 times the nitrogen load currently delivered to Charlotte Harbor by the Myakka River (Harm-net, 1988). Additional inputs of nitrogen into a nitrogen limited system such as the Harbor, will likely result in overproduction of phytoplankton, algae, and epiphytes, increased dissolved oxygen stress, and decreased sea grass coverage and health. The Harbor already experiences periods of dissolved oxygen stress under certain conditions of flow and salinity stratification (Fraser, 1986).

With concern over increasing anthropogenic nutrient loads, scattered reports of existing water quality problems, and confusion over the quantitative impacts of on-site disposal systems (OSDS) or septic tanks, it was realized that a comprehensive water quality monitoring plan was lacking for the area. Data would be useful to identify specific areas with poorer water quality, potentially identify controlling processes, and, over time, document any existing temporal trends.

Mote Marine Laboratory (MML) was accordingly contracted to design and implement a reconnaissance sampling program to provide background water quality data for the Port Charlotte area. To meet this goal, a diverse set of stations was chosen for monitoring, including canals in areas served by OSDS, as well as in sewered areas; urban areas as well as undeveloped areas; salt water canals as well as fresh. These data can provide information on the current water quality in the canal system, as well as forming a basis of comparison for future studies. The study was not designed to assess the quantitative impacts of septic systems on canal water quality, except as differences may be statistically apparent between sewered and unsewered areas.

The study was also to summarize and characterize available water quality data for canal communities of the southwest coast of Florida, with primary focus on the Charlotte Harbor region. Existing datasets in machine readable form were collected and analyzed statistically and graphically. Parameters examined were those typically associated with water quality changes resulting from excessive nutrient inputs. Data from various locations were compared and evaluated against water quality and trophic state indices. Relationships between water quality and some development characteristics were also examined for Port Charlotte data.

Study Area Description

The town of Port Charlotte is located on Charlotte Harbor on the southwest coast of Florida (Figure 1), between the mouths of the Myakka and Peace Rivers. Charlotte Harbor is the second largest estuary in Florida (approximately 270 square miles) and supports highly productive sport and commercial fisheries, as well as providing habitat for more than thirty threatened or endangered species (SWIM, 1993).

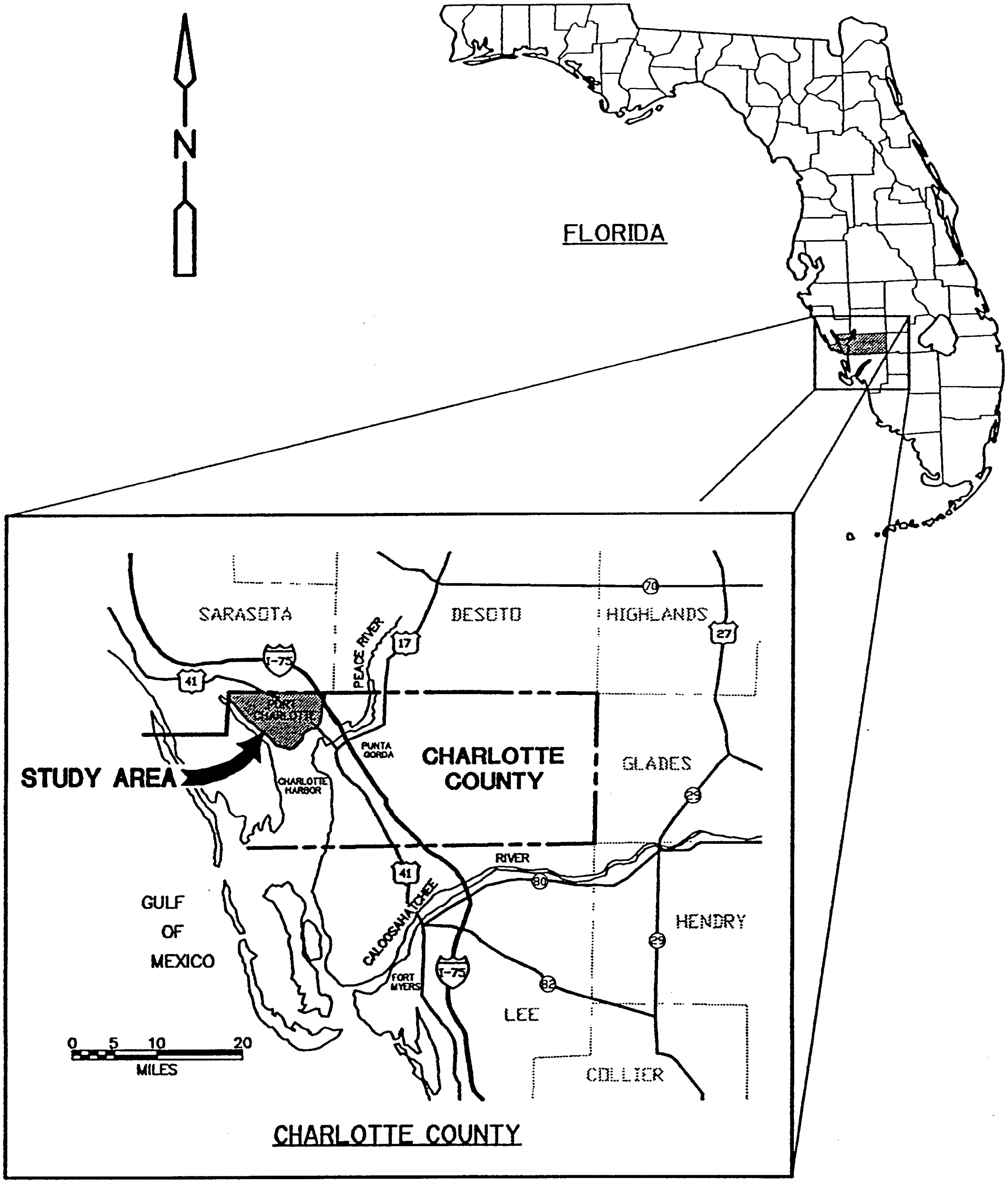


Figure 1. Port Charlotte water quality study area.

Port Charlotte was founded in 1955 when General Development Company purchased 80,000 acres and erected the first building (Henderson, 1984). Since then, as it is one of the major developments in the county, the population growth of the town has paralleled the population growth of Charlotte County. In 1930, there were approximately 4,000 residents of the county; by 1980, this figure had increased to 60,000 (Henderson, 1984). The population in 1990 reached 80,000; projections for 2000 and 2020 are 96,000 and 123,000, respectively (SWIM, 1993).

Although Charlotte Harbor is relatively undeveloped compared to Tampa Bay, land use adjacent to the Harbor is predominantly (40 percent) classified as residential. Large areas have been platted, with minimal roadway construction though the densities of completed residences in many areas is low. The Cocoplum Waterway forms a major east-west canal system along the boundary between Sarasota and Charlotte Counties. Numerous canals and waterways cross the study area from north to south, with at least nine separate canal systems receiving excess water from the Cocoplum Waterway and transporting it south through the study area and eventually to Charlotte Harbor. Water control structures at a number of locations along the canals effectively limit the upstream penetration of salt water and biota. The canal systems were originally built for water supply, flood control, and to increase the land available for development by providing additional drainage and lowering water tables. Canal systems such as these effectively transport water, but are frequently the site of water quality problems associated with increased loads of nutrients, metals, organic compounds, and low dissolved oxygen levels (SWIM, 1993; Florida Department of Natural Resources, 1983; Sarasota Bay National Estuary Program, 1993).

Soil types in the study area are predominantly sandy, level and poorly drained (Table 1). One of the largest areas of manmade soils (ie. fill) in Charlotte County is included in the study area. This area runs southwest and northeast of Highway 41 at Port Charlotte, and is up to 2 miles wide (Henderson, 1984).

Currently sewered areas within the Port Charlotte Utility include seven separate areas (Figure 2). The remaining areas are served by individual OSDS. The study area of Port Charlotte includes nearly 15,000 permitted septic tanks, of which nearly 10,000, or approximately 66 percent, were installed prior to 1983. The typical design-life of these systems has been estimated at fifteen to twenty years (Scalf *et al.*, 1977), and so many of the OSDS may be approaching the limit of their effective life. The Port Charlotte Utility Unit has proposed extending sewerage collection and disposal systems to additional areas indicated on Figure 2, which primarily includes the more densely populated areas currently unsewered.

Table 1. Soil characteristics for the Port Charlotte Utility Unit Study Area (from Henderson, 1984).

Soil Type	% of Study Area	Characteristics	Drainage	Use	Limitations
Wabasso-Isles-Boca	48%	Sandy	Poor	Urban	Severe limitations for building site development and sanitary facilities due to high water table
Oldsmar-Myakka	38%	Sandy	Poor	Urban	Limitations for urban development due to high water table
Matlacha	10%	Sandy with 25% shell fragments and limestone	Somewhat poor	Urban; future urban	Limitations for septic system drain fields
Peckish-Estero-Isles	4%	Mucky sand	Very poor	Urban Natural	Limited urban use due to texture and high water tables

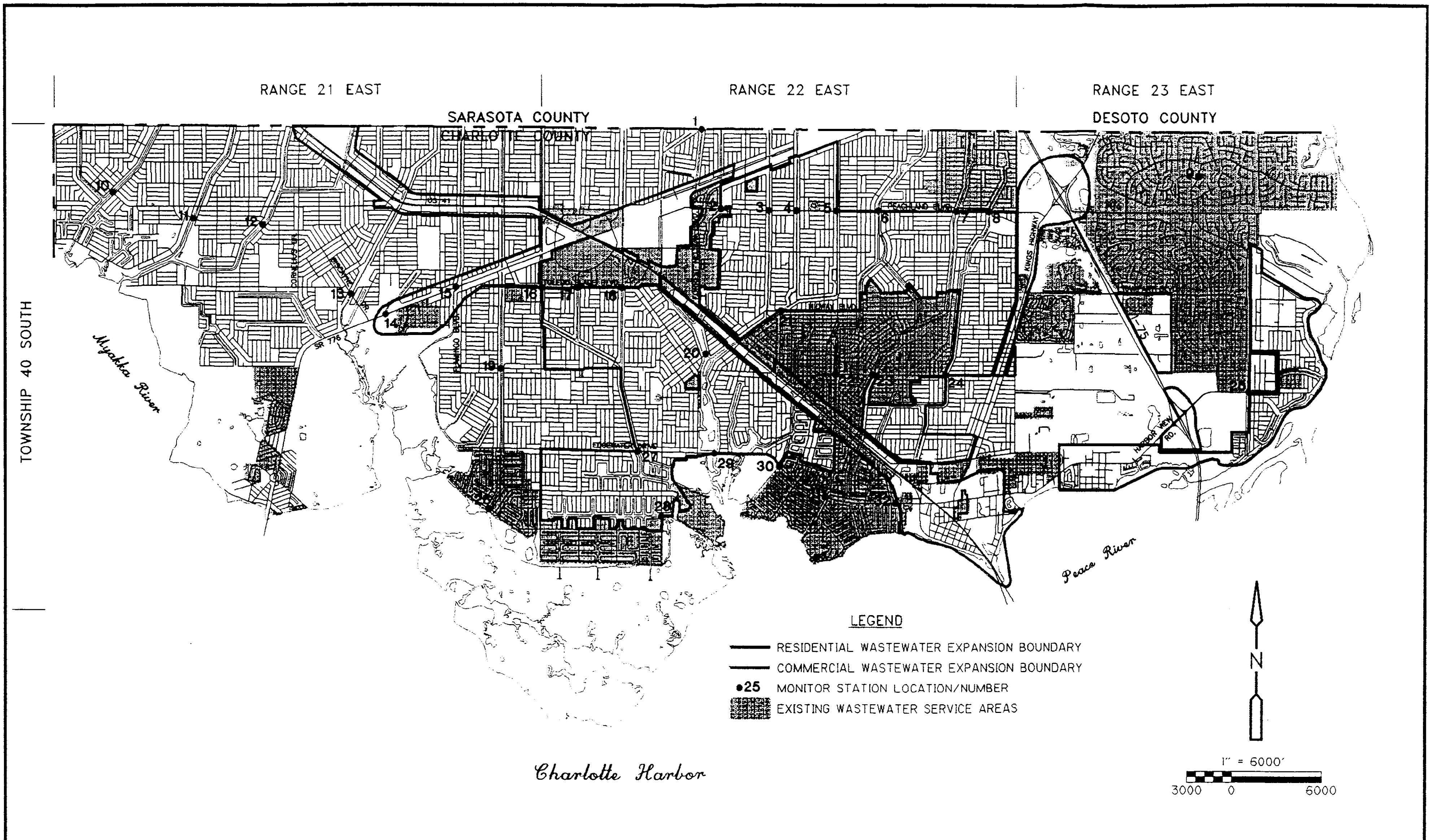


Figure 2. Existing and proposed wastewater service areas, Port Charlotte, Florida, 1994.

STUDY DESIGN

The study, as designed by MML, consisted of two discrete tasks;

1) field and analytical work, during a time period, to determine the current water quality in the canal systems of Port Charlotte, and
2) data analysis and evaluation of these data against indices of water quality and against data sets from other canal systems.

Data were to form a baseline for both fresh and estuarine areas, and to provide a basis for comparisons with future investigations. Parameters investigated were limited to those typically associated with impacts from excessive nutrients.

Determination of Current Conditions

Sampling Site Selection

Initially designed to characterize the dry season water quality, the two month study captured a broader range of conditions in the canals and waterways of the Port Charlotte Utility Unit area due to increasing rainfall amounts with the onset of the rainy season. A reconnaissance of more than 50 potential sampling sites was conducted in April, 1994. The site reconnaissance included evaluation for access, safety, and, less frequently, *in situ* water quality (i.e., dissolved oxygen and salinity). Subsequently, 32 sites were selected as the final sampling locations (Figure 3; Appendix A).

Station numbers 2, 3, 4, 5, and 13 were located upstream of, but adjacent to, water control structures. Stations 1, 6, 7, 8, 16, 17, 18, 21, and 22 were located immediately downstream of a control structure, while the remainder were located at bridges with relatively unimpeded flows. Sites were approximately evenly divided between salt and fresh water stations, with a total of 15 classified as fresh (less than 1,000 µmhos/cm conductivity or 0.5 ppt salinity) and 17 salt (greater than 1,000 µmhos/cm conductivity).

Sampling Design

Sampling events were scheduled for pre-dawn and early morning hours to assess potential low dissolved oxygen (DO) problems in the waterways with remaining parameters selected to assess the effects of potential excess nutrients. (As a result, DO values may appear lower in comparison to sampling programs conducted during daylight hours.) Two sample crews of at least two persons per crew began sampling in the predawn hours of 4/6/94, 4/20/94, 5/25/94, and 6/8/94. Bacteria samples collected on 6/8/94 were not analyzed within recommended holding times, resulting in an additional bacteriological collection on 7/6/94. All sample collection and analyses were conducted according to guidelines set forth in Mote Marine Laboratory's FDEP approved Comprehensive Quality Assurance Plan (DHRS #E84091). *In situ* measurements (Table 2) were taken near surface and near bottom in the water column unless water depths were less than 0.5 meters, when mid-depth readings were taken. Near-surface samples were collected using either pond or Niskin-type samplers for subsequent laboratory analyses (Table 3), preserved (as required), stored on ice, and transported to the appropriate location for analysis. Bacteriological examinations on blind samples were performed by a subcontractor, Environmental Quality Laboratory, Inc. (DHRS #E85086). All other analyses were performed by Mote Marine Laboratory.

Continuous Recorders

Additionally, four sites were selected for deployment of Hydrolab Datasonde continuous recorders of dissolved oxygen (DO), temperature, and conductivity (salinity). Locations were chosen based on the preliminary results of the water quality screening described above and the security and accessibility of the site. For both freshwater and saltwater conditions, stations with relatively high and relatively low percent saturation of dissolved oxygen were chosen (Stations 1, 2, 17, and 29; Figure 3). The meters were calibrated in the laboratory before and after deployment, and recorded data at 15 minute intervals. Deployments were conducted for approximately one week at a time during July and through the first week of August.

Comparisons with Existing Data Sets

Data Sources

Electronic water quality data sets were acquired from five sources: the Environmental Protection Agency STOrage and RETrieval database (STORET), Environmental Quality Laboratory, Inc. (EQL), City of Cape Coral Environmental Resources Division (CCERD), Coastal Environmental, Inc. (CE), and the MML dry season monitoring study described above. In addition, hard copy versions of water quality data in report form were received from the North Port Water Control District. These data simply extended the temporal coverage of data for the Northport data set received from EQL. A review of the reports indicated no notable differences from the earlier data and these data were not entered into electronic form for the analysis. Other agencies were solicited for relevant data (Sarasota County Stormwater Management, Florida Department of Environmental Protection/Southwest Florida Aquatic Preserve Office at Bokelia, Lee County Environmental Laboratory, and the Florida Department of Environmental Protection district office at Ft. Meyers), but none were available. With the exception of the MML monitoring stations, the locations of the sampling stations from which data were examined are plotted in Figure 4. The locations range from Sarasota Bay to Vanderbilt Beach (just north of Naples), with extensive coverage in the region near Port Charlotte.

The STORET data were retrieved based on a list of “canal” station identification numbers acquired from Sarasota County and the Florida Department of Environmental Protection (DEP) office in Punta Gorda. The resulting 69 stations, including STORET station numbers, locations, STORET textual descriptions, and number of records per station, are listed in Table 4. The water quality parameters queried were those which were relevant to the calculation of water quality indices (WQI) or trophic state indices (TSI) as described in Hand *et al.*, 1990, as well as others which were present in some other datasets and were judged of potential interest. The parameters queried, and their STORET codes are listed in Table 5. Data were requested from January 1, 1968 to the present, and 3679 records were retrieved, dating from January 1970 through November, 1991.

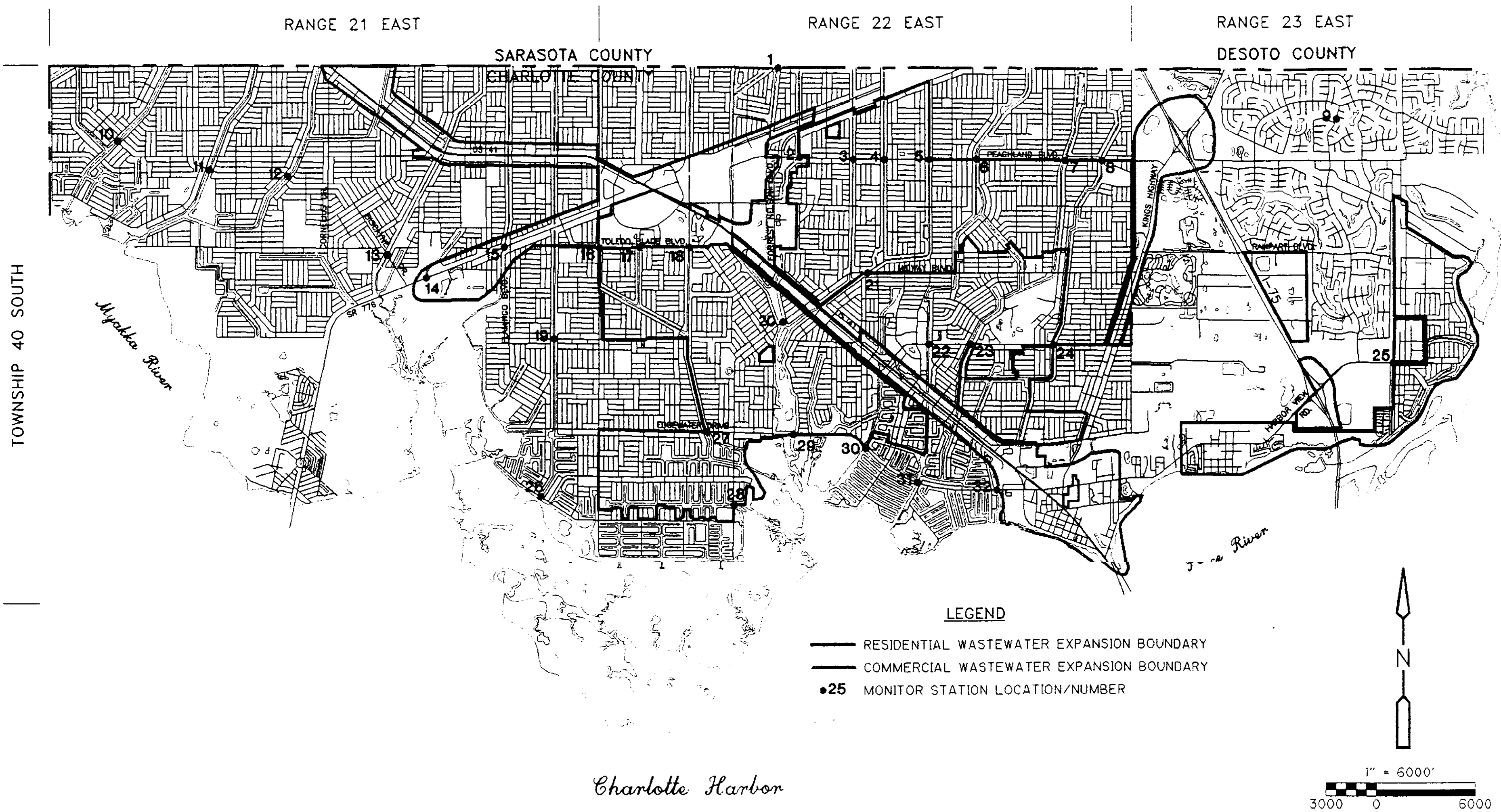


Figure 3. Monitor station locations and numbers. Mote Marine Laboratory Port Charlotte Water Quality Monitoring, 1994.

Table 2.	***In situ* parameters; Port Charlotte dry season water quality screening.**	
Parameter	**Sampling Depth**	**Method***
Dissolved Oxygen	Surface, Bottom	Dissolved oxygen meter pre- and post-sampling calibrated in the laboratory; air calibration at each site
Temperature/Conductivity	Surface, Bottom	Salinity - conductivity - temperature meter; pre- and post-calibrated in the laboratory

*conducted recording to MML's FDEP-approved Comprehensive Quality Assurance Plan

Table 3.	**Laboratory parameters; Port Charlotte dry season water quality screening.**	
Parameter	**Sampling Depth**	**Method***
5-Day Biochemical Oxygen Demand (BOD_5)	Surface	SM 5210 B
Color	Surface	SM 2120 B
Chlorophyll-*a*	Surface	SM 10200 H
Nitrogen Series	Surface	
Ammonia (NH_4N)		EPA 350.3
Nitrate/Nitrite (NO_{2+3}-N)		EPA 353.2
Total Kjeldahl (TKN)		EPA 351.2
Phosphorus Series	Surface	
Ortho Phosphate (O-PO_4-P)		EPA 365.3
Total Phosphorus (T-P)		EPA 365.4
Bacteria	Surface	
Fecal Coliform / 100 ml		SM 9222 D**
Fecal Streptoccoci / 100 ml		SM 9230 C**

SM = Standard Methods, 17th Edition
EPA = Methods for Chemical Analysis of Water & Wastes
* = Conducted according to MML's FDEP-approved Comprehensive Quality Assurance Plan
** = Conducted according to EQL's FDEP-approved Comprehensive Quality Assurance Plan

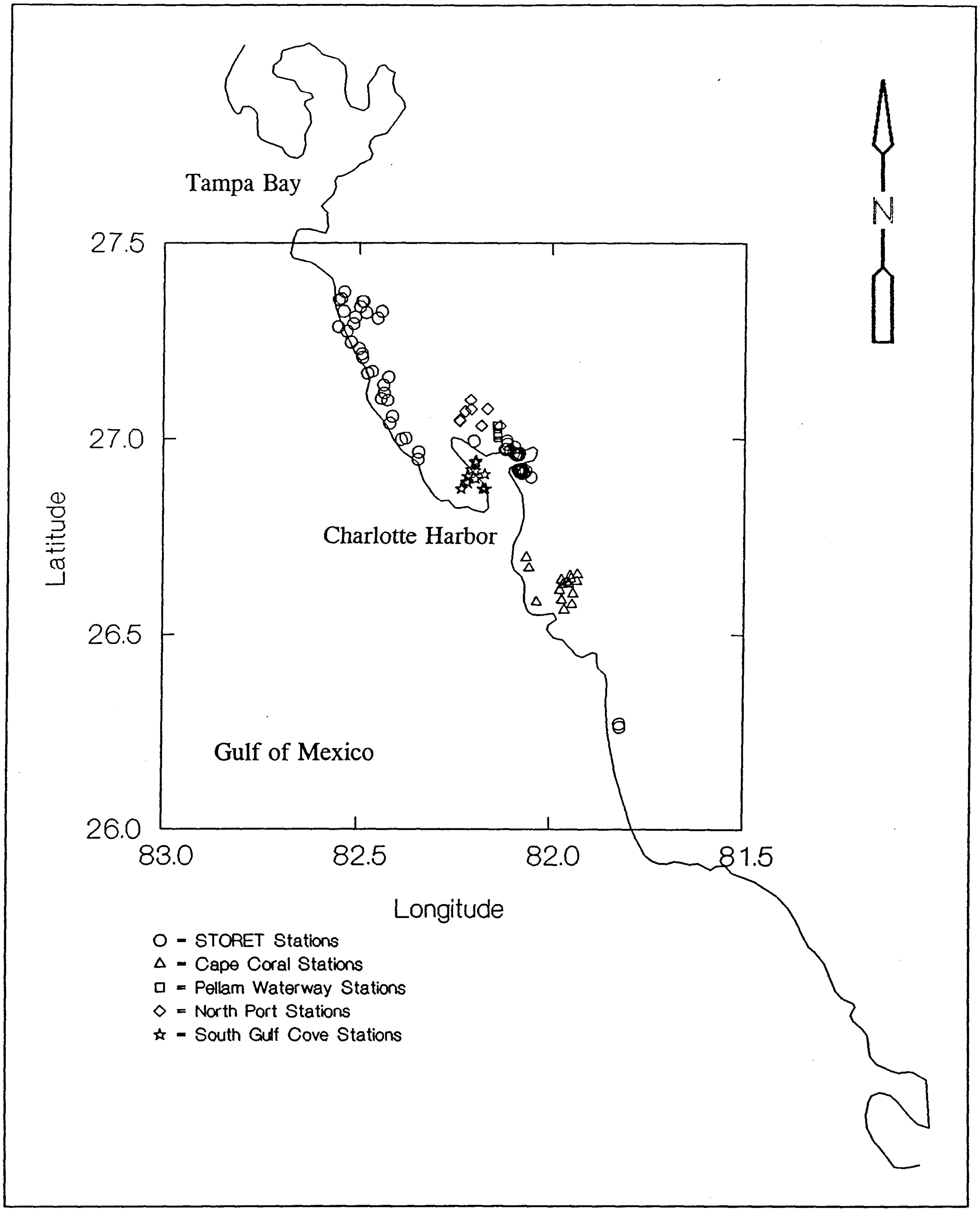


Figure 4. Geographic coverage. Station locations for all data excluding MML/Port Charlotte.

Table 4 STORET Stations Retrieved.

STORET Number	Latitude	Longitude	STORET textual description	Number of Records
24010534	27.286392	82.553059	"ENT GRAND CNL IN L SARASOTA BAY"	94
24010537	27.246670	82.520003	"LITTLE SARASOTA B CORAL COVE"	105
24010549	27.355559	82.551949	"ENT WHITAKER BYU & BIG SARASOTA"	124
24010553	27.358892	82.545837	"WHITAKER BAYOU ON 27TH STR"	114
24010558	27.376115	82.538060	"WHITAKER BYU AT TRI PAR DR-BRK D"	112
24010567	26.997226	82.389448	"LEMON B UP FORKED CR"	89
24010583	27.326115	82.539449	"HUDSON BYU AT ORANGE AVE BRIDGE"	81
24010584	27.275559	82.531116	"PHILLIPI CREEK AT US 41 BRIDGE"	75
24010587	27209448	82.490559	"NORTH CK US 41 BR"	106
24010588	27.168059	82.477505	"SOUTH CK US 41 BR"	100
24010593	26.966115	82.344170	"GOTTFRIED CRK AT END WENTWORTH S"	94
24010612	27.137503	82.435559	"SHAKET CREEK LAUREL RD"	105
24010613	27.158337	82.422782	"COW PEN SLGH AT 1ST BRDG ABV OS"	18
24010615	27.172503	82.466115	"STH CRK BRDG AT CNCSN STND SCH P'	98
24010617	27.117226	82.433893	"CURRY CRK AT ALBEE FARM RD BRIDG"	105
24010618	27.102782	82.441393	"HATCHET CR AT RR BRIDGE SARA C"	103
24010619	27.098615	82.425281	"HATCHETT CRK AT VENICE FARM RD"	93
24010620	27.056671	82.412781	"ALLIGATOR CREEK AT US 41"	78
24010621	27.039170	82.419448	"ALLIGATOR CREEK AT SHAMROCK BLVD"	95
24010623	27.001392	82.377781	"FORKED CREEK AT RT#775 BRIDGE"	95
24010624	26.947781	82.346392	"DEER CREEK AT NORTON AV ENGLEWD"	88
24010625	27.310281	82.510004	"PHILLIPPI CR BAHIA VISTA ST BR"	109
24010626	27.337226	82.496949	"PHILLIPPI CREEK AT FRUITVILLE RD"	101
24010627	27.351392	82.488893	"PHILLIPI CRK AT 17TH ST BRIDGE"	97
24010628	27.322226	82.481115	"MAIN A CNL AT BAHIA VISTA ST BRD"	97
24010629	27.307781	82.451671	"MAIN A CNL AT CATTLEMAN RD BRDG"	94
24010630	27325004	82.441116	"MAIN A CNL AT PALMER BLVD BRDG"	97
24010639	27.218615	82.491948	"CATFISH CREEK VAMO WAY BRIDGE"	107
24010642	27.294170	82.514448	"CLARK LKS DRAINAGE AT WILKINSN R"	82
24010670	27.351392	82.491948	"PHILIPPI CR 17TH ST. WEST BR"	48
24010672	27.231115	82.499448	"SEGMENT 24.1CA BODY OF WATE"	73
25010014	26.901948	82.052226	"ALLIGATOR CRK CNL E END OF CNL"	1
25020421	26.970837	82.106670	"SUNRISE WATERWAY & EDGEWATER DR"	13
25020436	26.985837	82.114726	"TARPON WATERWAY AT BLOSSOM ST"	4
25020437	26.993615	82.115282	"MORNINGSTAR WATERWAY AT US41"	5
25020439	26.964170	82.082503	"OLMAN WTWY EDGEWTR DR BR"	5
25020442	26.916115	82.078893	"N END MOONFISH LGN CNL PGI STAT"	7
25020450	26.918615	82.080003	"PUNTA GORDA ISLES END OF BASS BA"	6
25020451	26.917781	82.079170	"CANAL AT SNOOK BAYOU"	16
25020452	26.924170	82.073059	"PUNTA GORDA ISLES MD YCHT CLB BS"	
25020453	26.920837	82.075003	"SAILFISH EST MARION AV BR PGI CN"	78
25020455	26.965281	82.097781	"ELKCAM WATERWAY AT EDGEWATER DR"	
25020461	26.920281	82.081948	"PUNTA GORDA ISLES END SHEEPHD BA"	135
25020465	26.973059	82.116392	"E SPRING LAKE AT EDGEWATER DR BR"	5
25020473	26.978892	82.095282	"ELKCAM WATERWAY US41"	13
25020480	26.920837	82.086670	"PUNTA GORDA ISLES TARPON INLET"	27
25020482	26.924448	82.080837	"PGI BONEFISH BAYOU"	31
25020483	26.911392	82.076392	"PGI DEVILFISH BAY"	136
25020484	26.918059	82.065281	"PGI SEA BASS STRAIT"	8
25020486	26.912227	82.070281	"PGI CANAL E OF BAL HARB BLVD"	8
25020487	26.915559	82.071670	"PGI SAILFISH EST AT YELLOWTAIL C"	13
25020492	26.958338	82.088059	"MTH GENERAL DVLPMNT SEVERIN CNL"	18
25020493	26.962781	82.090004	"END GENERAL DVLPMNT SEVERIN CNL"	18

Table 4. STORET Stations Retrieved (Continued).

STORET Number	Latitude	Longitude	STORET textual description	Number of Records
25020494	26.962781	82.085281	"END GENERAL DVLPMNT ROSELLE CNL"	15
25020495	26.958892	82.084448	"MTH GENERAL DVLPMNT GARDNER WTWY"	14
25020499	26.923337	82.085281	"PGI BETA CNL END 2ND FINGER CNL"	39
25020512	26.916115	82.080003	"PGI DRUM BAYOU END OF CANAL"	2
25020513	26.915282	82.084448	"PGI-SUNFISH COVE MID-OF CANAL-CH"	2
25020515	26.923892	82.082226	"COBIA BAY MID CANAL CHARLOTTE CO"	12
25020516	26.923059	82.078337	"TURTLE BAY MID CANAL CHAR CO"	8
25020517	26.960837	82.090281	"BANGSBORG WTWY MDL OF CNL GNL DV"	12
25020518	26.959448	82.093616	"FIELDS WW MID CANAL CHAR CO"	11
25020519	26.921116	82.081116	"SHEEPHEAD BAY MID CANAL CHAR CO"	12
25020520	26.961670	82.085281	"ROSELLE WW MID CANAL CHAR CO"	6
25020521	26.961115	82.089170	"SEVERIN WW MID CANAL CHAR CO"	8
25020537	26.973059	82.120004	"WEST SPRINGLAKE WTRWY AT EDGEWATER"	4
25030028	26.993892	82.201392	"SAM KNIGHT CREEK AT SR 776"	5
28030005	26.261116	81.818059	"VANDERBILT LAGOON E FINGER C VAN"	5
28030014	26.269726	81.818892	"VANDERBILT WWAY E FINGER C BET H"	3

Table 5. STORET Water Quality Parameters Queried.

Parameter	STORET CODE		Alternate STORET CODE	UNITS
Station				
Date				
Depth				
Water temperature	**10**			degrees centigrade
eH	90			millivolts
Turbidity	70			JTU
Turbidity	76			NTU
Secchi	78			meters
Color	80			PCU
Conductivity	95	(field)	94 (lab)	micromho @ 25 C
DO	299	(probe)	300 (Winkler)	mg/l
BOD	310			mg/l
pH	400	(field)	403 (lab)	SU
Salinity	480			ppt
TSS	530			mg/l
VSS	535			mg/l
TN	600			mg/l, N
Organic N	605			mg/l, N
NH_4-N	608	(dissolved)	610 (total)	mg/l, N
TKN	625			mg/l, N
NO_2 + $N0_3$-N	630			mg/l, N
PO_4	660			mg/l, PO_4
PO_4-P	671	(dissolved)	70507 (total)	mg/l, P
TP	665			mg/l, P
TOC	680			mg/l, C
TIC	685			mg/l, C
Cu	1042			µg/l, Cu (total, water)
Pb	**1051**			µg/l, Pb (total, water)
Zn	1092			µg/l, Zn (total, water)
Fecal coliforms	31615			MPN
Fecal strep	31677			MPN
Chla	32210			µg/l, uncorrected
Chla	32230			mg/l, uncorrected
Chlb	32212			µg/l, uncorrected
Chlb	32231			mg/l, uncorrected

The following conversions were performed:

1. Chlorophyll- *a* in mg/l was converted to µg/l by multiplication by 1,000;
2. Orthophosphate (PO_4) was converted to orthophosphate phosphorus by multiplication by 0.326;
3. Conductivity was converted to salinity by the algorithm of Cox (Jaeger, 1973); and
4. Total nitrogen (TN) was calculated by adding NO_2 +NO_3-N with total Kjeldahl nitrogen (TKN) .

In all cases the converted value was used only if the original value was missing. Eight Chlorophyll-a conversions, seven orthophosphate conversions and 1467 conductivity conversions were performed. Stations with no salinity data or insufficient data to calculate either WQI or TSI were deleted. This resulted in 42 remaining stations, 15 fresh and 27 estuarine.

The data received from EQL were contained in three datasets, from South Gulf Cove (SGC), North Port (NP) and the Pellam Waterway (PW). The SGC data were the most temporally extensive, including records from September 1976 through June 1994. They were from 15 stations and included 4618 records. The parameters included: date, location, biochemical oxygen demand, fecal coliforms, total coliforms, copper, lead, zinc, inorganic and total nitrogen, orthophosphate and total phosphorus, temperature, dissolved oxygen, conductivity, and pH. Salinity was again calculated from conductivity by Cox's relation (Jaeger, 1973). The NP data extended from December 1978 through June 1987, with eight stations and 1618 records. Parameters included: date, location, depth, temperature, dissolved oxygen, conductivity, pH, salinity, percent oxygen saturation, turbidity (NTU), chloride, total dissolved solids, sulphate, hardness, Fl, inorganic and total nitrogen, orthophosphate and total phosphorus and biochemical oxygen demand. The PW data covered only one year, from June 1992 through June 1993, with four stations and 72 records. The parameters included: date, location, depth, temperature, dissolved oxygen, conductivity, pH,oxidation reduction potential, turbidity (NTU), inorganic nitrogen, orthophosphate and total phosphorus, total organic carbon, chlorophyll-a, chlorophyll-b, and biochemical oxygen demand. Salinity was calculated from conductivity as above.

The data from CCERD were dated from January 1991 through September 1993. The file as received contained 2919 records from 34 stations. However, examination of the list of station descriptions which accompanied the data indicated only 16 stations were in canals. When non-canal stations were eliminated, the resulting file consisted of 1324 records. The station descriptions and number of records from each station are listed in Table 6. The parameters included: location, date, depth, temperature, pH, conductivity, salinity, dissolved oxygen, inorganic and total nitrogen, orthophosphate and total phosphorus, fecal coliforms, total suspended solids, biochemical oxygen demand, alkalinity, and turbidity (NTU).

The data provided by CE were restricted to non-canal, open water stations in the Myakka and Peace Rivers and Charlotte Harbor proper. They were collected from several sources and processed as described in Coastal Environmental, Inc. 1994. They were obtained to be used as a reference for comparison with the canal data from communities adjacent to these waters.

Table 6. City of Cape Coral monitoring program sampling station descriptions.

STATION NUMBER	CODE	DESCRIPTION AND SYNONYMS	Number of Records
120	FICNW	North Spreader at junction with Laguna Lake N of Kismet. Drain NW comer of Cape. = MNS4.	69
150	FICNW	North Spreader W of Old Burnt Store Rd., N of NW 16th Terr. jct. with Gator Slough and Wray Canal = MNS6.	69
210	FACNE	Head of Meade Canal at Cleveland Canal, S of 6th St., E of 19th Ct. = RM3.	**138**
243	FACNE	Greene Canal at Hancock Bridge betw. SE 12th Ct and SE 13th Av; NE side of Bridge.	47
260	FECSE	Unnamed canal between SE 23rd Ave and SE 23rd Pl, S of Hancock Br. Pky. = RM4B.	112
275	FACSE	Rachel Canal at Dual Water Pumphouse 8	39
280	FACSE	Lake Saratoga outlet at SE First Pl between SE 5th St and SE 6th St. = BF9.	76
295	FACSE	Mackinac Canal at n side of SE 9th St bridge between SE 8th Pl and St. Jock Blvd	60
300	FACSE	Meade Canal above Weir 3, Viscaya Pky between SE 20th Ct. and SE 21st Ave. = BF7.	72
310	FACSE	Nicholas Canal, center of wide area between SE 3rd Ave and SE 4th Ave. = SC7.	222
315	SACSE	Industrial Park; jct Rubicon & Honolulu Canals, SE 12th Terr at SE 13th Ave. = BT1 = RM6.	38
400	SACSE	Lido Canal at Del Prado Bridge, S of Shelby Pky.	70
430	SACSE	San Carlos Basin, SE First Ave at 34th Terr. = SC4.	131
450	FECSW	South Spreader, Camelot Waterway, SW37th Terr. = SP5.	6
470	SACSE	Plato Canal, just W of Del Prado, S of 40th St. = RM9.	120
510	SACSE	Rubicon Canal, south end, between 5th Ave. and 6th Ave at 47th St. = RM8.	145

Some data records obtained contained, salinity but no conductivity, while others contained only conductivity. To obtain the most consistency, salinity was calculated as described above for all records where it was absent, but conductivity was available. Fresh and estuarine stations were then separated at an equivalent 'salinity' value of 0.5 ppt. The exception to this was the PW data which were all considered "fresh" although some stations were slightly over 0.5 ppt. median salinity.

The Port Charlotte stations sampled by MML were additionally categorized by residential and OSDS density. The number of dwelling units in the basin of each canal network was estimated from the Port Charlotte Utility Unit population tract map and projected dwelling units for 1994 (Giffels-Webster, 1991). As an indicator of the number of septic system units affecting a canal, those on lots adjacent to canals were counted (locations provided by CDM). In both cases, the counts were accumulated so that the values associated with each station reflected the total number of units "upstream" of that point to the Sarasota or DeSoto County boundary. This resulted in zero dwelling units and septic systems for station 1 (Figure 3) as the same level of detail regarding OSDS and dwelling densities were not available for the Northport area. Other stations all had some number of dwelling units, but several also had zero septic system units (areas which are currently sewered) (Table 7). (No distinction was made for the length of time that an area had been sewered.) Both dwelling unit and septic system counts were transformed before analysis *(ln(* 1 +value)) to improve the variance and to prevent undue weight from being assigned to a single observation in regression analyses.

Daily local rainfall data for the period of MML sampling were obtained from the Charlotte County Landfill. During data analyses, rainfall amounts were arbitrarily accumulated for the 96 hours prior to and including the sampling date, in an attempt to account for lagged effects of rainfall on water quality.

Water Quality and Trophic State Indices

Water quality indices and trophic state indices were calculated for all stations where requisite data were available according to the procedures described in Hand *et al.*, 1990. The WQI is appropriate for fresh water "streams" and the TSI is appropriate for "estuaries." The WQI is a composite value representing an estimate of percentile position of the station of interest within the range of values found in Florida for a number of parameters. A lower index reflects better water quality.

The categories considered in the WQI are:

1. water clarity;
2. dissolved oxygen;
3. oxygen demand;
4. nutrients;
5. bacteria; and
6. biological diversity.

Table 7. Estimated number of septic systems and dwelling units "upstream" of each station.

STATION	CUMULATIVE SEPTIC SYSTEMS	CUMULATIVE DWELLING UNITS
1	0	0
2	1	276
3	37	164
4	37	301
5	55	343
6	70	338
7	0	168
8	0	158
9	0	767
10	0	146
11	0	182
12	0	258
13	0	267
14	0	34
15	0	185
16	11	132
17	0	66
18	0	71
19	0	413
20	499	3904
21	355	2013
22	137	3011
23	126	1777
24	158	991
25	0	939
26	26	317
27	283	2343
28	251	751
29	63	804
30	181	661
31	137	4002
32	556	2800

The TSI, on the other hand, represents a technique to functionally describe a waterbody, such that an increase of 10 in the index represents a doubling of chlorophyll content.

The categories considered in the TSI are:

1. phytoplankton biomass;
2. water clarity; and
3. limiting nutrients.

In both cases, an index may be calculated with data from as few as one of the categories, with the qualification that the index becomes more reliable as more categories are included in the process. The parameters available from each dataset which were used in calculating the respective index or indices for those data are presented in Table 8.

Power and Trend Analyses

Power analysis is the process of estimating the capability of statistical tests to detect change in the moving geometric mean of a time series at a predetermined level of significance. The variance structure of historic data is examined and a model is constructed which provides an estimate of such parameters as the minimum detectable change and the probability of detecting a predetermined change at the selected significance level after a predetermined period of time. The power analysis performed for this study assumed a five year base period prior to change, a five year period after change, a significance level of 0.10, and a change of 25 % in the level of the constituent of interest.
Power analysis was conducted on TN, total phosphorus (TP), and dissolved oxygen (DO) from selected stations from the STORET dataset. These were three fresh, 24010615, 24010628 and 24010629, and three estuarine stations, 24010593,24010618 and 24010624. These stations were very similar to the fresh and estuarine stations in the MML/Port Charlotte data in their WQI and-TSI relationship with salinity, and had records extending at least 15 years with an average of two samplings per year. The purpose of the analysis was to estimate the level of change detection possible over a long term. The analyses were conducted using methodologies described in Smeltzer *et al.* (1989) as modified in the worksheet LRSD.WK1 (Walker, 1988). Desired analysis parameters were conservatively selected with a significance level of 0.10. The analysis required an estimate of the one day lag autocorrelation coefficient and 0.90 was used as a conservative estimate (Lettenmaier, 1976).

Trend analysis was performed on the annual WQI and TSI from the same six STORET stations listed for power analysis. Simple linear regression was used with time (years since the first sampling) as the independent variable. All statistical analysis was performed using SYSTAT (Wilkinson, 1990).

Table 8. Index parameters available in datasets used.

Index	Trophic State Index		*1,2		Water Quality Index								
Category	Biomass	Clarity	Nutrients		Clarity		DO	Oxygen Demand			Bacteria		Diversity
Parameter / Dataset	Chl-*a*	Secchi	TN	TP	JTU	TSS	DO	BOD	COD	TOC	Total coli	Fecal coli	DINS DIAS BBI
MML	X		X	X			X	X				X	
STORET*3	X	X	X	X	X	X	X	X		X			
CCERD		X	X	X		X	X	X				X	
SGC			X	X			X	X			X	X	
NP			X	X			X	X					
PW	X			X			X	X					

* 1. Nutrients are used for both indices.
2. For TSI, both TN and TP must be present for the index to be valid.
3. Since STORET data were from many sources, not all parameters were available for all stations.

RESULTS

Results - Current Water Quality Conditions

The results of the four MML sampling events are included in Appendix B and summarized as means and ranges by station in Tables 9 and 10 for freshwater stations (ie. conductivity less than 1,000 µmhos/cm) and Table 11 and 12 for saltwater stations (ie. conductivity greater than 1,000 µmhos/cm). Values less than the analytical limit of detection were converted to the value of the limit of detection for computation of means.

Local rainfall records (Figure 5) indicated that 11.82 inches of rain fell during the four month period from 3/1/94 to 6/30/94. Long term average rainfall for those same months is 12.69 inches, indicating that the sampling period was representative of typical dry season and early wet season rainfall. One sampling event (4/20/94) had approximately 3 inches of rainfall in the 96 hours prior to sampling.

Groups of data in short-term data sets typically exhibit non-normal distributions even when transformed. Accordingly, non-parametric tests (Mann-Whitney U) were used to assess differences between salt and freshwater stations. Differences were considered significant at the 0.05 probability level. Ranking of stations by water quality was conducted through comparisons of WQI and TSI values, depending on the salinity of the station.

Dissolved Oxygen

The study design called for sampling events to take place during the pre-dawn and early morning hours to identify areas of potential dissolved oxygen stress. Typical diurnal patterns associated with photosynthesis include respiration and, therefore, consumption of dissolved water during nighttime periods. Excessive vegetation, algae, or phytoplankton can, therefore, lead to depressed levels of DO just before dawn and can also result in excessive levels of DO at the end of the afternoon, after a day of photosynthesis.

Surface dissolved oxygen readings were below the 5.0 mg/l state standard (FAC, 17-302.560) for Class III, non-saline waters of the stations. Surface readings below 2.0 mg/l were recorded 9 percent of the time, and 5 percent of the readings were below 1.0 mg/l dissolved oxygen (Table 13). Bottom dissolved oxygen readings were below 5.0 mg/l for 83 percent of the time, while readings below 2.0 mg/l and 1.0 mg/l occurred in 21 percent and 8 percent of the cases, respectively.

Table 9. Range and average values for fresh water stations, all Sampling Events. Port Charlotte dry season water quality screening.

Station	O_2 Saturation (%) Range	$\bar{X}$	Temperature (C°) Range	$\bar{X}$	Conductivity µmhos/cm Range	$\bar{X}$	Salinity 0/00) Range	$\bar{X}$	Color, CoPt PCU Range	$\bar{X}$	Chlorophyll - *a* µg/ml Range	$\bar{X}$	BOD_5 mg/l Range	$\bar{X}$	NO_2+NO_3-N mg/l Range	$\bar{X}$	Ammonia-N mg/l Range	$\bar{X}$	TKN mg/l Range	$\bar{X}$	O-PO_4-P mg/l Range	$\bar{X}$	Total-P mg/l Range	$\bar{X}$
1	71.4-87.4	77.0	22.5-26	24.4	687-950	872	0.3-0.4	0.38	52-70	58	2.7-9.2	5.4	0.4-2.6	1.7	BDL-0.029	0.013	.017-.084	0.044	.66-.97	0.82	.016-.148	0.077	BDL-.16	0.10
2	3.5-55.0	26.2	22-26	23.8	636-905	787	0.2-0.4	0.32	58-69	63	3.4-15.6	10.3	1.5-2.0	1.6	0.006-0.042	0.018	.0ll-.114	0.042	.74-.96	0.86	.470-.642	0.504	.48-.63	0.53
3	29.8-49.7	39.7	22-26	24.2	570-764	686	0.2-0.3	0.28	35-52	45	3.3-14.2	8.6	1.7-2.1	1.8	BDL-0.016	0.010	BDL-.044	0.015	.54-.66	0.60	.015-.075	0.046	BDL-.10	0.07
4	29.1-56.5	43.8	22-26	24.4	550-626	586	0.2-0.2	0.20	43-68	51	5.8-35.2	16.8	1.1-3.7	2.1	BDL-0.500	0.016	BDL-.060	0.019	.77-1.21	0.89	BDL-.009	0.007	BDL-.08	0.06
5	32.1-48.1	40.8	22-26	24.6	480-615	574	<0.2-0.2	0.20	43-102	83	2.9-17.0	10.8	1.2-2.2	1.8	BDL-0.030	0.014	BDL-.081	0.042	.74-.92	0.84	.019-.050	0.034	.07-.12	0.10
6	22.6-76.6	46.7	22-26	24.3	370-520	458	<0.2-<0.2	<0.20	65-104	83	19.9-92.8	60.6	3.1-7.8	5.5	BDL-O.019	0.012	BDL-.087	0.038	1.02-2.46	1.54	BDL-.110	0.064	.09-.43	0.24
7	28.6-47.2	38.7	21-26	24.2	561-964	676	0.2-0.4	0.25	47-62	56	4.5-44.7	16.5	1.6-7.8	4.2	0.010-0.016	0.012	BDL-.050	0.023	.70-1.12	0.86	.137-.317	0.223	.18-.36	0.28
8	42.8-57.3	52.8	20-27	24.0	390-884	537	<0.2-0.4	0.25	55-90	68	6.3-64.3	24.8	2.3-6.1	3.4	BDL-0.029	0.012	BDL	BDL	.64-.95	0.75	.045-.067	0.061	.07-.13	0.09
9	19.2-61.9	27.6	23.9-29	25.3	335-470	446	<0.2-<0.2	<0.2	74-116	96	0.7-13.5	5.7	1.3-3.1	2.2	0.009-0.069	0.034	.018-.085	0.057	.82-.98	0.90	.037-.098	0.070	.05-.15	0.11
13	59.4-82.9	74.6	22-27	24.6	828-979	912	0.3-0.4	0.38	52-58	54	7.2-27.7	16.0	1.2-3.3	2.1	BDL-0.005	0.005	BDL-.019	0.008	.78-.92	0.83	BDL-.015	0.008	BDL-.07	0.06
15	5.7-61.1	23.9	20.5-26.5	23.0	719-832	794	0.3-0.4	0.35	29-45	37	1.3-3.2	2.2	1.1-17.5	5.5	BDL-0.046	0.030	BDL-.147	0.056	.60-.70	0.63	BDL-.112	0.052	BDL-.13	0.07
21	59.9-78.0	67.9	24.2-28	26.4	776-833	794	0.3-0.4	0.32	30.42	36	4.6-9.9	6.4	1.4-2.1	1.6	BDL-0.021	0.010	BDL-.022	0.009	.65-.70	0.68	BDL-.009	0.006	BDL	BDL
22	46.4-101.1	64.0	24-27	25.3	567-805	634	0.2-0.3	0.22	42-55	48	20.4-30.4	24.0	2.7-10.0	5.0	BDL-O.009	0.006	BDL-.019	0.008	.74-.98	0.84	BDL-.039	0.015	BDL-.09	0.07
23	41.0-83.7	57.1	24-28	26.0	595-714	650	0.2-0.3	0.25	40-60	46	12.1-67.0	36.4	2.2-7.9	4.3	BDL-0.021	0.013	BDL-.064	0.039	.95-2.05	1.32	BDL-.014	0.009	BDL-.15	0.08
24	57.0-83.7	72.0	25-27	25.8	589-900	679	0.2-0.4	0.25	49-55	52	10.3-58.5	26.4	2.1-7.3	4.8	BDL	BDL	BDL-.040	0.006	.80-1.28	0.98	.005-.017	0.010	BDL-.lO	0.07
ALL	3.5-101.1	49.7	20-29	24.7	335-979	667	<0.2-0.4	0.20	29-116	59	0.7-92.8	17.8	0.4-17.5	3.2	BDL-0.014	0.014	BDL-.147	0.028	.54-2.46	0.89	BDL-.642	0.078	BDL--63	0.13

BDL= Below Detection Limits; Detection limits for NO_2+NO_3-N, Ammonia-N and 0-PO_4-P = 0.005 mg/l for TKN and Total-P = 0.05 mg/l

Table 10. **Range and average values for bacteria, freshwater stations, all sampling events. Port Charlotte dry season water quality screening.**

Station	Fecal Coliform #/100 ml		Fecal Streptococcus #/100 ml	
	Range	$\overline{X}$	Range	$\overline{X}$
1	<1-12	5	6-220	96
2	4-120	43	4-290	143
3	2-85	38	16-350	105
4	8-20	14	10-290	86
5	32-170	82	10-410	120
6	8-55	23	10-450	175
7	<1-70	25	20-160	80
8	<1-12	6	12-220	80
9	<1-120	35	4->1600	353
13	2-15	8	<4-10	6
15	<4-75	28	32-230	88
21	4-180	58	4-310	118
22	30-310	143	32-400	201
23	5-96	35	52-150	93
24	4-150	47	32-340	149
ALL	<1-310	39	<4->1600	126

Table 11. Range and average values for salt water stations, all sampling events. Port Charlotte dry season water quality screening.

Station	O_2 Saturation (%)		Temperature (C°)		Conductivity µmhos/cm		Salinity (°/oo)		Color, CoPt PCU		Chlorophyll-*a* µg/l		BOD_5 mg/l		NO_2+NO_3-N mg/l		Ammonia-N mg/l		TKN mg/l		O-PO_4-P mg/l		Total-P mg/l	
	Range	$\overline{X}$	Range	$\overline{X}$	Range	$\overline{X}$	Range	$\overline{X}$	Range	$\overline{X}$	Range	$\overline{X}$	Range	$\overline{X}$	Range	$\overline{X}$	Range	$\overline{X}$	Range	$\overline{X}$	Range	$\overline{X}$	Range	$\overline{X}$
10	55.4-62.5	57.7	23.5-27.0	24.9	19560-24080	22142	11.6-14.5	13.3	55-80	64	11.7-53.0	23.9	2.5-4.7	3.4	BDL	BDL	BDL-.006	.005	.77-1.25	.93	.058-.095	.075	.11-.22	.17
11	47.3-70.8	61.5	23.5-27.0	25.0	20281-25814	23731	12.1-15.7	14.3	45-60	53	7.6-18.9	13.0	2.0-2.9	2.5	BDL	BDL	BDL-.047	.016	.77-.97	.86	.075-.129	.091	.11-.20	.15
12	56.4-68.4	61.4	23.5-27.0	25.2	16266-22924	20202	9.5-13.8	12.0	50-58	53	9.5-100.2	34.9	2.1-8.5	4.2	BDL-.005	.005	BDL	BDL	.82-1.51	1.00	.046-.132	.083	.09-.25	.17
14	31.2-66.7	42.2	24.0-26.5	25.1	25470-29361	27576	15.5-18.1	16.8	45-52	48	3.8-20.9	10.5	1.5-2.9	2.4	BDL-.015	.007	.008-.102	.033	.62-.88	.74	.025-.062	.051	.06-.13	.10
16	38.8-53.3	46.8	25.0-27.5	26.1	11775-29830	20242	6.7-18.4	12.2	50-62	56	28.1-55.1	37.2	2.9-17.1	7.3	BDL-.022	.010	BDL-.065	.035	.75-.97	.89	.121-.174	.149	.20-.27	.23
17	12.0-63.0	36.3	24.5-26.5	25.6	14096-30223	21721	8.1-18.7	13.1	43-65	55	16.7-55.2	36.5	3.6-9.0	5.6	BDL-.012	.007	BDL-.091	.039	.93-1.17	1.02	.083-.205	.134	.20-.30	.25
18	30.2-88.1	56.5	25.5-27.0	26.5	13485-31593	24018	7.7-19.6	14.6	49-55	53	14.8-36.2	20.8	2.6-7.1	4.8	BDL-.024	.010	BDL-.128	.056	.81-1.12	.98	.091-.171	.123	.17-.24	.22
19	43.6-89.5	66.8	24.1-28.0	25.9	29609-34711	31709	18.3-21.7	19.7	50-55	51	5.9-8.9	7.2	1.6-2.2	1.8	BDL-.010	.006	BDL-.045	.019	.64-.92	.78	.028-.063	.042	.07-.14	.10
20	40.9-99.1	73.3	24.8-29.0	27.2	28800-31320	30199	17.7-19.5	18.7	40-58	49	12.5-27.9	17.7	3.8-7.6	5.0	BDL-.023	.014	BDL-.059	.028	.78-.99	.88	.118-.248	.166	.22-.30	.25
25	8.1-75.4	55.5	24.0-28.0	26.1	13763-26494	19891	7.9-16.2	11.8	55-80	66	6.2-17.1	11.5	1.9-3.4	2.4	BDL-.015	.010	BDL-.075	.026	.57-.73	.62	.156-.411	.298	.18-.55	.37
26	38.7-70.3	61.3	24.0-27.5	25.7	13253-37700	29473	7.6-23.8	18.3	43-65	52	5.2-19.5	10.7	1.7-3.8	2.4	BDL	BDL	BDL-.028	.010	.56-.84	.71	.019-.159	.061	.08-.18	.11
27	43.6-72.6	61.9	24.0-27.0	25.8	24498-38235	32941	14.8-24.3	20.6	35-62	45	5.6-39.0	16.1	2.1-6.6	3.6	BDL	BDL	BDL-.019	.011	.52-.84	.74	.106-.219	.141	.16-.31	.22
28	61.7-75.0	69.2	24.0-27.0	25.6	37211-39780	38647	23.6-25.3	24.6	35-42	38	4.1-8.7	6.8	1.6-6.3	3.2	BDL-.014	.008	BDL-.073	.030	.66-1.04	.78	.088-.170	.112	.16-.24	.21
29	65.5-93.4	78.0	23.5-27.0	25.4	31400-36602	34505	19.5-23.1	21.7	35-40	39	4.4-16.7	8.3	1.9-5.0	3.0	BDL	BDL	BDL-.020	.012	.42-.81	.65	.107-.215	.142	.15-.32	.21
30	54.6-76.6	65.2	23.5-28.0	26.2	36307-38778	37128	22.9-24.6	23.5	35-42	38	6.8-16.2	11.8	1.7-6.9	3.4	BDL-.022	.009	BDL-.060	.020	.47-.74	.61	.100-.207	.149	.17-.24	.21
31	42.3-80.3	59.9	24.0-28.0	26.2	35522-38305	36826	22.4-24.3	23.3	32-42	37	5.1-8.7	6.8	1.9-10.5	5.0	BDL-.008	.006	BDL-.021	.013	.39-.71	.61	.094-.229	.141	.14-.28	.20
32	6.3-78.9	59.1	23.5-28.0	25.9	33554-38778	35503	21.0-24.0	22.4	35-80	47	7.9-58.7	22.7	2.5-13.8	7.2	.065-.032	.014	.065-1.350	.417	.82-3.03	1.41	.207-.751	.356	.27-.92	.45
ALL	6.3-99.1	60.4	23.5-29.0	25.8	19560-39780	30727	11.6-25.3	19.1	32-80	48	3.8-100.2	16.6	1.2-17.1	4.2	BDL-.032	.008	BDL-1.35	.047	.39-3.03	.84	.019-.751	.135	.06-.92	.21

BDL=Below Detection Limits; Detection limits for NO_2+NO_3-N, Ammonia-N and O-PO_4-P = 0.005 mg/l; for TKN and Total-P = 0.05 mg/l

Table 12. Range and average values for bacteria, salt water stations, all sampling events. Port Charlotte dry season water quality screening.

Station	Fecal Coliform #/100 ml		Fecal Streptococcus #/100 ml	
	Range	$\overline{X}$	Range	$\overline{X}$
10	8-56	38	16-180	96
11	8-48	26	22-220	123
12	16-32	24	30-460	170
14	<4-30	23	16-320	174
16	<1-16	9	2-510	160
17	15-52	28	24-1100	360
18	<1-160	54	16-540	244
19	4-22	14	24-210	118
20	4-70	20	32-160	120
25	24-170	107	62-400	250
26	<1-20	13	20-270	182
27	4-150	54	56-450	324
28	<1-48	15	72-450	288
29	4-12	8	36-710	254
30	8-15	11	42->1800	568
31	<1-36	13	48-270	150
32	150-320	380	80-1200	376
ALL	<1-320	49	2->1800	233

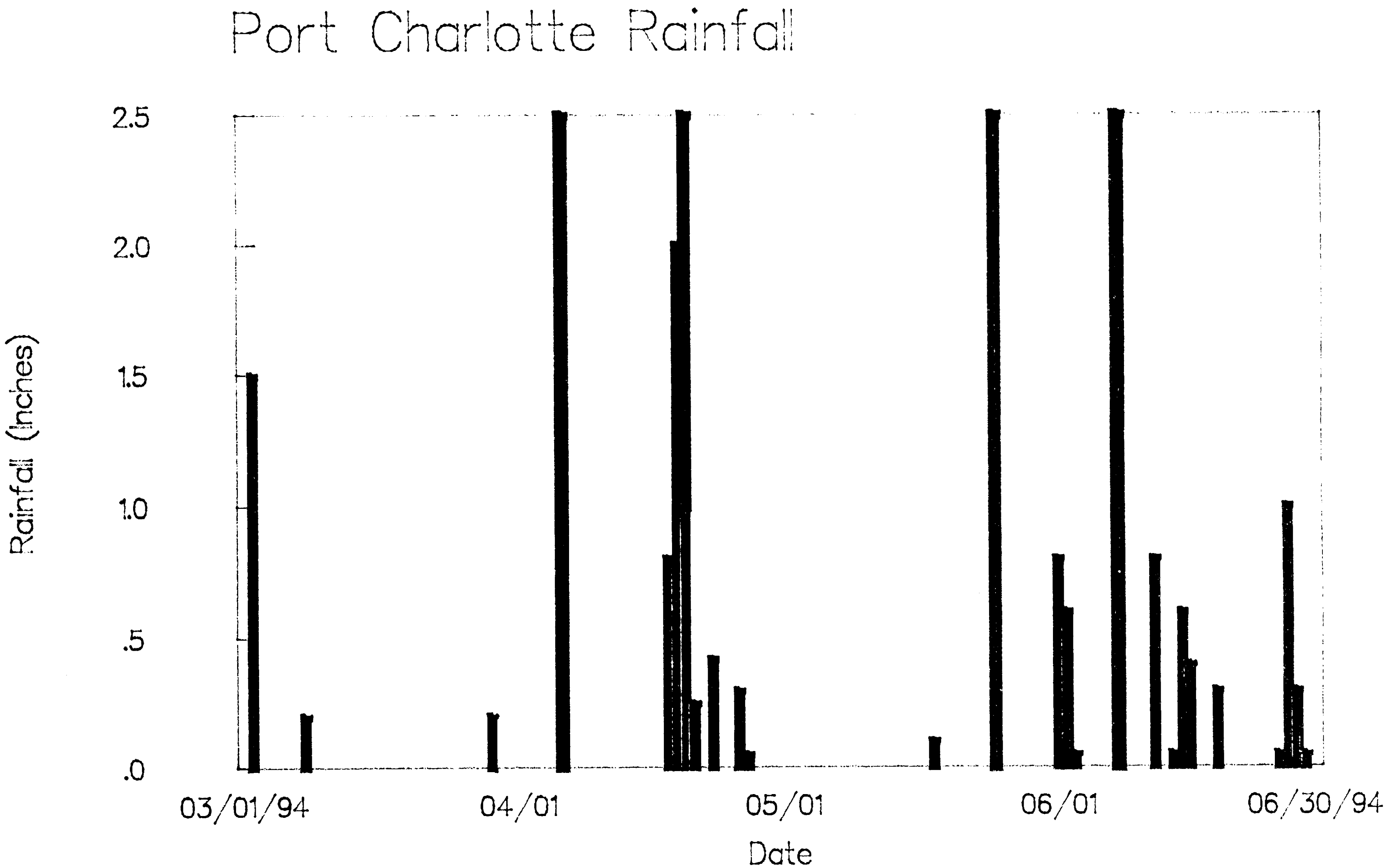


Figure 5. Rainfall during the Port Charlotte water quality monitoring. Blue - rainfall, Red - sampling dates. Source: Charlotte County landfill.

Table 13.	**Dissolved oxygen stress. Port Charlotte dry season water quality screening.**			
Depth	Total Observations	Dissolved Oxygen, mg/l		
		<5.0	<2.0	<1.0
Surface	128	84 (65.6%)	11 (8.6%)	6 (4.7%)
Bottom	116	96 (82.8%)	24 (20.7%)	9 (7.8%)

State standards for Class III saline waters call for the average dissolved oxygen readings to equal 5.0 mg/l, and the minimum readings to never be less than 4.0 mg/l. During all sampling events, the average dissolved oxygen for salt water sites was 4.4 mg/l and 34 percent of the readings were less than 4.0 mg/l.

Generally, whenever water depths were greater than 0.5 meters, surface dissolved oxygen readings were higher than bottom readings. The average vertical gradient (surface reading minus bottom reading) at the freshwater stations was 0.5 mg/l, and the maximum gradient found was 4.6 mg/l. At the saltwater stations, the mean gradient was 0.9 mg/l, with a maximum gradient of 4.1 mg/l.

The ability of water to contain dissolved oxygen is dependent on the temperature and the salinity of the water, making direct comparisons of dissolved oxygen concentrations between locations potentially misleading. Traditionally, percent oxygen saturation has been used to allow these comparisons. Station 1 had the highest average oxygen saturation percentage for the freshwater stations, and Station 15 had the lowest. Station 1 was immediately downstream of a spillway from the Cocoplum Waterway and recorded flow during all of the samplings, while Station 15 was a small, very shallow, heavily vegetated stream with minimal flow. Stations 29 and 17 had the highest and lowest percentage saturations, respectively, for saltwater stations. Station 29 is on the West Spring Waterway, in an area with substantial tidal exchange, while Station 17 is at the base of the most downstream control structure, in an area which experienced minimal flow and notable salinity stratification. The difference in oxygen saturation between fresh and salt water stations as a group was not statistically significant.

Temperature

Water temperature ranged between 20 and 29°C for all stations and all events. The average freshwater site temperature (25°C) was slightly lower than the average saltwater temperature (26°C). This difference was statistically significant at the 0.05 level.

Conductivity/Salinity

The Port Charlotte area is crossed by numerous canals and waterways. Many are equipped with controls to prevent saltwater from moving upstream. The sites selected for this study could be readily classified as salt or freshwater, based on their location relative to the controls, and the conductivity readings further confirmed those classifications. The freshwater group of sites had conductivities ranging from 335 to 979 µmhos/cm. These conductivities correspond to salinities of up to 0.4 ppt. The other group of sites, the saltwater sites, had conductivities ranging from 19,560 to 39,780 µmhos/cm, corresponding to a salinity range of 11.6 to 25.3 ppt. The conductivity differences between fresh and salt water stations were obviously significant, as there was no overlap between the two data sets.

Little or no conductivity stratification was observed for the freshwater sites. At the salt water sites however the conductivity (salinity) was typically lower for the surface samples than for the bottom samples. The vertical salinity gradient ranged from 0-11.6 ppt for all saltwater stations. The two largest differences in surface to bottom salinity (10.1 and 11.6 ppt) occurred at Stations 16 and 18, respectively, during the June 8 sampling event. These stations represent the maximum penetration of salt water into the canal system, as both were located immediately downstream of control structures.

No clear pattern emerged for freshwater conductivity, in spite of the rainfall that occurred prior to and during the 4/20/94 sampling event. Of freshwater stations, 33 percent recorded the lowest conductivity of the four events at that time. An equal number of the stations, however, recorded their minimum conductivity during the fourth event on 6/8/94. Time of travel, contributing watershed, antecedent moisture conditions, and relative amounts of baseflow undoubtedly exert further controls on freshwater conductivity.

For the saltwater stations a more obvious pattern emerged, with nearly 60 percent of the stations exhibiting the lowest salinity during the first event (4/6/94) and an equal number demonstrating the highest during the fourth event (6/8/94). Times of tides and predicted heights at Punta Gorda (Table 14) indicate that the sampling times were nearer to the predicted low of 0.1 feet on 4/6/94, while the predicted heights sampled on the third and fourth events (5/25/94 and 6/8/94) were much higher, between 1.1 and 2.3 feet, respectively. This suggests that for the saline stations during the events sampled, tide stage was more of an influence than antecedent rainfall.

Table 14. Times and heights of predicted tides during the Port Charlotte dry season water quality screening. As listed for St. Petersburg and corrected to Punta Gorda, Florida.

Date	hhmm	ft	hhmm	ft	hhmm	ft
04/06/94	0702	0.1	1322	1.2	1905	0.6
04/20/94	0508	0.1	1050	1.2	1708	0.8
05/25/94	0448	1.2	0727	1.1	1407	2.3
06/08/94	0355	1.2	0707	1.1	1338	2.2

Color

For the data set as a whole, samples collected from the freshwater sites were more highly colored than samples collected from saltwater sites, although this difference was not statistically significant. Average color for all freshwater sites was 59 cobalt/platinum units (PCU), while color at the saltwater stations averaged 48 PCU. Highly colored water can mediate light availability in Charlotte Harbor, thereby limiting phytoplankton productivity (Montgomery *et al.*, 1991). The slightly higher levels of color could be contributing to the lower chlorophyll-a levels found at the fresh water sites.

No clear temporal pattern of color levels emerged for the salt water sites. The highest color at a site occurred with similar frequency during each of the events. At the fresh water sites, the highest color levels at any of the sites were not observed during the first sampling. High colors (> 100 PCU) were typically observed at stations at the upstream reaches of the Port Charlotte canal system, i.e. Stations 5, 6, 8, and 9, while lower colors were recorded at stations closer to the harbor.

Biochemical Oxygen Demand (5 Day)

Low DO levels during a pre-dawn sampling program could be a product of diurnal patterns of photosynthesis, DO demand of the sediments (SOD), or the biochemical oxidation of organics in the water column (BOD).

Samples from both fresh and saltwater sites had similar BOD, ranges and average values and the difference between groups was not statistically significant. Saltwater samples ranged from 1.2-17.1 mg/l, with an average value of 4.2 mg/l. Freshwater samples ranged from 0.4-17.5 mg/l, with an average value of 3.2 mg/l. Overall, the highest BOD, values at a given station were measured during the first (4/6/94) or the third (5/25/94) sampling event in 65 percent of the samples. High BOD, values were least likely to occur (16 percent overall, and none of the freshwater sites) during the second sampling event (4/20/94). Stations with BOD, values greater than 10.0 mg/l were Stations 15 and 22 for the freshwater sites, and Stations 16, 3 1, and 32 for the estuarine stations.

Chlorophyll-a

Chlorophyll values for freshwater stations were slightly higher on average than the values for the saltwater stations (17.8 µg/ml versus 16.6 µg/ml), but these differences were not statistically significant. Some stations had extremely high levels of chlorophyll. In particular, the estuarine Station 12 on the Jupiter Waterway recorded a value of 100.2 µg/l, with a number of other saline stations recording values above 50 µg/l. Differences existed in the timing of high and low levels of chlorophyll-a between fresh and salt water stations. For freshwater stations, many demonstrated the highest reading of the four events during the fourth (6/8/94) event. An equal percentage showed the lowest levels during the first (4/6/94) event. The majority (53 percent) of salt water sites showed highest levels of chlorophyll-a during the second sampling event (4/20/94), while 47 percent had the lowest levels during the third event (5/25/94).

While other studies (McPherson *et al.,* 1990) in Charlotte Harbor found that color limited phytoplankton growth and therefore chlorophyll-a levels in the Harbor during the wet season, there were no significant relationships found in the project's data sets between either chlorophyll-a and salinity or chlorophyll- *a* and color. Other work has also observed that chlorophyll-a levels decrease in the Harbor with increasing salinity (McPherson and Miller, 1990). Again, for this project, regression analysis of salinity at the salt water stations against chlorophyll-a concentration produces no significant relationship. Sampling of many stations over a relatively narrow salinity gradient (11-25 ppt) rather than a linear system over a broader salinity range may account for this result.

Chlorophyll-a data for the second sampling event was characterized by low precision (relative to MML quality assurance limits). No reanalysis was possible, but, reference to sampler's observations attributed the low precision to macroalgal species, particularly at the fresh water stations, which are difficult to homogeneously subsample.

Nutrients

Samples were analyzed for nutrients, nitrogen (nitrate plus nitrite nitrogen, ammonia nitrogen, and total Kjeldahl nitrogen) and phosphorus (ortho-phosphate phosphorus and total phosphorus). These elements are required for primary productivity (ie. plant growth) to take place. The quantity of these nutrients in a system and the ratio of nitrogen to phosphorus will reveal which of the nutrients limit plant growth or are in excess in the system.

Fresh water samples had nitrate plus nitrite levels that ranged from < 0.005 to 0.069 mg/l, with an average value of 0.014 mg/l. Salt water samples were lower, ranging from < 0.005 to 0.032 mg/l and averaging 0.008 mg/l. The differences between salt and fresh water samples were statistically significant at the 0.05 probability level. Dilution curves for Charlotte Harbor (McPherson and Miller, 1990) indicated that these nutrients were being removed from the water column more rapidly than simple dilution, indicating a sink for nitrate plus nitrite in the low salinity zones of the Harbor. That study also concluded that the sink was likely biological (ie. phytoplankton), and that an inverse relationship existed between chlorophyll-a and nitrate plus nitrite concentrations.

Ammonia in the water from the fresh water sites ranged from <0.005 to 0.147 mg/l and averaged 0.028 mg/l. Ammonia at the salt water sites ranged from <0.005 to 1.35 mg/l and averaged 0.047 mg/l, but the difference was not statistically significant. One reading of 1.35 mg/l ammonia was obtained at Station 32 during the second sampling event. All other ammonia levels were an order of magnitude less; the next highest level of ammonia for salt water stations was 0.135 mg/l, also at Station 32. The highest ammonia levels were most likely to occur (69 percent) at the salt water stations during the second event. At fresh water sites, the highest levels occurred either during the second **or** the fourth event (both 43 percent of the time). The highest ammonia levels never occurred during the third event for either salt or fresh water samples.

Total Kjeldahl nitrogen (TKN) levels were very similar (both range and mean values) for the salt and fresh water stations; no significant differences were found between the means. Fresh water sites ranged from 0.54 to 2.46 mg/l with an average value of 0.89 mg/l, while the salt water sites ranges from 0.39 to 3.03 mg/l with an average of 0.84 mg/l. No obvious pattern existed in that no sampling event was much more likely to record high levels of TKN than another. The levels were consistent not only between salt and fresh, but also among the stations.

Significant differences existed between salt and fresh water levels of both ortho-phosphate and total phosphorus. Concentrations of both parameters were higher at the salt than at the fresh water sites. Ortho-phosphate at the freshwater sites ranged from < 0.005 to 0.642 mg/l with an average value of 0.078 mg/l. The salt water sites ranged from 0.019 to 0.751 mg/l with an average value of 0.135 mg/l. Total phosphorus ranged from < 0.05 to 0.63 mg/l and 0.06 to 0.92 mg/l for fresh and salt water sites, respectively. The average values for total phosphorus were 0.21 mg/l (salt water) versus 0.13 mg/l (fresh water). Other investigators have previously observed the effects of Peace River water which is high in phosphorus and this is apparently the same phenomena.

In general, ortho-phosphate levels seemed to gradually increase at the fresh water sites during the course of the four sampling events. At any of the fresh water stations, the first event (4/6/94) was the least likely to have the highest concentration of ortho-phosphate for that station and the fourth event (6/8/94) was the most likely to have the highest concentration. At the salt water stations, 82 percent of the highest concentrations by site of ortho-phosphate occurred during the second sampling event (4/20/94). Neither the first (4/6/94) or the third (5/25/94) event had any of the highest concentrations. Total phosphorus concentrations at both fresh and salt water sites were most likely to be highest during the second event (4/20/94), and least likely to be highest for the site during the first event (4/20/94).

Nitrogen. to phosphorus ratios can help to determine which of the nutrient species in a system are limiting to plant growth. Conventionally, molar ratios of 16: 1 N:P are considered balanced, although in practice, a range of between 10 and 25 N:P represent the uptake rates of various species of phytoplankton. If the molar ratios are converted to mass ratios (mg:mg), then a range of 4.5 to 11.3, with a central tendency of 7.2, could be considered a potentially balanced system. Values above 11.3 are viewed as a phosphorus limited system, below 4.5, a nitrogen limited system. Ratios of total nitrogen to total phosphorus are indicative of growth that has occurred (i.e. N and P incorporated in algal tissues) as well as any additional growth potential, while ratios of inorganic quantities are more illustrative of short term growth potential, ignoring the eventual remineralization of senescent biotic materials.

Fresh water ratios of total nitrogen to total phosphorus masses (Table 15) ranged from 1.19 to 22.90 with an average of 10.97, while salt water ratios ranged from 1.35 to 12.58 with an average of 4.77. The differences between the means of the two groups was significant. The salt water stations, in general, are strongly nitrogen limited, particularly for Station 25. Station 25 is quite near the confluence of the Harbor with the Peace River and the elevated levels of phosphorus in this river undoubtedly produces this result. Similar to other work in the Harbor, salt water stations are even more strongly limited by inorganic nitrogen, with no station average for the four samplings exceeding a value of 0.9 IN:IP. Individual salt water site ratios ranged from 0.06 to 2.09 and averaged 0.34.

Table 15.	Nitrogen:Phosphorus Ratios. Port Charlotte dry season water quality.			
	Total N:P Range	Total N:P $\bar{X}$	Inorganic N:P Range	Inorganic N:P $\bar{X}$
FRESH WATER	1.19 - 22.90	10.97	0.04-13.75	2.00
SALT WATER	1.35 - 12.58	4.77	0.06-2.09	0.3

Freshwater stations appear to be a mix of either nitrogen or phosphorus limited when examining TN:TP ratios, with Stations 23, 4, 13, 24, 21, and 22 reporting excess nitrogen on average (phosphorus limited, however) and Stations 2 and 7 higher in phosphorus (nitrogen limited). When examining only inorganic ratios, all but two stations, 23 and 4, were nitrogen limited. Fresh water site inorganic ratios ranged from 0.04 to 13.75 with an average ratio of 1.96

Bacteriology

Fecal coliform and fecal streptococci bacteria were enumerated for all samples. Fecal coliform counts have long been used as indicators of fecal pollution and pathogens in water (Krueger *et al.*, 1988; APHA, 1992). Fecal streptococci normally inhabit the gastrointestinal tract of warm-blooded animals, so their presence can also indicate fecal pollution (APHA, 1992). The ratio of fecal coliform to fecal streptococci has previously been used to differentiate human fecal contamination from that of other warm-blooded animals. In a general sense, ratios greater than 4 were previously considered indicative of human contamination,. while ratios less than 0.7 are indicative of non-human sources of contamination. The ratio, however, is no longer deemed reliable in differentiating definitively between human and non-human contamination sources (APHA, 1992), particularly when the distance to the source is unknown and in saline waters.

Comparisons between fresh and salt water stations revealed nearly identical ranges (Tables 10 and 12) for both fecal coliform (<1-310, fresh; < 1-320, salt) and fecal streptococci (< 4- > 1600, fresh; 2- > 1800, salt). Average coliform counts were slightly higher for the salt water stations (39 colonies/ 100 ml, fresh; 49, salt) while average fecal streptococci counts were nearly two times higher in salt than in fresh (126, fresh; 232, salt). The difference between salt and fresh water stations was not significant for fecal coliform, although the difference in fecal streptococci counts was significant.

State standards (FAC, 17-302.560) for bacteriological quality in Class III waters indicate that the monthly average for fecal coliform counts should not exceed 200 colonies/100 ml nor should the counts for one day ever exceed 800/100 ml. Within the restrictions of the limited number of samples collected during a month, all sites in the study area met these criteria.

The majority of the fresh water stations had the highest bacterial counts during the second sampling event (4/20/94). Fifty-three percent of the stations recorded their highest fecal coliform counts during that event and 73 percent of the stations recorded their highest fecal streptococci counts. The 4/20/94 event was also the only one of the four preceded by rain. The majority of the salt water stations (53 percent) had their highest levels of fecal coliform during first event (4/6/94); 59 percent of the stations had the highest level of fecal streptococci during the third event on 5/25/94.

Water Quality Index and Trophic State Index

The WQI and TSI are helpful as a composite values which reflect the overall quality of water in fresh water streams and estuarine reaches, respectively. As a composites, they tend to reduce the variability inherent in the individual parameters which make up the calculation and provide more stable indicators of water condition. Again, a lower index value is equivalent to better water quality.

For the freshwater stations, the WQI values for the MML/Port Charlotte data (Table 16) ranged from 36 at Station 1 to 67 at Station 6. The median value was 51. The WQI values placed these stations in the “fair” category overall, with Stations 1, 13 and 21 “good” and Stations 6 and 7 “poor” (Hand *et al.*, 1990). TSI values (Table 16) ranged from 45 at Station 14 to 62 at Station 17. The median value was 51. The median value is again in the “fair” quality range, with Stations 14, 19, 25, 26, 28, 29 and 31 within the “good” category and Stations 16 and 17 “poor” (Hand *et al.*, 1990).

The strongest predictor of WQI in the freshwater MML/Port Charlotte data is salinity (mineral content), with water quality decreasing as mineral content decreases. Over the range of values present in these data, the WQI is significantly related to salinity ($p = 0.02$) (Figure 6). In this application of dilution analysis, the salinity generally tends to decrease with increasing distance downstream from the Cocoplum Waterway or with greater time in the canals. The highest salinity in this “fresh water” group is at Station 1 which directly at the spillway from the Cocoplum Waterway (Figure 3).

As distance from the waterway increases and the developed area through which the water has passed increases, the salinity is reduced, probably due to dilution from ram water runoff and inflow through the surficial water table. The exception to this trend is Station 21. Station 21 is more mineralized (0.33 ppt equivalent salinity) than stations above it in the network (Stations 4 and 5, 0.23 ppt) (Figure 3), indicating the probable influence of a source of more highly mineralized water.

One plausible explanation is dilution with a low-nutrient, high-mineral content source of water. Examination of maps in Sutcliffe (1975, page 29), indicate an inventoried well tapping the upper artesian (50-150 feet below grade) aquifer very near the location of Station 21. It is plausible that this well (or other similar feature) is the source of the increased mineralization at this station. In addition to the unusual salinity level at Station 21, the water quality at that station (WQI = 40) is also notably better than at stations above it (Stations 4, WQI = 47 and 5, WQI = 57), as would be expected from a dilution of nutrients, BOD and chlorophyll- *a*. In particular, this station was the only one at which total phosphorus was consistently below the limits of detection (0.05 mg/l). This supports the probability that some non-surficial source is entering the canal system near this point.

Table 16. **WQI, TSI and median parameter values for MML/Port Charlotte data. Separated into fresh and estuarine groups, ordered by decreasing water quality.**

STATION	WQI	TSI	SAL	CHLA	TN	TP	DO	BOD	FECCOLI
			ppt	µg/l	mg/l	mg/l	mg/l	mg/l	#/100 ml
1	36		0.403	4.90	0.856	0.090	6.30	1.95	4.0
13	39		0.401	14.50	0.820	0.050	5.90	2.60	8.0
21	40		0.329	5.55	0.700	0.050	5.10	1.55	24.0
24	47		0.236	18.30	0.915	0.060	5.90	4.80	17.0
8	47		0.142	14.40	0.706	0.080	4.15	2.60	5.5
15	47		0.343	2.15	0.652	0.050	1.25	1.70	16.0
4	47		0.225	13.05	0.818	0.050	3.05	1.85	13.5
3	51		0.285	8.40	0.615	0.070	2.60	1.75	32.0
9	51		0.159	6.10	0.943	0.105	1.65	1.90	7.0
23	55		0.256	33.35	1.156	0.065	4.20	3.50	19.0
2	56		0.337	11.15	0.884	0.505	1.90	1.55	24.0
5	57		0.228	11.65	0.850	0.095	3.20	1.85	62.0
22	59		0.220	24.15	0.818	0.060	4.90	3.70	116.0
7	61		0.223	8.40	0.814	0.285	2.90	3.75	26.0
6	67		0.160	64.80	1.341	0.230	3.15	5.50	14.0
14		45	17.558	5.35	0.720	0.100	2.80	1.65	25.5
29		46	22.017	6.00	0.690	0.180	5.55	2.65	9.0
31		46	23.442	6.75	0.675	0.185	4.05	3.75	7.5
28		47	24.779	7.10	0.730	0.215	4.75	2.40	5.5
19		48	20.994	6.90	0.775	0.085	4.10	1.75	14.0
25		49	11.838	11.40	0.586	0.375	5.25	2.20	106.0
26		49	22.808	8.80	0.735	0.090	4.00	2.30	16.0
30		50	23.151	12.20	0.615	0.205	4.30	2.45	10.0
27		51	22.945	9.95	0.795	0.205	4.25	2.90	31.0
11		53	15.114	12.75	0.860	0.150	4.25	2.50	24.5
12		54	12.508	14.95	0.845	0.175	4.50	3.05	23.0
10		55	13.750	15.50	0.855	0.170	4.10	3.15	43.0
20		55	19.691	15.15	0.894	0.245	4.50	4.95	14.0
32		56	22.552	17.95	0.907	0.310	3.50	6.35	285.0
18		57	18.502	18.60	0.978	0.230	2.25	3.60	52.0
16		61	16.187	32.80	0.929	0.225	2.90	4.65	9.5
17		62	15.614	37.00	0.999	0.255	2.05	4.90	22.0

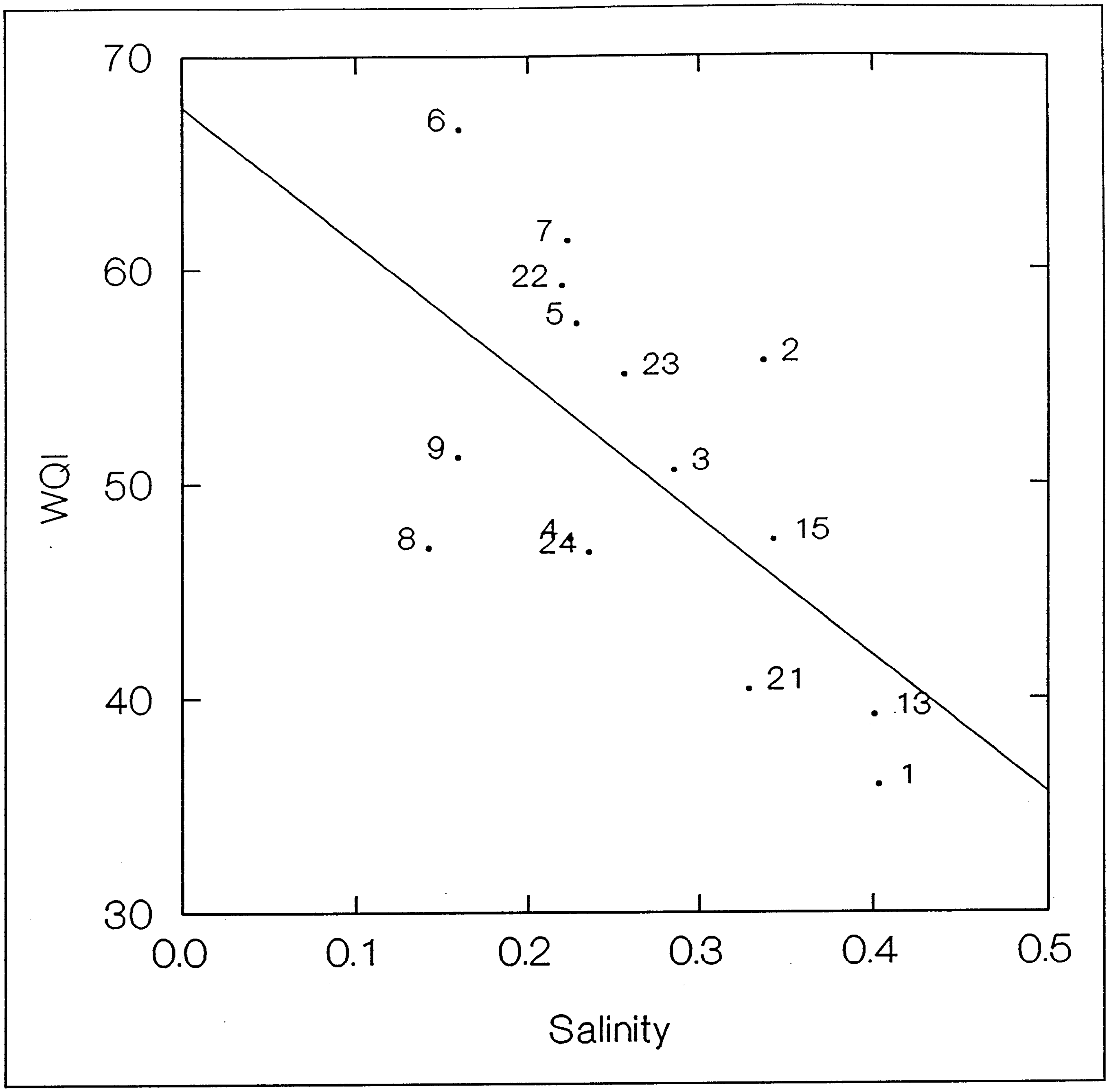


Figure 6. WQI vs. median salinity, MML/Port Charlotte data. Numbers are station identification numbers. The line represents the least squares regression, p =0.02.

The relationship of the WQI with dwelling units and septic systems was also examined. Station 21 was removed from this analysis because of the anomalous character of the WQI and salinity data for that station. Inclusion of Station **21** in the analysis strongly decreased the significance of the relationships. Neither dwelling units nor septic systems alone had a significant relationship with WQI. No additional relationships were determined when septic systems were segregated into pre- and post-1983 installation. Examination of Figures 7 and 8 show the scatter of WQI *vs* dwelling unit estimates (p=0.14) and septic system counts (p=0.13). However, when dwelling units and septic systems are combined by addition of the log transformed data, a significant relationship is apparent (p=0.04). Figure 9 demonstrates that as the accumulated effects of dwelling units and septic systems increase, water quality decreases.

Although, the TSI values for the "estuarine" stations are also strongly predicted by salinity, and the trend is similar to that in the fresh areas, with higher quality in the more saline stations, the relationship is only marginally significant (p=0.09) (Figure 10). Neither dwelling units, septic systems, nor their combination were significantly related to TSI. It seems that the effect of dilution by water from the Peace River is the dominant influence, and the variability in the data makes it impossible to find other trends in a dataset of this size.

Both WQI and TSI were calculated over all stations for each sampling date, and their relationships with temperature and local rainfall were examined (Figure 11). No statistically significant effects were found, although there is indication that the TSI for 4/20/94 may have been affected by the rainfall immediately prior to that sampling. The overall decreasing trend in water quality seems to coincide with the seasonal increase in temperature.

Other studies in South Florida and the Florida Keys have found similar relationships between development (increases in population and the resulting increases in dwelling units and septic systems) and decreases in water quality. As early as 1972, McNulty *et al.* demonstrated the relation between human population and sources of pollution (McNulty *et al.*, 1972, p. 120). In 1975, the US EPA published a report (Hicks and Cavinder, 1975) in which the level of development was positively correlated with nutrient and bacteriological levels and negatively correlated with the resulting water quality in Punta Gorda and Big Pine Key. More recently LaPointe *et al.* (1990) found correspondence between the presence of septic systems and high nutrient levels in the nearshore waters of the Florida Keys. And in the canal systems of Cape Coral, Morrison (1989) and Morrison *et al.* (1989) found relationships between water quality and the presence of septic systems and development very similar to those revealed by the present study.

Continuous Monitors

Hydrolab continuous monitors were deployed at pairs of stations, endeavoring to identify typical diurnal patterns in areas with minimal and with maximum DO depressions. For freshwater sites, Stations 1 and 2 were selected as having maximum and minimum DO saturation values. For saline sites. Station 29 and 17 were selected as having maximal and minimal DO saturation values, respectively. Continuous data recorded is displayed in Figures 12-15.

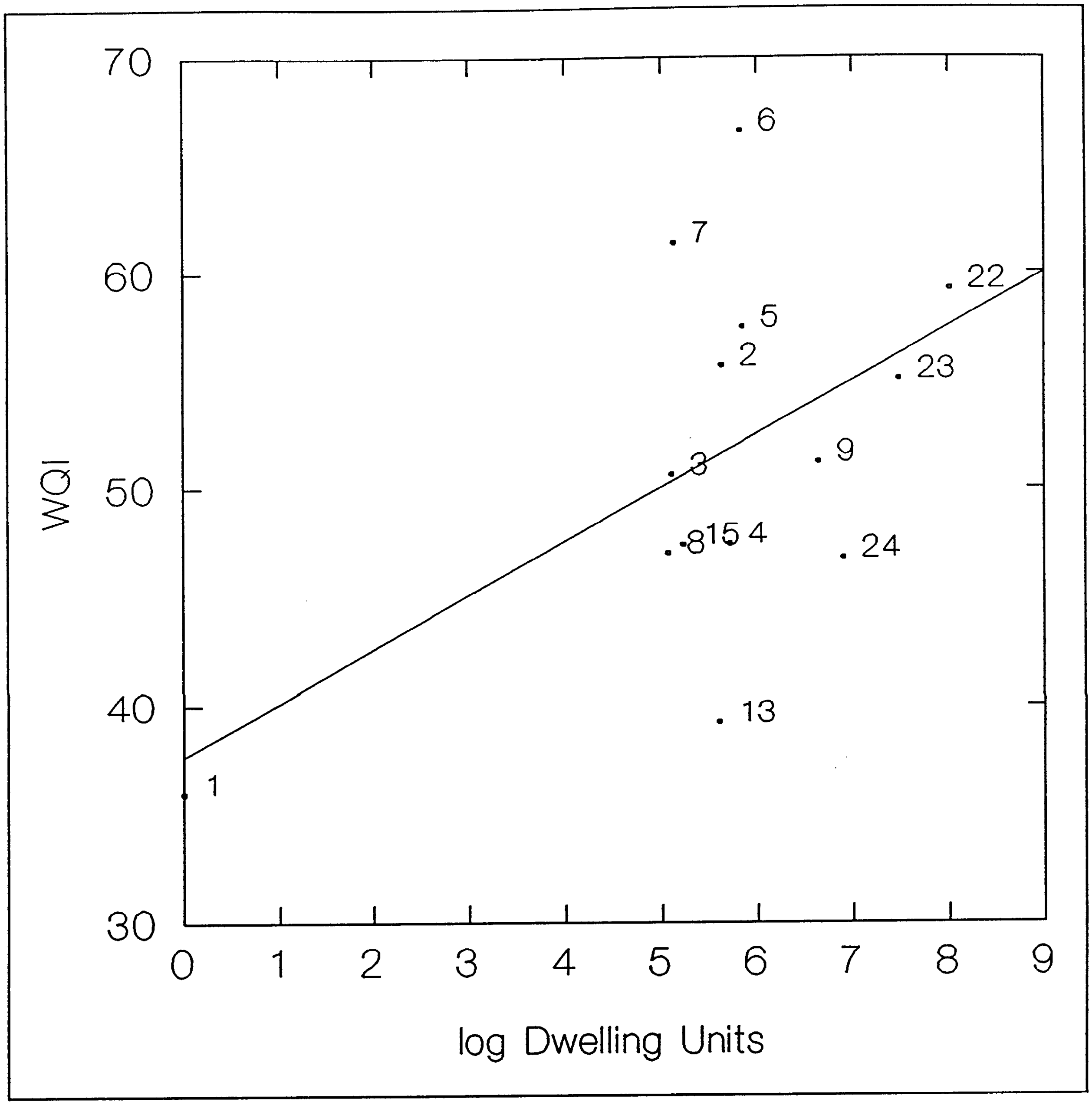


Figure 7. WQI *vs.* log of the estimated number of dwelling units affecting that station. The line represents the least squares regression, $p=0.14$.

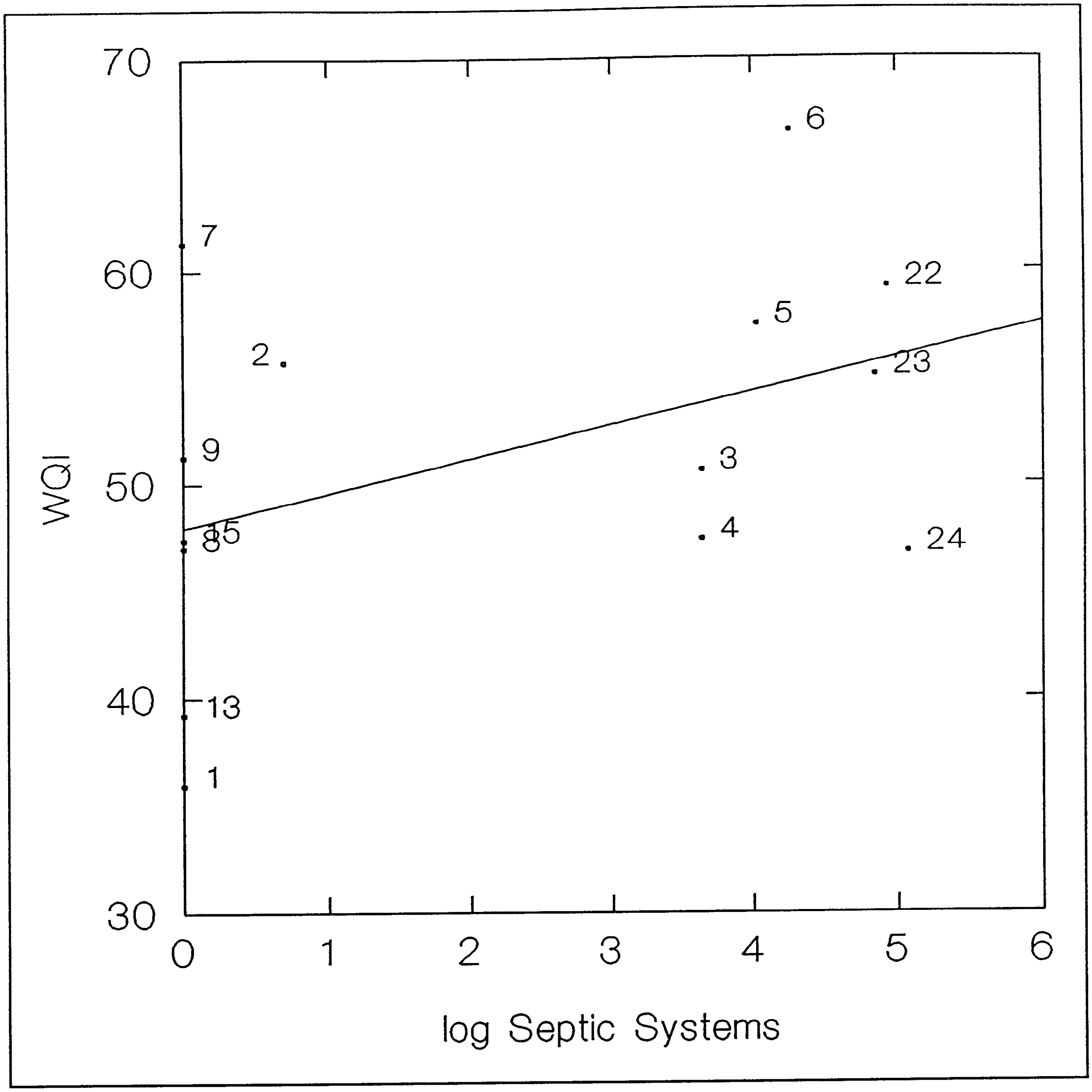


Figure 8. WQI *vs.* log of the number of canal adjacent septic systems above each station. The line represents the least squares regression, p = 0.13.

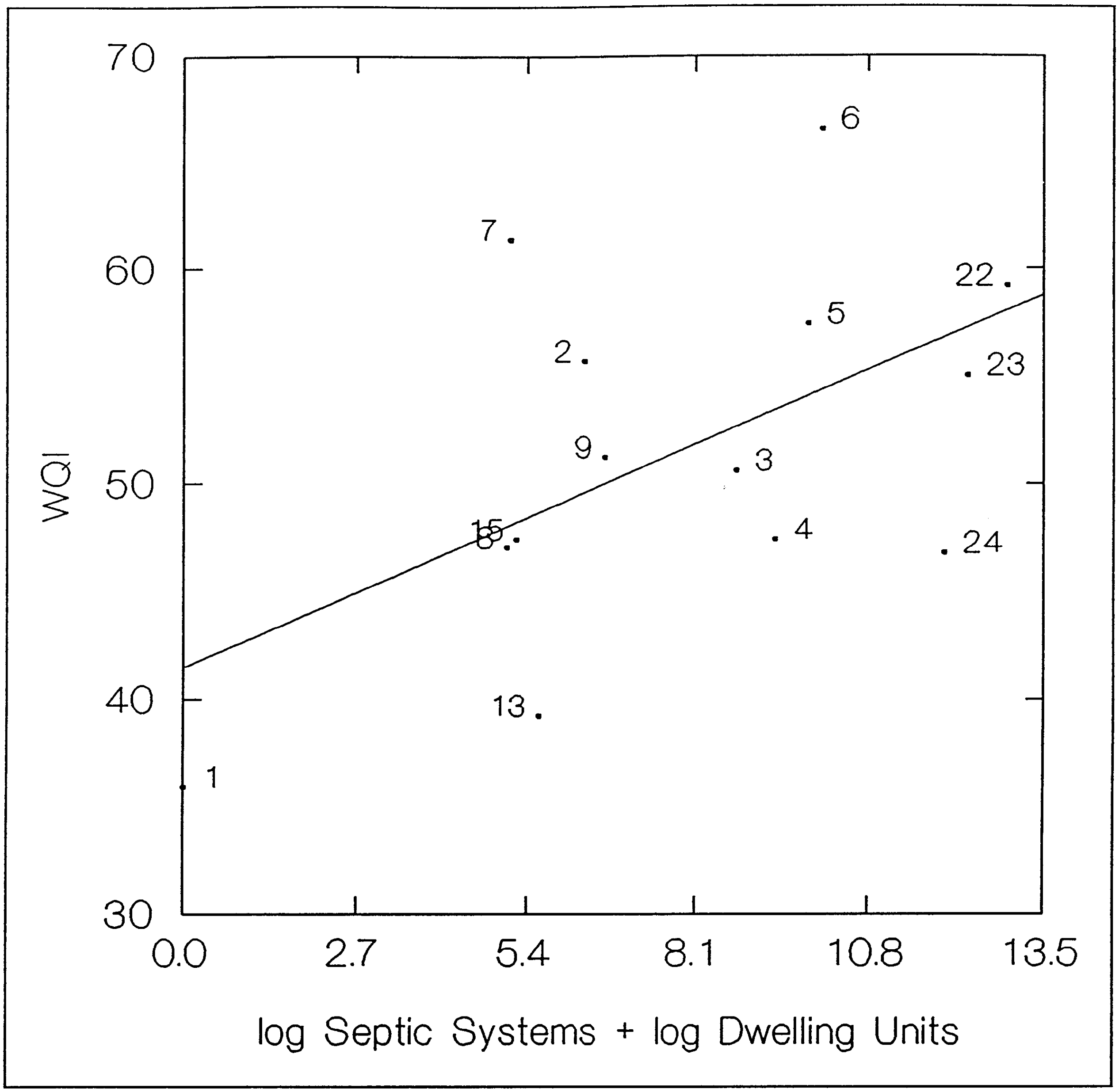


Figure 9. WQI *vs.* log of dwelling units plus log of septic systems. The line represents the least squares regression, p = 0.04.

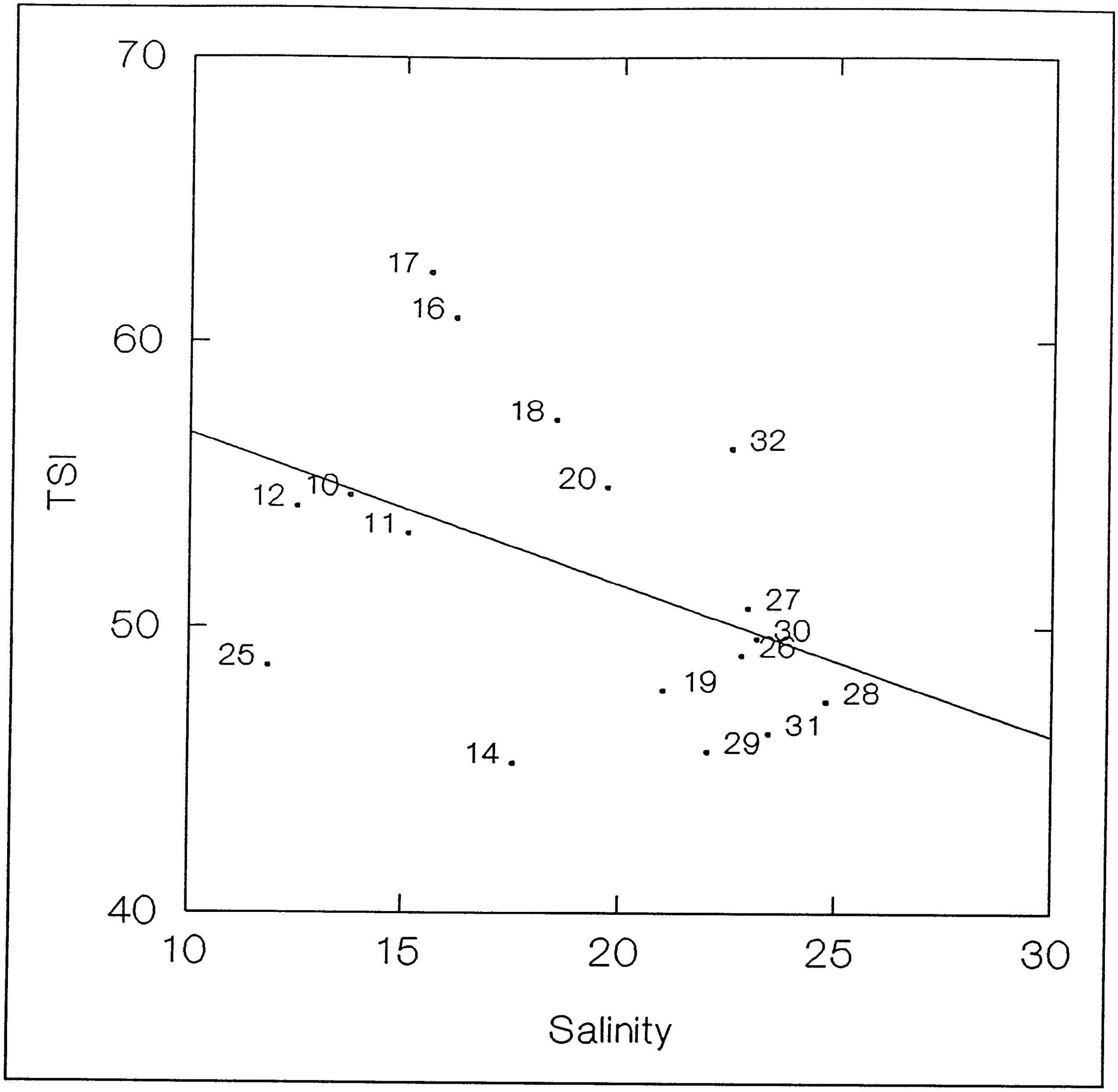


Figure 10. TSI vs. median salinity, MML/Port Charlotte data. Numbers are station identification numbers. The line represents the least squares regression p = 0.09.

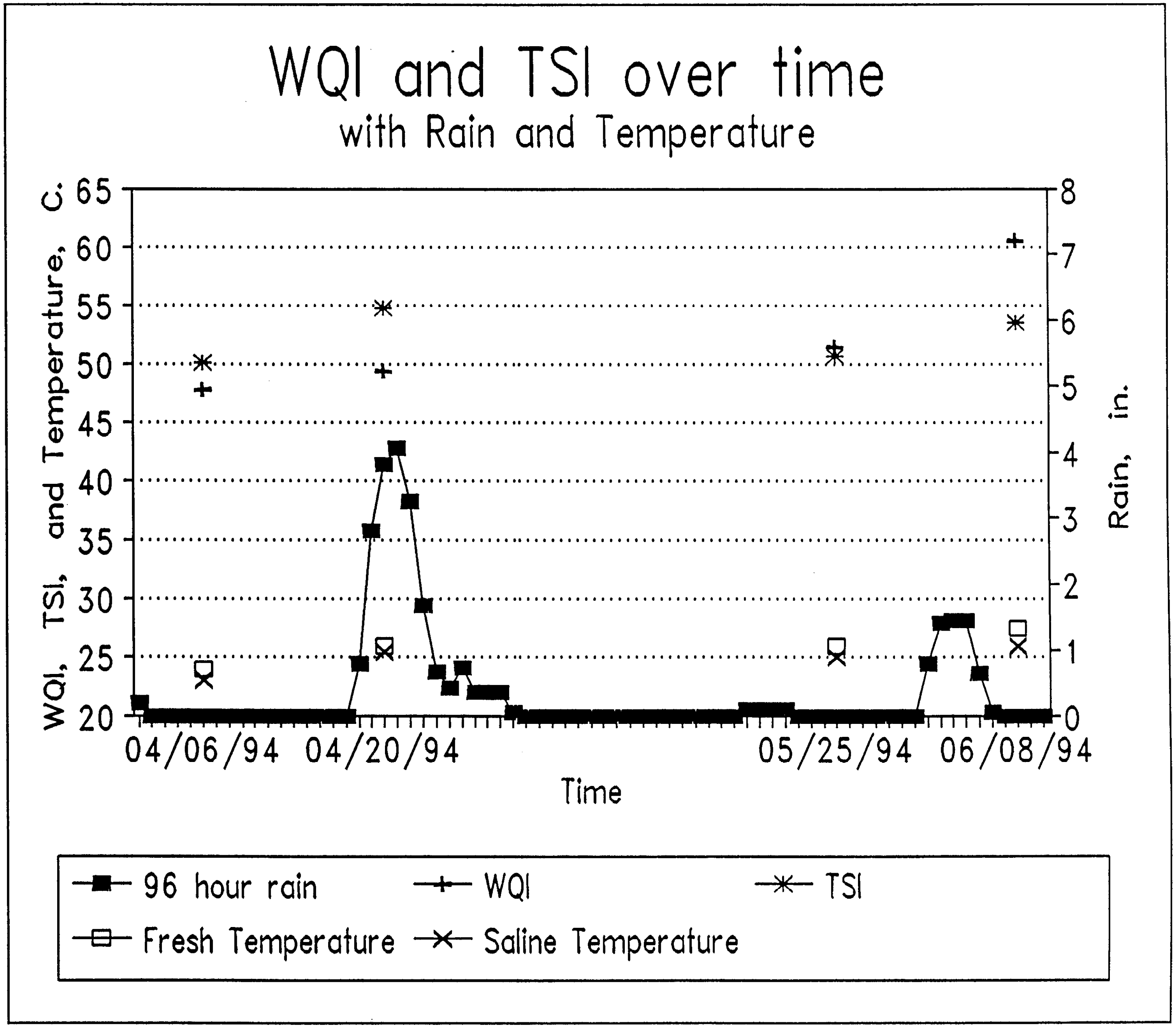
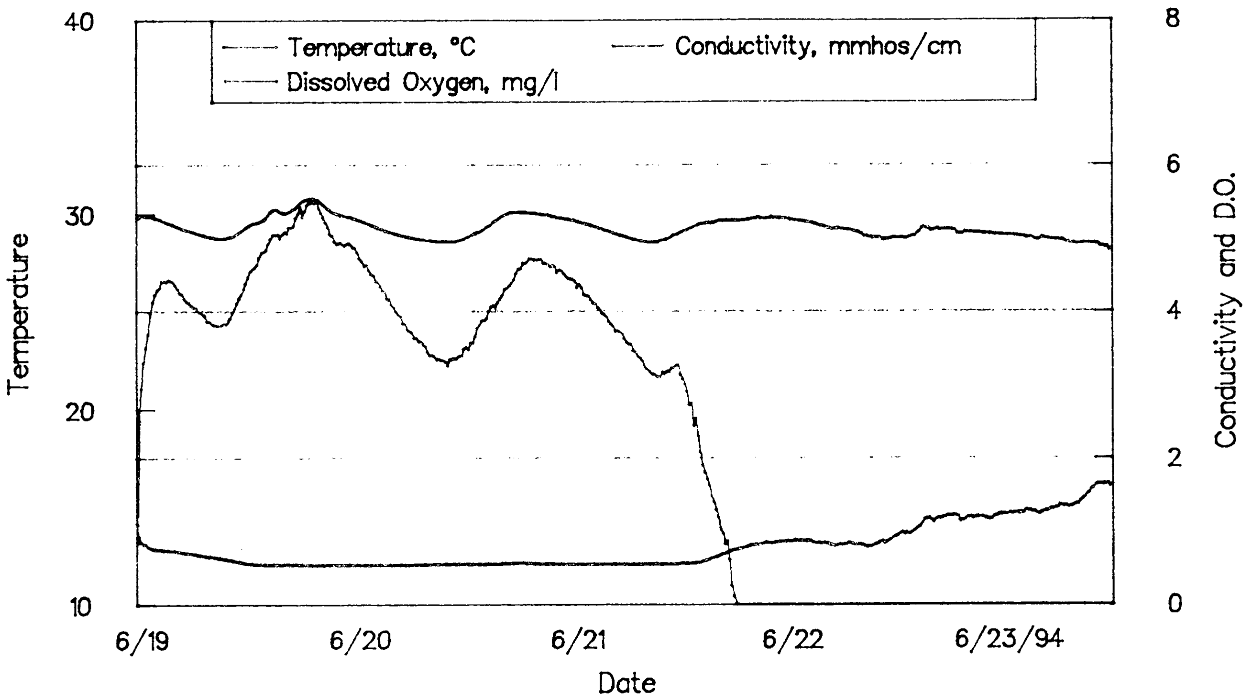


Figure 11. WQI and TSI *vs.* time, with rain (in.) and temperature (C) at Port Charlotte. WQI and TSI are the from the median values for all fresh and saline stations, respectively. The rain has been accumulated over the 96 hours prior to the date identified.

Port Charlotte Water Quality

Hydrolab DataSonde, Site 1



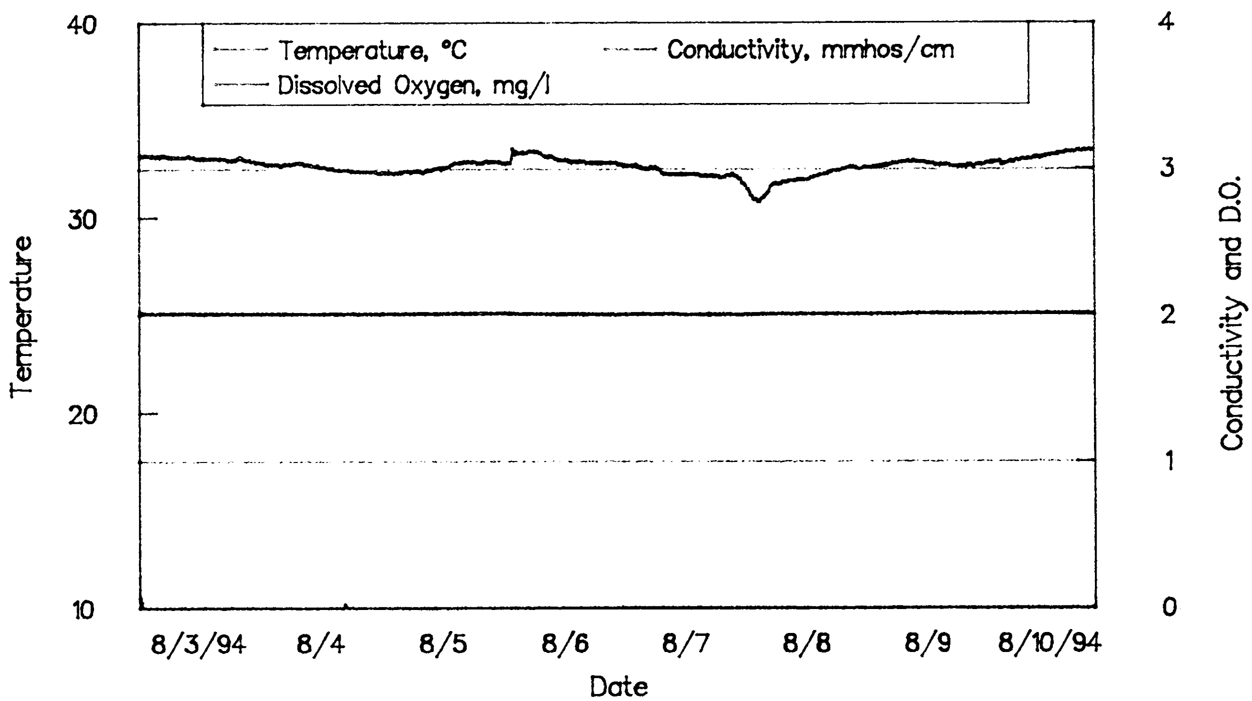


Figure 12. Continuous data recorded at Station 1.

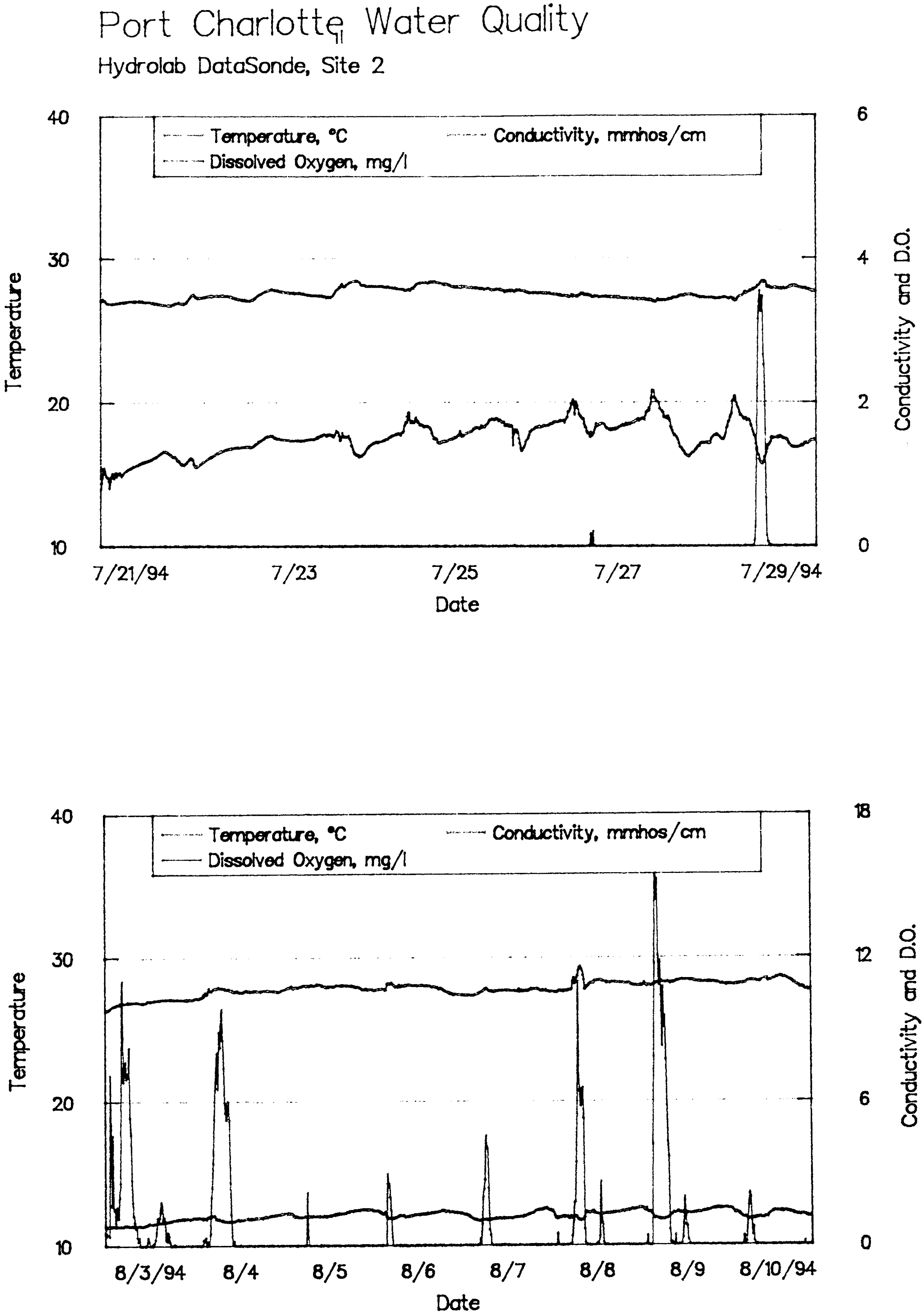


Figure 13. Continuous data recorded at Station 2.

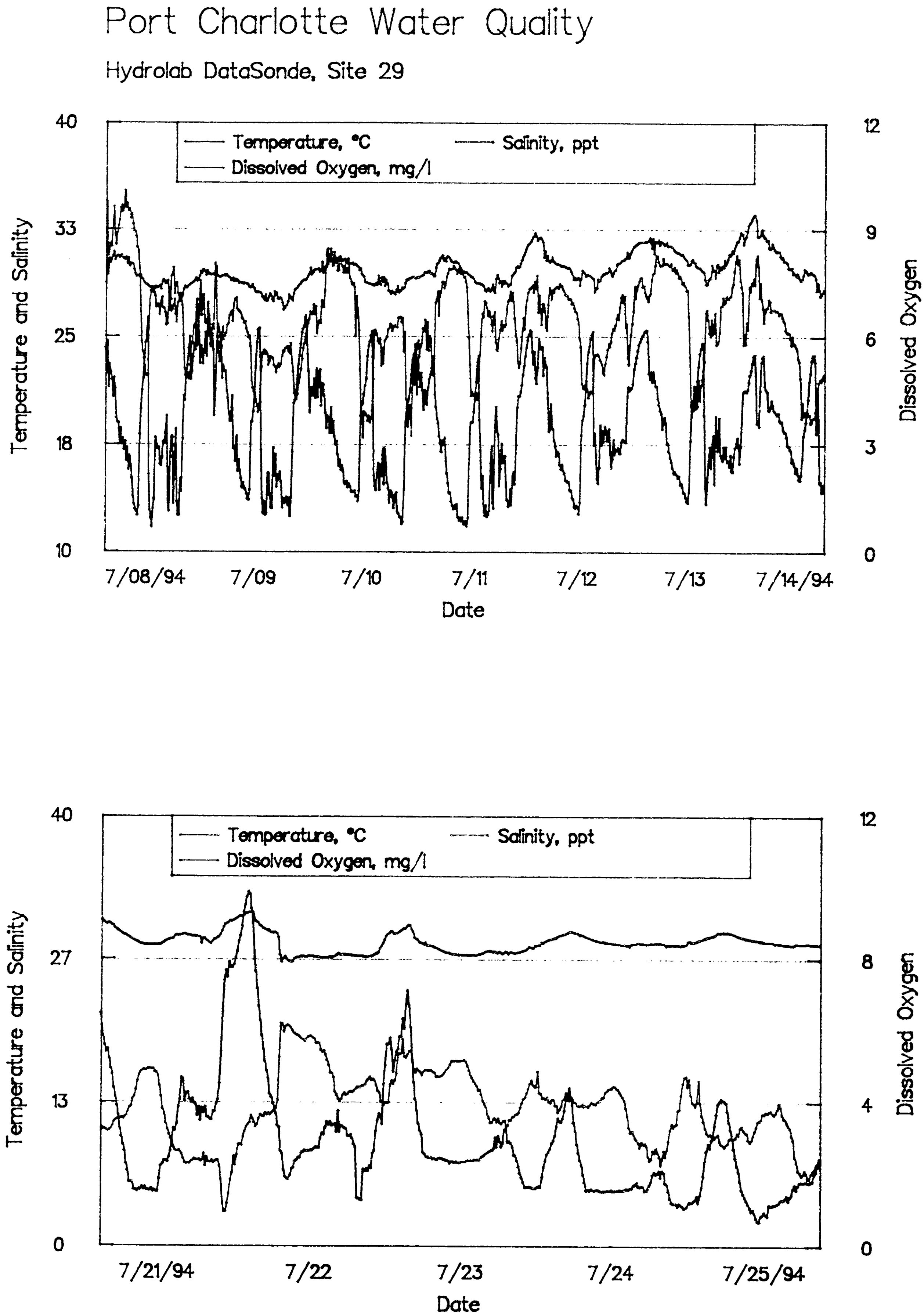


Figure 14. Continuous data recorded at Station 29.

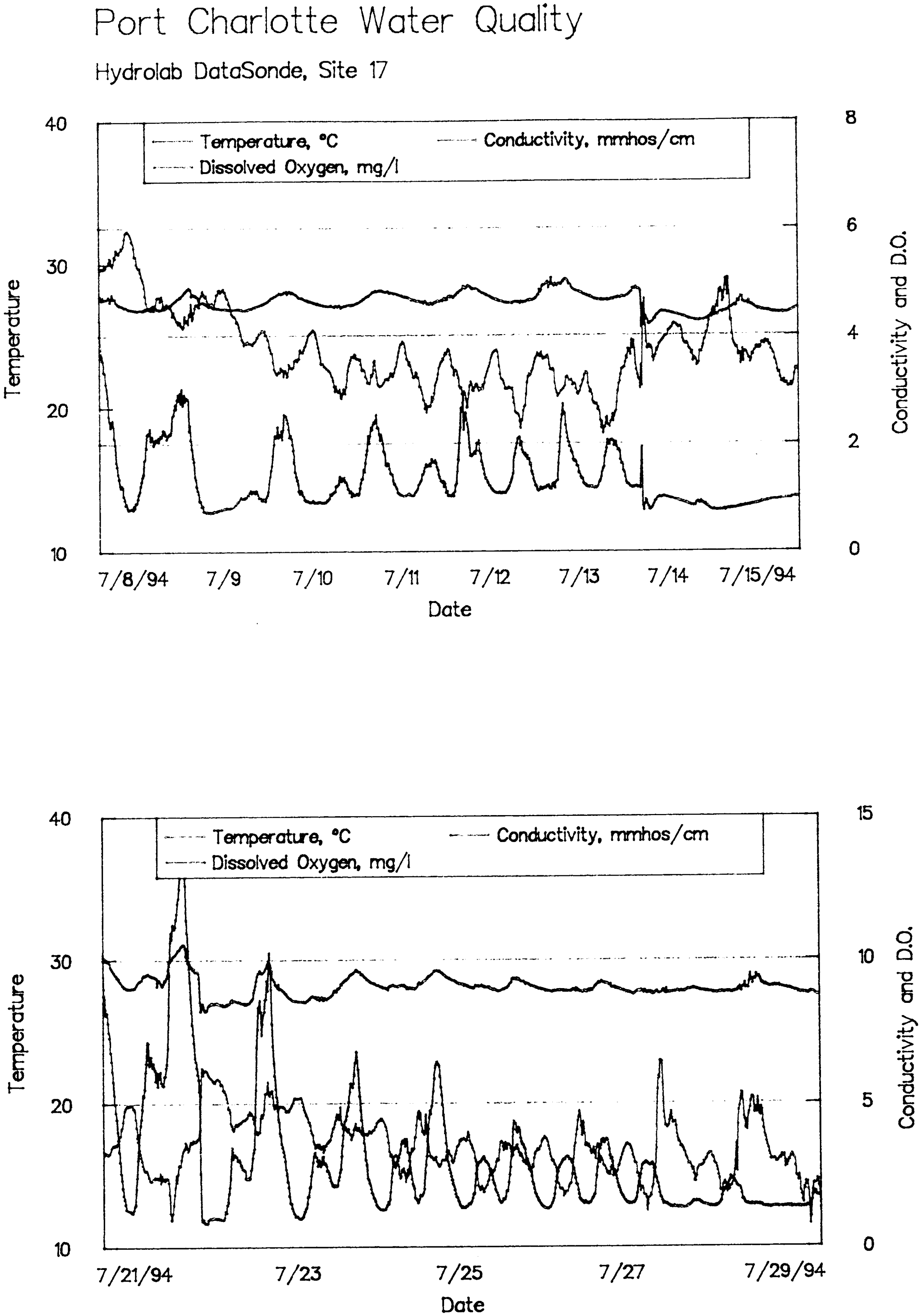


Figure 15. Continuous data recorded at Station 17.

Station 1 is the location receiving continuous outflow from the Cocoplum Waterway during the period of the MML study and exhibited typical diurnal DO and temperature patterns under a relatively constant conductivity during the first portion of the first deployment. An illegal dumping of oil or asphalt-type material, however, occurred during the deployment and is evident in the depiction of both DO and conductivity. The originally clean sandy bottom was now black and viscous. While it was possible that the DO membrane was simply fouled by the dumped material, a subsequent deployment, when the probe was not subjected to water column concentrations of petroleum products, reveal that the impacts to DO at this location were long-lasting and severe. Even before the dumping, however, very few of the DO measurements met 17-302 criteria for DO.

Station 2, in contrast to the flows observed at Station 1, is a relatively stagnant waterbody with substantial amounts of macroalgae and submerged vegetation. Values of DO were extremely depressed at this location, with none of the DOs in the initial deployment meeting 17-302 criteria and only a few instances of any measurable DO. The impact of increasing vegetation by the second deployment can be seen in the diurnal cycles produced in August, as anoxic nighttime conditions are routinely followed by supersaturated conditions. The mean DO for this site, however, was still only 0.8 mg/l.

Station 29, the saline station with one of the better records of DO saturation was shown to illustrate strong diurnal temperature patterns and expected tidal variations in salinity. Signals of DO, however, were not exclusively tidal or diurnal, appearing as a mixed signal. Salinities were much lower during the second deployment and are also accompanied by lower overall DO levels. Average DO for the first deployment was 7.6 mg/l and for the second, 3.9 mg/l, suggesting a lower ambient DO or a higher BOD associated with freshwater discharges.

The final continuous data station, Station 17 was selected because of the overall poor record of DO saturation in a tidal canal. Field data additionally indicated that salinity stratification occurred frequently and was accompanied by depressed DO values in the more saline waters at the bottom of the water column. Very few values were above 4.0 mg/l for this station with successive deployments averaging 3.7 and 3.5 mg/l, respectively.

Results - Comparisons with Existing Data Sets

The results for the four water quality screening events were initially compared to published ranges of data from the Charlotte Harbor inflow area and Charlotte Harbor (as compiled by Hammet, 1988). Some of the average values for the fresh water sites were compared to average values for the Myakka and Peace Rivers (Table 17). Color, total nitrogen, nitrate plus nitrite nitrogen, ammonia nitrogen, total phosphorus, and ortho-phosphate were all lower in the study area than in the rivers. The differences in nitrate plus nitrite nitrogen and the two types of phosphorus are especially dramatic, with up to 65 fold differences in concentrations for nitrate-nitrite-nitrogen between the Peace River and the Port Charlotte study area. The high phosphorus concentrations for the rivers is likely due to the phosphate-rich soils which occur throughout their courses (SWIM, 1993; Hammet, 1988; Fraser, 1986; McPherson and Miller, 1990).

Table 17.	**Myakka and Peace Rivers water quality average values compared to Port Charlotte fresh water average values.**		
	Myakka River* X	Peace River* X	MML/Port Charlotte Fresh, X
Temperature, °C	24.4	24.1	24.7
Color, PCU	138	88	59
Conductance, µmhos/cm	148	286	667
Total-N, mg/l	1.5	1.9	1.03
Ammonia, mg/l	0.080	0.078	0.028
NO, + NO_3-N, mg/l	0.17	0.918	0.014
Total-P, mg/l	0.34	2.59	0.13
O-PO_4, mg/l	0.254	2.44	0.078
Chlorophyll- *a*, µg/l	20.0	8.0	17.8
(*from Han-met, 1988)			

A major source of fresh water to the study area, the Cocoplum Waterway, is reportedly composed of groundwater from wells in the area (EQL, 1988), which usually contain lower nutrients, but higher dissolved solids than river water. Conductivity values were indeed higher in the study area than in the respective river data sets. Similar comparisons of ranges of values between the study area salt water sites with Charlotte Harbor data (Table 18), revealed similar levels of color, chlorophyll-a, and phosphorus. Ammonia was elevated in the study area compared to the Harbor, while nitrate plus nitrite nitrogen was lower.

Table 18.	**Charlotte Harbor water quality ranges compared to Port Charlotte salt water ranges.**	
	Charlotte Harbor* Range	MML/Port Charlotte Salt Water Range
Color, PCU	9-100	32-80
Chlorophyll-a, µg/l	1.9-60.3	3.8-100.2
Total-P, mg/l	0.09-0.99	0.06-0.92
O-PO_4, mg/l	0.05-0.88	0.019-0.751
TN, mg/l	0.53-1.31	0.39-3.03
Ammonia-N, mg/l	0.04-0.08	<0.005-1.35
NO_2 +NO_3-N, mg/l	0.01-0.23	< 0.005-0.032
(*from Stoker, 1986)		

Subsequent comparisons were conducted in greater detail, using the trophic state and water quality indices previously discussed. In the STORET data, the WQI ranged from 28 to 80, far beyond the MML/Port Charlotte data in both directions (Table 19). The distribution of water quality categories was however, fairly similar, with 13 percent of the stations rated as good, 60 percent as fair and 27 percent as poor. The WQI for the Cape Coral stations were markedly better, ranging from 15 to 38, all in the good category (Table 20). The North Port WQI were similar, though slightly lower quality, ranging from 48 to 68, with 63 percent fair and 37 percent poor stations (Table 21). In the Pellam Waterway, WQI ranged from 52 to 63, with two fair stations and two poor (Table 22). In both North Port and Pellam Waterway, the lower water quality stations were so categorized because of low DO values.

The relationships of WQI with salinity in these data sets are plotted in Figures 16 and 17 along with the MML/Port Charlotte data. (For this graph, freshwater stations with a zero salinity were eliminated, as natural water almost never has an equivalent salinity less than 0.2 ppt [200 µmhos/cm], and it was assumed that these measurements were simply not of sufficient precision to be used for this purpose). The similarity of the slope of the relationship for three of the five datasets is notable. The coincidence between the STORET data and the MML/Port Charlotte is particularly strong, while the Pellam Waterway is fairly close (Figure 16). Apparently over a wide area, in many circumstances, fresh water canal systems in this region share this characteristic relationship with mineral content, such that more mineralized water is of higher quality and is degraded by less mineralized surface water. The North Port and Cape Coral (Figure 17) data show the opposite trend with respect to salinity. Apparently, in these systems, the length of time the water remains in the system and therefore the degradation it suffers, is indicated by increasing salinity.

TSI in the STORET data ranged from 23 to 74, with 26 percent good, 48 percent fair and 26 percent poor quality (Table 19). Again the range is much broader than the MML/Port Charlotte data, and in this case the proportion of fair and poor stations is much higher. The distribution of stations in the Cape Coral data is more similar to that for MML/Port Charlotte, but there are some stations with much higher quality, with TSI as low as 24 and as high as 61 (Table 20). The South Gulf Cove TSI ranged from 36 to 71, with 40 percent good, 53 percent fair and 7 percent poor water quality (Table 23).

The relationships of TSI with salinity for these datasets are plotted with that of the MML/Port Charlotte data in Figures 18 and 19. Again, the trend in the STORET data is strongly coincident with that of the local system, and the regression lines are nearly indistinguishable. The regional pattern seems to be that when a system is connected with open estuarine water, the water quality improves as the proportion of water from the estuarine source increases. Both South Gulf Cove and Cape Coral seem to be exceptional. The basis of this condition in Cape Coral is unknown. In the case of South Gulf Cove, there is generally no direct and open connection with the source of natural water, and salinity is introduced into the system only episodically at the exit point with no constant flushing. In this case there is no stable dilution gradient and increased salinity seems to indicate only increased time in the system. This is quite different from the situation in Port Charlotte where the saline canals have a direct, open connection with the estuary.

Table 19. WQI, TSI and median parameter values for STORET data. Separated into fresh and estuarine groups, ordered by decreasing water quality.

STATION	WQI	TSI	SAL	CHLA	SECCHI	JTU	TSS	TN	TP	DO	BOD	TOC
			ppt	µg/l	m		mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
24010613	28		0.000			2.50		1.150	0.121	7.5		
25030013	32		0.000	3.27		1.50		1.240	0.314	6.3	0.90	
24010670	40		0.000				1	3.570	1.101	5.9	4.20	
24010615	42		0.500	3.91		1.60		1.380	0.396	4.0	0.70	
24010642	44		0.000	2.34		2.00	1.5	1.320	0.414	5.8	1.50	
25020473	46		0.202			3.50			0.120	6.8	2.90	
24010619	48		0.438	5.87		5.05		1.030	0.141	3.6	0.80	
24010629	52		0.293	4.70		2.50	4.5	1.475	0.469	5.8	2.00	
24010672	53		0.000	28.16				3.260	1.444	5.1		
24010627	55		0.000	14.23		7.00	2.5	1.030	0.435	5.6	2.35	
24010630	57		0.327	10.74		1.30	4.5	1.375	0.318	5.5	4.15	
24010628	63		0.165	7.26		1.50	9.5	2.390	0.797	6.4	5.10	
24010558	65		0.085	2.18		8.60		0.865	0.378	5.8	150.00	
24010626	74		0.037	8.39		5.80	4	3.680	0.728	4.0	3.35	
24010625	80		0.168	18.42		5.10	13	2.680	0.846	4.6	5.30	
25020461		23	20.500		1.6	2.00			0.390	5.8	3.00	
25020483		23	22.000		1.6	2.00			0.340	6.6	3.00	
25020453		23	18.000		1.6	3.00				6.8		
25020518		35	25.000		0.7	0.80				7.8		
24010588		41	20.000	1.12		3.00		1.450	0.387	5.0	1.20	
24010587		48	17.000	3.30		2.90		1.295	0.236	4.5	1.40	
24010624		48	22.255	4.01				1.160	0.347	4.9		
24010618		50	20.000	6.57		2.80		1.000	0.501	5.0	1.50	
24010583		51	28.500	8.14				0.910	0.182	5.2		
24010534		52	28.478		1.3	10.00	23	0.800	0.162	6.3	0.65	
24010553		52	8.277	2.21		4.50		2.830	1.118	3.8	1.90	
24010617		53	6.500	7.88		2.10		1.240	0.239	5.7	2.30	
24010612		55	14.341	10.35		2.65		1.195	0.183	6.4	1.20	
24010593		55	11.883	9.75		1.85		1.250	0.441	4.2		
24010567		56	25.526		1.1		20	0.950	0.301	5.7		
24010584		58	10.326	11.09		10.00	14	1.605	0.440	5.8	4.25	
25020421		58	18.560			3.00		1.130	0.430	6.2	3.20	
25030028		59	11.558					1.135	0.160	5.2	2.00	
25020537		59	13.686					1.155	0.255	8.4	2.95	
24010621		59	17.403	16.41		3.40		1.295	0.300	4.8		
24010620		60	2.500	18.00		3.70		1.350	0.265	5.0	1.00	
24010537		60	26.522		0.9	19.00	18	1.075	0.298	5.1	0.60	
25020455		61	16.257			3.00		1.310	0.360	6.8	3.20	
25020524		65	15.342		0.5	1.00	1	0.670	0.370	6.8		17.05
24010549		68	19.500	6.66	0.7	3.50	36	5.680	1.384	5.0	1.80	
24010623		69	24.000	64.18		3.25		1.260	0.326	4.9	5.30	
24010639		74	8.054	92.95		1.70		1.580	0.323	3.6	4.60	

Table 20. WQI, TSI and median parameter values for Cape Coral data. Separated into fresh and estuarine groups, ordered by decreasing water quality.								
STATION	**WQI**	TSI	SAL	SECCHI	TSS	DO	BOD,	FECCOLI
			ppt	m	mg/l	mg/l	mg/l	#/100 ml
295	15		0.200	1.7	2.00	7.80	1.15	16.0
280	16		0.200	2.2	2.50	8.08	1.30	11.0
310	20		0.200	2.1	2.50	7.70	1.50	9.5
243	20		0.300	1.6	2.50	8.00	1.30	27.0
210	25		0.300	2.1	2.50	6.50	1.20	24.0
275	31		0.200	1.0	4.50	6.99	1.60	40.0
300	35		0.300	0.9	10.75	8.26	2.30	20.0
355	38		0.200	1.0	5.75	6.66	1.45	88.0
150		24	1.960	1.5		6.33	0.05	10.0
120		26	3.000	1.3	0.25	7.24	0.05	5.0
450		26	4.000	1.3	5.70	6.67	1.90	
430		45	12.000	1.3	20.75	6.50	1.70	8.0
400		53	8.900	0.9	17.50	6.25	1.90	14.0
470		53	12.400	1.0	18.15	6.30	1.50	10.5
510		53	11.000	1.0	17.00	5.90	1.70	12.0
315		61	1.500	0.7	10.00	6.89	2.20	132.0

Table 21. WQI and median parameter values for North Port data. Ordered by decreasing water quality.						
STATION	**WQI**	SAL	TN	TP	DO	BOD_5
		ppt	mg/l	mg/l	mg/l	mg/l
7	48	0.122	1.077	0.228	5.9	1.32
8	49	0.069	1.157	0.249	6.0	1.32
3	49	0.390	0.788	0.057	5.4	1.99
6	55	0.176	1.048	0.220	4.6	1.23
2	57	0.390	0.905	0.049	4.0	1.99
5	62	0.336	0.962	0.084	3.2	1.67
4	64	0.416	0.954	0.064	1.9	1.96
1	68	0.336	1.190	0.173	2.3	1.78

Table 22. WQI and median parameter values for Pellam Waterway data. Ordered by decreasing water quality.

STATION	WQI	SAL	CHLA	TP	DO	BOD_5
		ppt	µg/l	mg/l	mg/l	mg/l
2	52	0.666	22.21	0.046	5.83	3.18
1	54	0.621	28.80	0.054	5.64	2.96
4	60	0.321	10.90	0.085	4.77	2.00
3	63	0.345	12.05	0.091	4.01	1.83

Table 23. TSI and median parameter values for South Gulf Cove data. Ordered by decreasing water quality.

STATION	TSI	SAL	TN	TP	DO	BOD_5	FECCOLI	TOTCOLI
		ppt	mg/l	mg/l	mg/l	mg/l	#/100 ml	#/100 ml
4	36	1.271	0.985	0.019	6.4	1.21	4.0	33.5
7	39	1.185	0.957	0.022	5.6	1.32	3.3	35.0
8	41	2.835	1.025	0.025	7.3	2.13	2.5	6.0
2	42	1.287	0.917	0.026	6.5	1.30	3.5	40.0
5	45	3.524	1.055	0.030	6.5	2.34	2.2	10.0
6	45	2.746	1.022	0.031	7.1	2.27	2.3	9.5
12	50	23.023	0.737	0.193	6.7	1.76	0.0	0.0
10	51	22.324	0.779	0.208	6.5	1.72	0.0	0.0
3	52	3.544	1.016	0.035	6.6	2.01	3.0	20.0
14	53	19.932	0.854	0.184	6.2	1.98	2.0	5.0
1	55	0.936	0.994	0.047	6.0	1.45	3.4	35.0
9	55	22.429	0.936	0.290	6.9	1.40	0.0	2.0
13	55	4.226	0.980	0.051	5.9	2.75	3.1	20.0
11	56	22.708	1.014	0.300	6.9	1.55	0.0	1.5
15	71	19.932	1.740	0.157	6.4	1.99	2.0	3.0

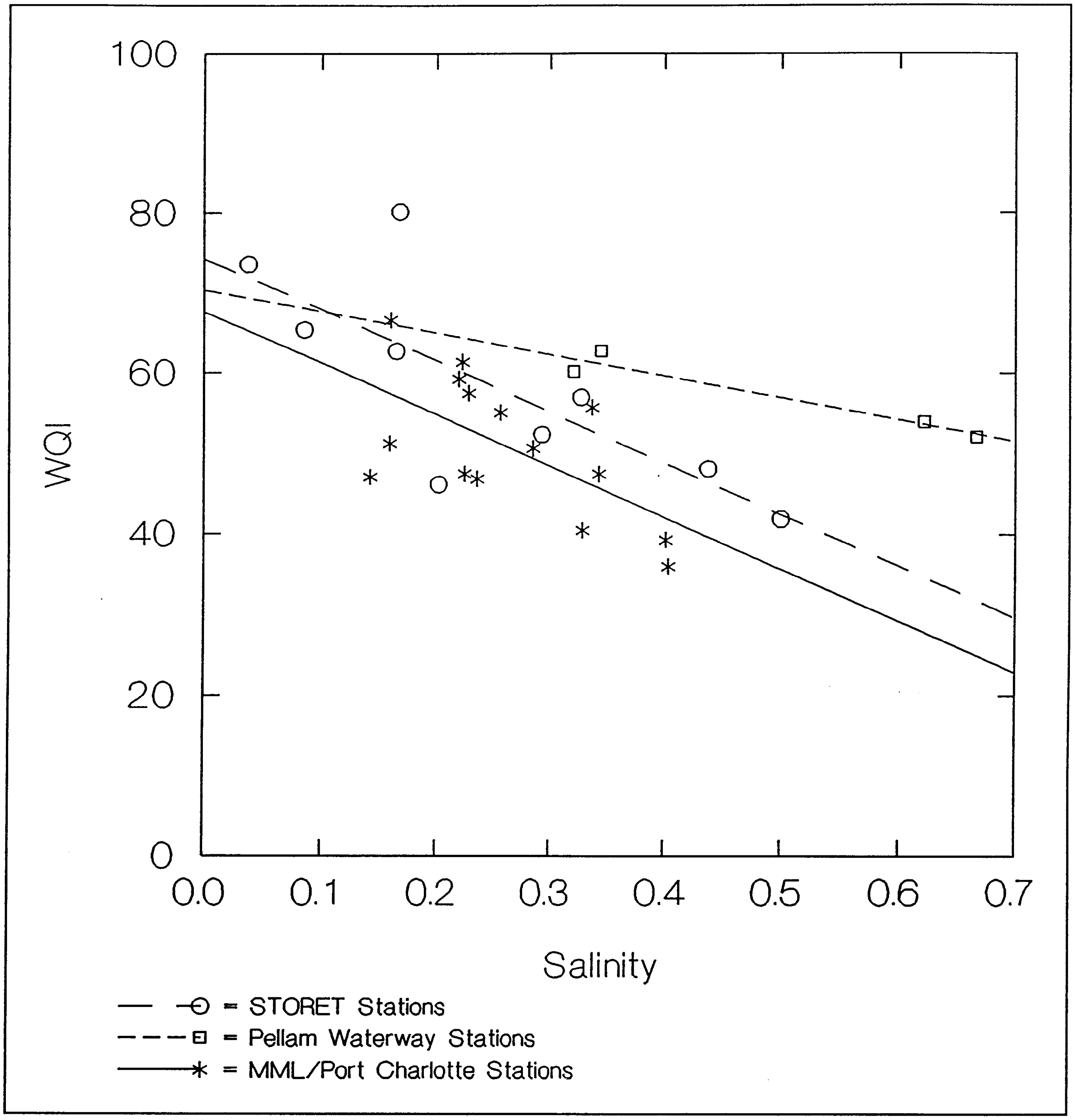


Figure 16. WQI *vs.* median salinity for Port Charlotte and other regional datasets with similar trend.

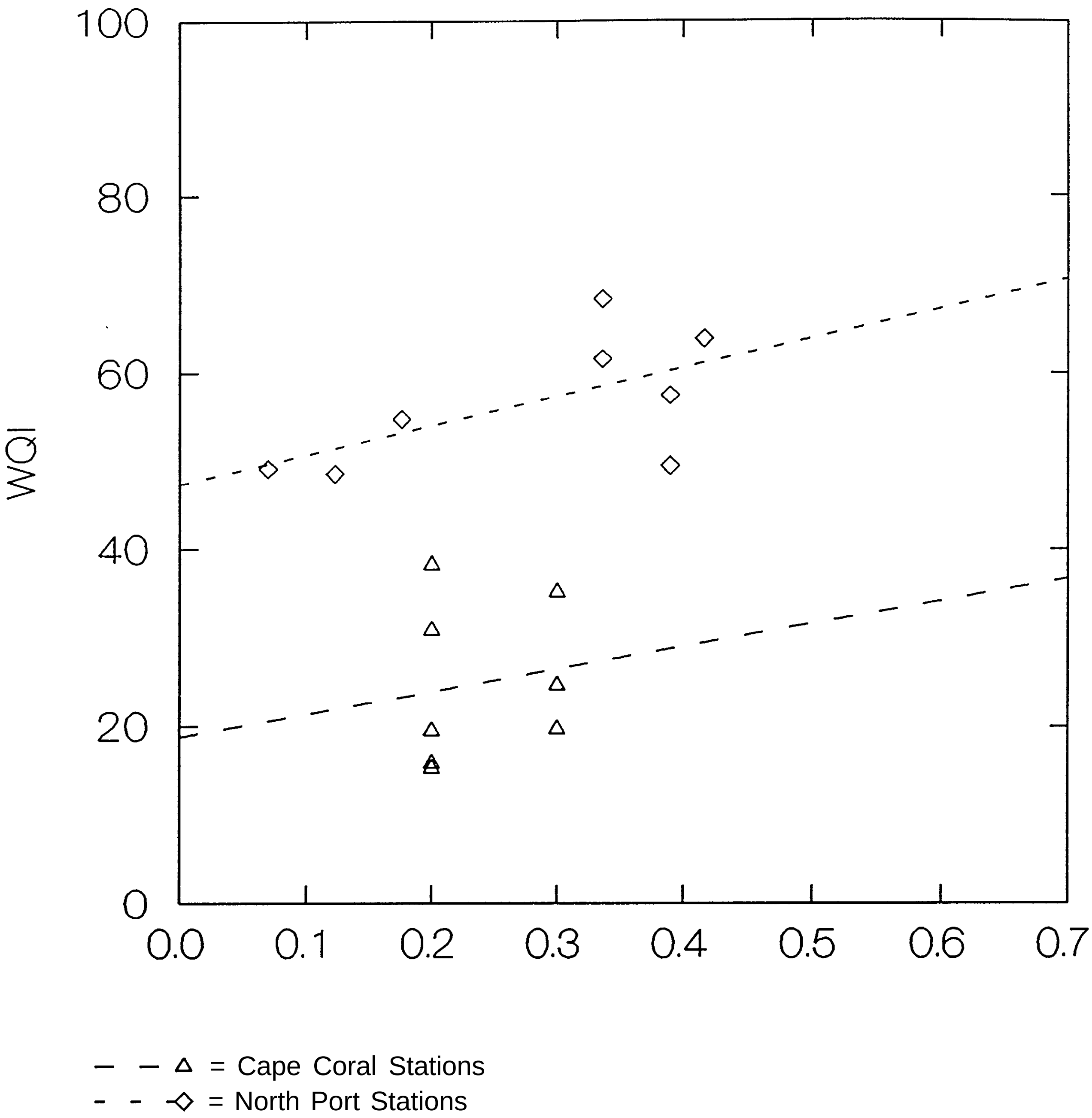


Figure 17. WQI *vs.* median salinity for regional datasets with trend opposite to Port Charlotte data.

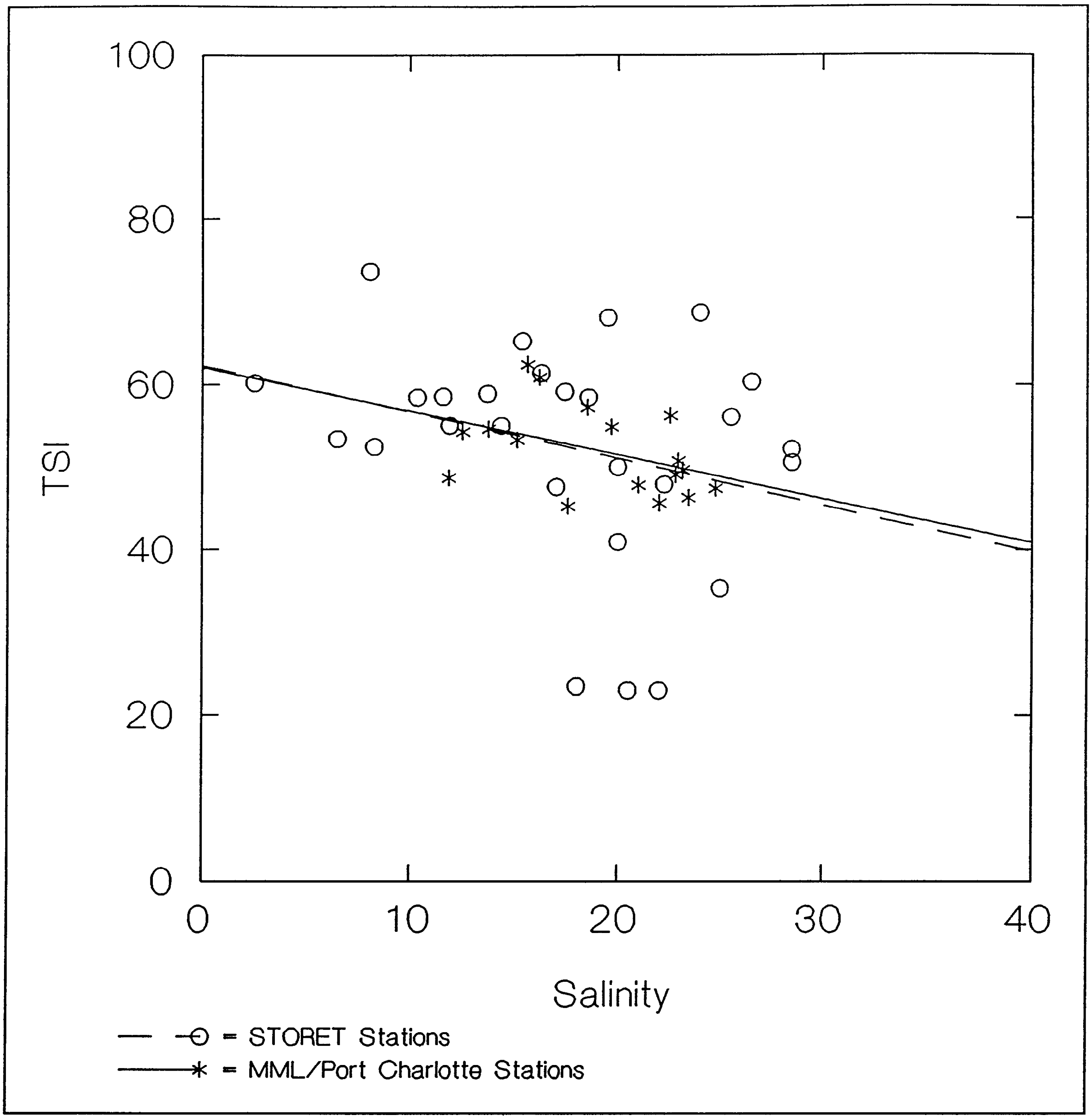


Figure 18. TSI *vs.* median salinity for Port Charlotte and STORET data.

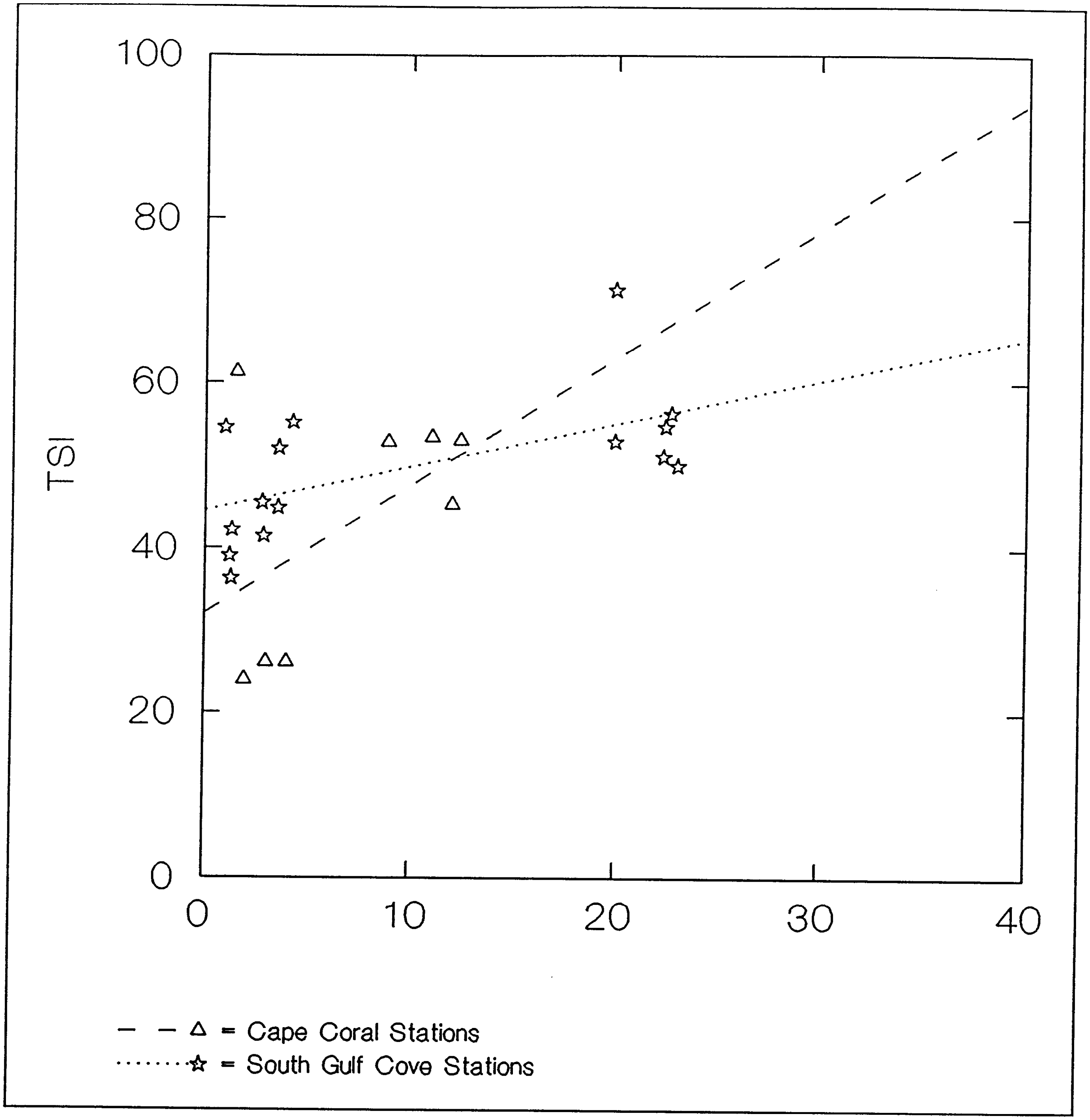


Figure 19. TSI *vs.* median salinity for regional datasets with trend opposite to Port Charlotte data.

Power Analysis

Power analysis is the process of estimating the capability of statistical tests to detect change in the moving geometric mean of a time series at a predetermined level of significance. The variance structure of historic data is examined and a model is constructed which provides an estimate of such parameters as the minimum detectable change and the probability of detecting a predetermined change at the selected significance level after a predetermined period of time. The power analysis performed for this study assumed a five year base period prior to change, a five year period after change, a significance level of 0.10, and a change of 25 % in the level of the constituent of interest. The results of the analysis are summarized in Table 24, modeled for both monthly and bimonthly sampling intervals. For each of the three constituents of interest, the mean and standard deviation (SD) of the results from the three stations of both the minimum detectable percent change (MDC) and the probability of detecting (power to detect (PTD)) a 25 % change are listed. A smaller mean MDC and higher mean PTD indicate a greater likelihood of discerning a change. A large SD indicates a wide differences in variability between the historic datasets examined, indicating individual station characteristics are probably more important than regional similarities.

Of the datasets available from locations near Port Charlotte, only the SGC and NP data had sufficient temporal extent to be used for this purpose. However, neither system exhibited behavior similar to that of the Port Charlotte canal systems when analyzed in relation to salinity and therefore dilution mechanics. Because the overall behavior of the STORET data was so similar to the MML/Port Charlotte data, STORET stations which were very close to the Port Charlotte WQI vs salinity and TSI vs salinity relationships were selected for this analysis. The three fresh stations were 24010615, 24010628 and 24010629. The three estuarine stations were 24010593, 24010618 and 24010624. The desired detectable change was set at 25 percent, a rather large change which would be more readily detectable. Monthly and bimonthly sampling frequencies were modeled to estimate the effect of more than one sampling frequency. Five years was used as both the base and the change sampling period. TN, TP and DO data were examined. The results of the analyses are presented in Table 24.

Although the standard deviations are relatively large, the fresh water stations exhibited a much higher power to detect the given change, and the monthly sampling regime showed a notable increase in power over the bimonthly for these stations. Correspondingly, the minimum detectable change in five years is much smaller for TN and DO, with means of 15 percent for monthly sampling. Apparently the levels for these constituents are fairly stable. The power to detect is much lower and the minimum detectable levels much higher for the estuarine stations, indicating much greater variability (such as tidal variations) in these systems and longer monitoring is needed to be sure an apparent trend is significant.

Trend Analysis

Trend analysis was conducted on an approximately 14-15 year data set of the WQI and TSI of the same three fresh water and three estuarine STORET stations mentioned above. The results of those analyses were very ambiguous. Of the six regressions, two were significant, one fresh water and one estuarine. The fresh water station, 24010629, had a significant negative slope of -0.936 ($p=0.006$), indicating that the water quality at that station is improving by about 1

WQI unit (approximately 1 composite percentile value) per year. The estuarine station, 241010624, had a significant positive slope of 2.258 (p =0.04), indicating a history of degradation at over **2** TSI units per year, or an approximate 15 % increase in chlorophyll content per year. The meaning of these results for the Port Charlotte system is unclear, but serve to illustrate that no regional trends of surface water quality are apparent and that local influences must predominate.

Table 24. Results of power analysis on selected STORET data.

	Bi-Monthly Sampling				Monthly Sampling			
	Minimum % Detectable		Power to Detect 25%		Minimum % Detectable		Power to Detect **25%**	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Fresh Water Stations								
Total Nitrogen	15	8	7 4	30	12	6	84	21
Total Phosphorus	30	28	52	37	25	21	61	42
Dissolved Oxygen	15	2	73	9	15	2	75	9
Estuarine Stations								
Total Nitrogen	22	9	51	26	20	8	56	27
Total Phosphorus	26	7	36	15	24	6	42	19
Dissolved Oxygen	**32**	11	29	15	31	11	30	16

SUMMARY AND CONCLUSIONS

The dry season water quality screening was designed to sample those parameters associated with excessive nutrients and potential eutrophication in the Port Charlotte system of canals. The pre-dawn samplings were effective at capturing numerous instances of depressed dissolved oxygen in both fresh estuarine sites. Two-thirds of the surface freshwater readings were below the State criteria of 5.0 mg/l while over 80 % of the bottom readings were below 5.0 mg/l. For saline sites, one third of the readings were below the instantaneous standard of 4.0 mg/l. Continuous monitors illustrated depressed (by State regulatory criteria) DO levels at even the stations considered the least impacted in the Port Charlotte study. DO levels, although they exhibited diurnal patterns, appeared to be predominantly depressed due to oxygen-demanding substances rather than the respiration of primary productivity. Only one of the four stations sampled illustrated the supersaturated conditions of DO characteristic of respiration from excessive algal or macrophyte biomass. The effects of illegal dumping were dramatically captured.

Not all of the low DO values were the result of diurnal fluctuations associated with photosynthesis, as BOD_5 values from several fresh and estuarine stations (Stations 15, 22, 16, 31, and 32), were greater than 10.0 mg/l. Station 12 was also noteworthy for the highest chlorophyll value of the study.

Nutrient values observed supported previous work indicating the nitrogen limitation of Charlotte Harbor in that both freshwater and estuarine stations were strongly nitrogen limited for inorganic species. Total nitrogen and phosphorus ratios indicated long-term nitrogen limitation for saltwater stations, while freshwater sites were a mix of phosphorus- and nitrogen-limited conditions. Additional amounts of nitrogen added to this system could be expected to produce further depressed dissolved oxygen conditions and chlorophyll excesses. One site, Station 32, recorded some extremely high levels of ammonia, TKN, and nitrate. Bacterial levels were within State criteria and displayed no significant differences between the saline and freshwater stations as a group.

Summary water quality indices ranked most freshwater stations during the dry season screening as 'fair' with Stations 1, 13 and 21 "good" and Stations 6 and 7 "poor". For the fresh stations, water quality generally decreased with increasing distance from the upstream end of the canals. Station 21 was postulated to receive substantial amounts of groundwater due to its relatively high mineralization and better water quality. Estuarine stations were also generally "fair" quality range, with Stations 14, 19, 25, 26, 28, 29 and 31 within the "good" category and Stations 16 and 17 "poor".

There was clear indication that simple population levels as estimated by dwelling unit numbers and the number of septic systems have independent additive deleterious effects on the water quality in the Port Charlotte system. This result has been observed elsewhere and is indicative of a host of cumulative anthropogenic impacts.

Comparison of the Port Charlotte water quality screening results with existing data sets was performed to register the system with respect to other canal systems. Water quality and trophic state indices were used for the comparison to provide for more stable estimates. For freshwater stations, the MML data set was comparable (despite the pre-dawn and early morning samplings) to data sets from both STORET, Northport, and (not unexpectedly) the Pellam Waterway, although the spread in the STORET data in particular was much larger. Cape Coral conditions were markedly better than Port Charlotte. In some instances, including Port Charlotte, relatively mineralized surface water (of groundwater origin) is degraded by dilution with lower conductivity, higher nutrient surface runoff.

For estuarine stations, the MML Port Charlotte data set is again much narrower than the TSIs calculated from the STORET data base, with a higher percentage of 'fair' and 'poor' classifications contained within the STORET stations. Cape Coral is also similar, but with some stations of much higher quality. Regionally, including Port Charlotte canals, systems with an open connection to an estuary exhibit improved water with dilution of higher salinity waters. South Gulf Cove, due to the anomalous flow regime and restricted entrance of estuarine waters, does not constitute a good comparison to the Port Charlotte system.

In summary, Port Charlotte water quality is, for the most part, nitrogen limited with depressed DO values produced by oxygen demanding substances. Primary productivity plays a smaller role in influencing DO levels. General spatial patterns appear to be produced by anthropogenic impacts, as has been previously demonstrated for other regions of Florida. Power analyses on data sets similar to Port Charlotte indicate that a long-term monitoring program will be necessary to statistically determine a 25 % change in water quality at a minimal confidence level, although selected parameters may show significant changes more readily.

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APPENDIX A

Station Descriptions

1. Santa Marta and Hillsborough at head of LionHeart Waterway just downstream of concrete spillway from Cocoplum Waterway.

2. East from Peachland and Forest Nelson on east branch of Lion Heart Waterway, next canal east from CDM offices.

3. East of Peachland and Hinton on Dorchester Waterway.

4. East of Peachland and Yorkshire on Morningstar Waterway.

5. East of Peachland and Waterside, west of Harbor Blvd.

6. East of Peachland and Strasburg on Elkam Waterway.

7. East of Peachland and Invemess/Torrington on Fordham Waterway.

8. East of Peachland and Hallcrest/Aberdeen on Niagra Waterway.

9. South of Rio De Janiero and Deep Creek, near Mamora.

10. West of Chamberlain and Cheshire on Cheshire Waterway (Bridge).

11. West of Biscayne and Hoffer on Apollo Waterway (Bridge).

12. West of Biscayne and Clear-view on Jupiter Waterway (Bridge).

13. West of Biscayne and Private Jenks, east of Bruning (second canal from 776).

14. East fork of Sam L. Knight Creek at 776 - just south of Ballpark, small reflector on northeast bank, creek crossing of phone cable on south bank.

15. East of 776 and Flamingo.

16. West of Toledo Blade and Collingswood on Auburn Waterway.

17. West of Toledo Blade and Barksdale on Courtland Waterway.

18. West of Toledo Blade and Pellam on Pellam Waterway.

19. East of Wintergarden and Como on Como Waterway (Bridge).

APPENDIX A - (Continued)

20. Midway Blvd. at North Spring Lake between Broad Ranch and Elliot Bridge.

21. Midway Blvd. between Elkam and Yancy on Morningstar Waterway (Bridge).

22. East of Olean and Easy St, west of Harbor Blvd. (Bridge).

23. East of Olean and Conway, west of Starlite (Bridge).

24. East of Olean and St. James, west of Clifford/Achilles (Bridge).

25. East of Harbor View and Desoto in Harbor Heights (Bridge).

26. East of OHara and Library, east from Flamingo on Como Waterway (Bridge).

27. East of Edgewater and Yukon, west of Rock Creek on Pellam Waterway (NARROW Bridge).

28. South of Midway and McGrath on Lewis Creek (Narrow Bridge).

29. East of Edgewater and Lake View, West of Spring Lake, on West Spring Waterway (Bridge - sample on abutment under bridge).

30. East of Edgewater and Carlisle on Sunrise Waterway (Bridge).

31. West of Edgewater and Cousey/Conried on Elkam Waterway (Bridge, sample on northwest side, stay close to bridge to avoid trespass - go after daylight).

32. East of Edgewater and Gardner, west of Lister, on Olman Waterway (Bridge).

APPENDIX B. Field and analytical data. Port Charlotte dry season water quality screening.
- = <MDL

DATE	STATION	TIME	DEPTH	CONTN	COLOR PCU	CORRDO mg/l	PERSAT %	TEMP_FLD C°	CONDCORR µmhos/cm	SALINITY ppt	CHL_A_CORR µg/l	PHEO_A µg/l	NO23N mg/l	NH4N mg/l	TKN mg/l	TOTP mg/l	PO4P mg/l	CORRBOD mg/l	FECALCOLI #/100 ml	FECALSTREP #/100 ml
06-Apr-94	1	1007	B			6.6	76.4	22.5	945	0.4										
06-Apr-94	1	1007	S	1894	52	6.7	77.5	22.5	945	0.4	2.7	0.8	0.012	0.084	0.85	-0.05	0.039	2.3	4	6
06-Apr-94	2	0711	B			4.2	48.1	22.0	859	0.4										
06-Apr-94	2	0711	S	1908	60	4.8	55.0	22.0	891	0.4	3.4	3.1	0.012	0.020	0.86	0.49	0.470	1.6	4	4
06-Apr-94	3	0653	B			3.3	38.2	22.5	756	0.3										
06-Apr-94	3	0653	S	1904	35	4.0	45.8	22.0	764	0.3	3.3	1.3	0.005	0.005	0.61	-0.05	0.015	1.8	4	34
06-Apr-94	4	0641	B			4.2	48.1	22.0	573	0.2										
06-Apr-94	4	0641	S	1901	43	4.7	53.9	22.0	552	0.2	5.8	2.3	-0.005	-0.005	0.77	-0.05	-0.005	1.1	12	10
06-Apr-94	5	0617	B			3.8	44.1	22.7	565	0.2										
06-Apr-94	5	0617	S	1905	90	4.2	48.1	22.0	615	0.2	12.3	5.2	-0.005	-0.005	0.92	0.08	0.019	1.8	32	10
06-Apr-94	6	0625	B			1.9	22.3	23.2	466	-0.2										
06-Apr-94	6	0625	S	1888	80	1.9	22.6	24.0	468	-0.2	19.9	3.0	0.005	0.015	1.02	0.17	0.110	3.1	8	10
06-Apr-94	7	0654	B			2.3	27.4	24.0	561	0.2										
06-Apr-94	7	0654	S	1884	59	2.4	28.6	24.0	561	0.2	4.5	0.5	0.010	0.023	0.7	0.18	0.137	7.8	-1	38
06-Apr-94	8	0708	B			4.1	48.8	24.0	428	-0.2										
06-Apr-94	8	0708	S	1881	62	4.0	46.7	23.0	437	-0.2	6.3	2.2	0.007	-0.005	0.7	0.07	0.045	2.6	12	12
06-Apr-94	9	1126	B			2.0	23.6	23.5	454	-0.2										
06-Apr-94	9	1126	S	1890	74	2.0	23.8	23.9	460	-0.2	3.4	1.3	0.069	0.076	0.84	0.08	0.065	1.3	-1	64
06-Apr-94	10	0906	B			4.0	51.7	24.5	21505	12.9										
06-Apr-94	10	0906	S	1899	64	5.0	62.5	23.5	19560	11.6	13.4	3.9	-0.005	-0.005	0.91	0.11	0.058	2.7	56	16
06-Apr-94	11	0856	B			3.8	49.7	25.0	23800	14.4										
06-Apr-94	11	0856	S	1900	60	5.6	70.8	23.5	20281	12.1	9.4	2.1	-0.005	-0.005	0.77	0.11	0.077	2	48	22
06-Apr-94	12	0842	B			5.2	64.9	23.5	16369	9.6										
06-Apr-94	12	0842	S	1896	58	5.5	68.4	23.5	16266	9.5	9.5	5.0	-0.005	-0.005	0.82	0.09	0.046	2.1	32	30
06-Apr-94	13	0832	B			6.8	77.9	22.0	955	0.4										
06-Apr-94	13	0832	S	1903	52	7.0	80.2	22.0	923	0.4	7.2	3.3	-0.005	-0.005	0.92	-0.05	-0.005	2.9	12	4
06-Apr-94	14	0823	B			5.0	65.5	24.0	25997	15.9										
06-Apr-94	14	0823	S	1891	52	5.1	66.7	24.0	25997	15.9	6.2	2.5	-0.005	0.021	0.75	0.06	0.025	1.6	28	16

DATE	STATION	TIME	DEPTH	CONTN	COLOR PCU	CORRDO mg/l	PERSAT %	TEMP_FLD C°	CONDCORR µmhos/cm	SALINITY ppt	CHL_A_CORR µg/l	PHEO_A µg/l	NO23N mg/l	NH4N mg/l	TKN mg/l	TOTP mg/l	PO4P mg/l	CORRBOD mg/l	FECALCOLI #/100 ml	FECALSTREP #/100 ml
06-Apr-94	15	0813	M			0.7	7.8	20.5	831	0.4										
06-Apr-94	15	0813	S	1907	40	0.7	7.8	20.5	831	0.4	2.4	0.7	0.046	0.062	0.61	-0.05	0.061	17.5	20	52
06-Apr-94	16	0923	B			2.1	27.9	25.0	26500	16.2										
06-Apr-94	16	0923	S	1909	50	2.9	38.8	25.0	26000	15.9	55.1	4.1	0.007	0.065	0.75	0.2	0.157	17.1	16	2
06-Apr-94	17	0935	B			1.9	25.5	25.0	28500	17.5										
06-Apr-94	17	0935	S	1892	43	0.9	12.0	24.5	24736	15	16.7	1.7	0.012	0.056	0.96	0.23	0.152	3.6	28	66
06-Apr-94	18	0945	B			2.2	30.6	25.5	29914	18.5										
06-Apr-94	18	0945	S	1902	49	2.4	31.8	25.5	27933	17.1	17.7	1.3	0.006	0.060	0.81	0.17	0.118	4	-1	16
06-Apr-94	19	0758	B			4.0	55.6	26.0	31891	19.8										
06-Apr-94	19	0758	S	1897	50	6.7	89.5	24.1	29609	18.3	7.6	2.7	-0.005	-0.005	0.77	0.07	0.028	1.7	4	46
06-Apr-94	20	0945	B			4.6	63.3	25.2	31978	19.9										
06-Apr-94	20	0945	S	1873	40	7.3	99.1	24.8	31320	19.5	16.8	4.7	-0.005	-0.005	0.99	0.22	0.118	6.1	4	32
06-Apr-94	21	1009	B			4.9	58.6	24.2	833	0.4										
06-Apr-94	21	1009	S	1876	30	5.5	65.7	24.2	833	0.4	5.5	2.5	-0.005	-0.005	0.69	-0.05	-0.005	1.4	180	86
06-Apr-94	22	1026	B			5.8	70.4	25.0	600	0.2										
06-Apr-94	22	1026	S	1885	50	8.3	101.1	25.2	578	0.2	27.1	2.9	-0.005	-0.005	0.98	0.07	-0.005	10	310	32
06-Apr-94	23	1045	B			4.8	58.2	25.0	650	0.3										
06-Apr-94	23	1045	S	1887	40	6.8	83.7	25.8	640	0.2	25.8	1.9	-0.005	-0.005	1.14	-0.05	-0.005	2.2	96	52
06-Apr-94	24	1102	M			6.9	83.7	25.0	600	0.2										
06-Apr-94	24	1102	S	1878	50	6.9	83.7	25.0	600	0.2	10.3	5.8	-0.005	0.010	0.88	0.06	0.017	7.3	4	130
06-Apr-94	25	1147	B			5.6	72.8	25.0	20000	11.9										
06-Apr-94	25	1147	S	1886	62	5.3	66.7	24.0	13763	7.9	6.2	-0.1	-0.005	-0.005	0.58	0.18	0.156	1.9	130	62
06-Apr-94	26	0737	B			1.8	24.0	24.5	34328	21.6										
06-Apr-94	26	0737	S	1893	45	5.4	70.3	24.0	26710	16.3	19.5	15.5	-0.005	-0.005	0.78	0.08	0.019	2.5	20	20
06-Apr-94	27	0847	B			4.3	58.9	24.5	36852	23.3										
06-Apr-94	27	0847	S	1879	40	5.4	72.6	24.0	32623	20.4	13.2	1.5	-0.005	-0.005	0.84	0.17	0.106	6.6	56	56
06-Apr-94	28	0913	B			5.4	73.8	24.0	37211	23.6										
06-Apr-94	28	0913	S	1877	42	5.5	75.0	24.0	37211	23.6	8.7	3.8	-0.005	-0.005	0.74	0.19	0.103	6.3	-1	72
06-Apr-94	29	0831	M			5.9	79.0	23.5	35518	22.4										

DATE	STATION	TIME	DEPTH	CONTN	COLOR PCU	CORRDO mg/l	PERSAT %	TEMP_FLD C°	CONDCORR µmhos/cm	SALINITY ppt	CHL_A_CORR µg/l	PHEO_A µg/l	NO23N mg/l	NH4N mg/l	TKN mg/l	TOTP mg/l	PO4P mg/l	CORRBOD mg/l	FECALCOLI #/100 ml	FECALSTREP #/100 ml
06-Apr-94	29	0831	S	1889	35	5.9	79.0	23.5	35518	22.4	4.4	2.7	-0.005	0.016	0.69	0.15	0.107	2.7	12	36
06-Apr-94	30	0815	B			4.4	59.5	24.0	36701	23.2										
06-Apr-94	30	0815	S	1882	35	4.2	56.6	23.5	37062	23.5	13.6	3.3	-0.005	0.008	0.74	0.18	0.100	6.9	8	42
06-Apr-94	31	0801	B			4.4	60.7	24.0	37517	23.8										
06-Apr-94	31	0801	S	1875	32	4.7	64.3	24.0	36905	23.4	5.1	1.0	-0.005	0.012	0.7	0.18	0.123	10.5	-1	48
06-Apr-94	32	0704	B			2.7	37.1	24.2	36051	22.8										
06-Apr-94	32	0704	S	1883	35	5.5	73.1	23.5	34179	21.5	7.9	5.3	0.009	0.118	0.92	0.32	0.253	13.8	250	80
20-Apr-94	1	0955	B			7.2	87.4	25.0	950	0.4										
20-Apr-94	1	0955	S	1922	70	7.2	87.4	25.0	950	0.4	6.8	1.2	-0.005	0.017	0.66	-0.05	0.016	0.4	-1	65
20-Apr-94	2	1043	B			2.3	27.6	24.5	636	0.2										
20-Apr-94	2	1043	S	1915	69	2.3	27.6	24.5	636	0.2	11.6	2.3	0.012	0.011	0.74	0.63	0.642	1.5	120	290
20-Apr-94	3	1032	B			2.2	26.2	24.0	571	0.2										
20-Apr-94	3	1032	S	1912	47	4.1	49.7	25.0	570	0.2	7.0	1.1	0.016	-0.005	0.54	0.08	0.055	1.7	85	350
20-Apr-94	4	1021	B			2.6	31.5	25.0	550	0.2										
20-Apr-94	4	1021	S	1927	50	2.4	29.1	25.0	550	0.2	10.9	3.6	-0.005	-0.005	0.78	-0.05	0.005	2.5	15	290
20-Apr-94	5	1017	B			2.7	33.1	25.5	485	-0.2										
20-Apr-94	5	1017	S	1921	43	3.2	39.2	25.5	480	-0.2	2.9	0.9	0.030	0.078	0.74	0.07	0.050	1.2	80	410
20-Apr-94	6	0830	B			5.9	72.9	26.0	473	-0.2										
20-Apr-94	6	0830	S	1945	65	6.2	76.6	26.0	473	-0.2	45.5	12.4	0.017	0.047	1.32	0.09	-0.005	4.7	55	450
20-Apr-94	7	0848	B			2.0	24.7	26.0	589	0.2										
20-Apr-94	7	0848	S	1936	58	2.7	33.4	26.0	589	0.2	7.4	8.3	0.016	0.050	0.71	0.31	0.257	3.3	70	160
20-Apr-94	8	0905	B			5.3	65.5	26.0	441	-0.2										
20-Apr-94	8	0905	S	1930	65	5.2	64.5	26.2	438	-0.2	15.0	9.6	-0.005	-0.005	0.70	0.08	0.067	2.3	10	65
20-Apr-94	9	0535	B			0.7	8.3	24.0	488	-0.2										
20-Apr-94	9	0535	S	1928	116	1.6	19.2	24.5	469	-0.2	0.7	3.1	0.036	0.078	0.98	0.14	0.095	1.5	110	350
20-Apr-94	10	0804	B			2.5	33.4	26.0	22471	13.5										
20-Apr-94	10	0804	S	1919	80	4.4	56.5	24.5	21707	13.0	17.6	4.4	-0.005	-0.005	0.79	0.16	0.089	2.5	50	140
20-Apr-94	11	0752	B			3.1	42.0	26.0	25316	15.4										
20-Apr-94	11	0752	S	1944	55	3.6	47.3	25.0	24800	15.0	7.6	0.9	-0.005	0.047	0.81	0.2	0.129	2.9	15	170

DATE	STATION	TIME	DEPTH	CONTN	COLOR PCU	CORRDO mg/l	PERSAT %	TEMP_FLD C°	CONDCORR µmhos/cm	SALINITY ppt	CHL_A_CORR µg/l	PHEO_A µg/l	NO23N mg/l	NH4N mg/l	TKN mg/l	TOTP mg/l	PO4P mg/l	CORRBOD mg/l	FECALCOLI #/100 ml	FECALSTREP #/100 ml
20-Apr-94	12	0740	B			4.5	58.8	25.5	19316	11.4										
20-Apr-94	12	0740	S	1926	50	4.6	60.0	25.5	19018	11.2	15.3	6.1	-0.005	-0.005	0.82	0.2	0.132	3.1	30	130
20-Apr-94	13	0730	B			4.7	57.0	25.0	920	0.4										
20-Apr-94	13	0730	S	1924	52	4.9	59.4	25.0	920	0.4	11.7	1.8	0.005	0.019	0.83	-0.05	-0.005	1.5	15	10
20-Apr-94	14	0720	M			2.8	38.0	25.5	28528	17.5										
20-Apr-94	14	0720	M			2.8	38.0	25.5	28528	17.5										
20-Apr-94	14	0720	S	1920	46	2.8	38.0	25.5	28528	17.5	17.3	3.3	-0.005	0.017	0.88	0.13	0.057	2.5	25	270
20-Apr-94	15	0707	M			0.5	5.7	22.0	796	0.3										
20-Apr-94	15	0707	S	1916	45	0.5	5.7	22.0	796	0.3	1.3	1.0	0.011	0.147	0.7	0.13	0.112	1.1	75	230
20-Apr-94	16	0825	B			0.7	10.2	27.5	22715	13.6										
20-Apr-94	16	0825	S	1910	50	3.8	49.4	26.0	11775	6.7	37.4	-0.1	0.005	0.051	0.91	0.27	0.174	2.9	15	45
20-Apr-94	17	0926	B			2.1	28.9	27.0	24851	15.0										
20-Apr-94	17	0926	S	1923	0	2.1	26.9	25.5	17830	10.5	55.2	-0.1	-0.005	0.091	1.02	0.28	0.205	4.4	15	1100
20-Apr-94	18	0935	B			0.4	5.1	28.0	30266	18.7										
20-Apr-94	18	0935	S	1925	52	3.3	44.5	26.0	23060	13.9	19.5	7.4	0.024	0.082	1.03	0.23	0.171	3.2	160	250
20-Apr-94	19	0641	B			1.4	20.7	28.5	34682	21.7										
20-Apr-94	19	0641	S	1913	50	4.2	58.1	26.0	30125	18.6	8.9	3.1	0.010	0.021	0.64	0.08	0.036	2.2	20	190
20-Apr-94	20	0716	B			1.1	15.1	27.0	36505	23.0										
20-Apr-94	20	0716	S	1933	52	2.9	40.9	27.9	29373	18.1	27.9	3.1	0.023	0.059	0.86	0.30	0.248	7.6	70	130
20-Apr-94	21	0731	B			4.7	58.2	26.1	784	0.3										
20-Apr-94	21	0731	S	1939	30	4.8	59.9	26.5	778	0.3	4.6	2.9	0.011	0.022	0.65	-0.05	-0.005	1.7	30	310
20-Apr-94	22	0746	B			4.8	59.3	26.0	569	0.2										
20-Apr-94	22	0746	S	1935	55	4.9	60.8	26.2	567	0.2	30.4	6.9	0.009	0.019	0.75	0.09	0.039	4.1	30	400
20-Apr-94	23	0757	B			3.4	42.0	26.0	599	0.2										
20-Apr-94	23	0757	S	1938	48	3.3	41.0	26.3	595	0.2	40.9	7.1	0.007	0.044	1.16	0.08	0.008	4.5	5	150
20-Apr-94	24	0810	M			6.2	78.0	27.0	626	0.2										
20-Apr-94	24	0810	S	1942	55	6.2	78.0	27.0	626	0.2	58.5	10.4	-0.005	-0.005	1.28	0.10	0.005	5.6	30	95
20-Apr-94	25	0600	B			1.0	13.6	26.2	21996	13.2										
20-Apr-94	25	0600	S	1941	80	0.6	8.1	26.5	19637	11.6	17.1	1.3	0.013	0.075	0.73	0.55	0.411	2.3	130	370

DATE	STATION	TIME	DEPTH	CONTN	COLOR PCU	CORRDO mg/l	PERSAT %	TEMP_FLD C°	CONDCORR µmhos/cm	SALINITY ppt	CHL_A_CORR µg/l	PHEO_A µg/l	NO23N mg/l	NH4N mg/l	TKN mg/l	TOTP mg/l	PO4P mg/l	CORRBOD mg/l	FECALCOLI #/100 ml	FECALSTREP #/100 ml
20-Apr-94	26	0628	B			3.6	51.6	27.0	36120	22.8										
20-Apr-94	26	0628	S	1918	43	4.4	61.1	26.5	33539	21.0	6.9	2.6	-0.005	0.028	0.68	0.09	0.031	1.7	-1	240
20-Apr-94	27	0618	B			2.7	38.7	26.5	34220	21.4										
20-Apr-94	27	0618	S	1911	62	3.2	43.6	26.5	24498	14.8	39.0	-0.1	-0.005	0.019	0.83	0.31	0.219	3.3	150	450
20-Apr-94	28	0546	B			4.6	65.5	26.0	38269	24.3										
20-Apr-94	28	0546	S	1937	37	4.9	69.2	26.0	37975	24.1	6.3	8.4	0.014	0.073	0.70	0.24	0.170	2.6	-1	380
20-Apr-94	29	0702	M			4.7	65.5	26.0	31400	19.5										
20-Apr-94	29	0702	S	1943	40	4.7	65.5	26.0	31400	19.5	16.7	4.1	-0.005	0.020	0.81	0.32	0.215	5	10	140
20-Apr-94	30	0649	B			4.1	59.4	27.2	36564	23.1										
20-Apr-94	30	0649	S	1931	40	3.8	54.6	27.5	36364	22.9	16.2	6.3	-0.005	0.06	0.64	0.24	0.207	2.8	15	180
20-Apr-94	31	0639	B			3.2	44.9	26.5	35192	72.1										
20-Apr-94	31	0639	S	1932	40	3.7	52.8	26.9	36573	23.1	7.7	3.5	-0.005	0.021	0.64	0.28	0.229	3.1	-1	120
20-Apr-94	32	0627	B			1.5	20.7	25.2	34668	21.8										
20-Apr-94	32	0627	S	1940	80	0.4	6.3	27.1	33554	21.0	58.7	2.3	0.032	1.350	3.03	0.92	0.751	8.7	950	1200
25-May-94	1	0827	B			5.8	69.1	24.0	907	0.4										
25-May-94	1	0827	S	1961	53	6.0	71.4	24.0	907	0.4	3.0	1.2	0.029	0.048	0.82	0.16	0.148	2.6	12	220
25-May-94	2	0922	B			0.1	1.8	23.5	916	0.4										
25-May-94	2	0922	S	1951	65	0.3	3.5	23.0	905	0.4	10.7	3.0	0.006	0.025	0.89	0.52	0.508	2	20	230
25-May-94	3	0907	B			1.7	20.2	24.0	744	0.3										
25-May-94	3	0907	S	1956	45	2.5	29.8	24.0	734	0.3	14.2	3.5	0.012	-0.005	0.66	0.06	0.038	1.7	2	20
25-May-94	4	0901	B			3.2	38.5	24.5	626	0.2										
25-May-94	4	0901	S	1957	68	4.7	56.5	24.5	626	0.2	35.2	12.6	-0.005	-0.005	1.21	0.08	0.009	3.7	20	18
25-May-94	5	0843	B			3.2	38.8	25.0	60	-0.2										
25-May-94	5	0843	S	1947	102	3.6	43.7	25.0	600	0.2	11.0	3.4	-0.005	-0.005	0.84	0.11	0.035	2.2	44	42
25-May-94	6	0851	B			1.5	18.2	25.0	375	-0.2										
25-May-94	6	0851	S	1969	104	4.1	49.7	25.0	370	-0.2	84.1	18.9	-0.005	-0.005	1.34	0.29	0.091	7.8	12	100
25-May-94	7	0909	B			3.1	38.3	26.0	579	0.2										
25-May-94	7	0909	S	1977	62	3.7	45.7	26.0	589	0.2	44.7	0.2	0.012	-0.005	1.12	0.26	0.182	4.2	8	110
25-May-94	8	0923	B			3.0	37.8	27.0	395	-0.2										

DATE	STATION	TIME	DEPTH	CONTN	COLOR PCU	CORRDO mg/l	PERSAT %	TEMP_FLD C°	CONDCORR µmhos/cm	SALINITY ppt	CHL_A_CORR µg/l	PHEO_A µg/l	NO23N mg/l	NH4N mg/l	TKN mg/l	TOTP mg/l	PO4P mg/l	CORRBOD mg/l	FECALCOLI #/100 ml	FECALSTREP #/100 ml
25-May-94	8	0923	S	1981	55	3.4	42.8	27.0	390	-0.2	13.8	3.1	0.029	-0.005	0.64	0.08	0.065	2.6	-1	20
25-May-94	9	0530	B			1.6	19.4	25.0	480	-0.2										
25-May-94	9	0530	S	1966	90	1.7	20.6	25.0	470	-0.2	8.8	1.8	0.027	0.043	0.95	0.13	0.066	2.3	2	130
25-May-94	10	0719	B			4.0	52.2	25.0	24400	14.8										
25-May-94	10	0719	S	1952	55	4.3	56.5	24.5	23222	14.0	11.7	1.8	-0.005	-0.005	0.77	0.18	0.089	3.6	36	180
25-May-94	11	0709	B			3.3	43.7	25.0	25000	15.2										
25-May-94	11	0709	S	1949	52	4.7	61.3	24.5	24029	14.5	16.1	2.1	-0.005	-0.005	0.97	0.13	0.075	2.3	34	220
25-May-94	12	0658	B			1.9	25.7	25.5	23080	13.9										
25-May-94	12	0658	S	1946	55	4.3	56.4	25.0	22600	13.6	14.6	0.5	-0.005	-0.005	0.86	0.15	0.083	3	16	460
25-May-94	13	0647	B			5.8	69.7	24.5	959	0.4										
25-May-94	13	0647	S	1963	52	6.9	82.9	24.5	979	0.4	27.7	-0.1	-0.005	-0.005	0.80	-0.05	0.006	2.9	2	4
25-May-94	14	0639	M			2.8	36.9	24.0	29361	18.1										
25-May-94	14	0639	S	1958	48	2.8	36.9	24.0	29361	18.1	3.8	2.0	-0.005	0.008	0.62	0.08	0.056	1.7	26	320
25-May-94	15	0631	M			1.8	21.0	23.0	832	0.4										
25-May-94	15	0631	S	1948	35	1.8	21.0	23.0	832	0.4	1.9	1.8	0.038	0.011	0.60	-0.05	0.030	1.2	12	32
25-May-94	16	0739	B			3.1	42.0	26.0	30713	19.0										
25-May-94	16	0739	S	1965	60	3.3	45.7	26.0	29830	18.4	28.2	2.6	-0.005	-0.005	0.97	0.25	0.121	5.8	-1	510
25-May-94	17	0752	B			4.2	56.8	26.0	27671	17.0										
25-May-94	17	0752	S	1960	65	4.6	63.0	26.0	30223	18.7	31.4	8.4	-0.005	-0.005	1.17	0.3	0.098	9	52	-250
25-May-94	18	0804	B			2.2	31.2	26.5	32081	20.0										
25-May-94	18	0804	S	1962	55	6.3	88.1	27.0	31593	19.6	36.2	6.7	-0.005	-0.005	1.12	0.23	0.091	7	8	340
25-May-94	19	0621	B			4.2	59.7	27.5	35123	22.0										
25-May-94	19	0621	S	1955	55	5.5	75.9	25.5	32391	20.2	5.9	3.2	-0.005	-0.005	0.77	0.09	0.040	1.8	22	210
25-May-94	20	0729	B			5.0	70.5	27.0	34579	21.7										
25-May-94	20	0729	S	1968	58	6.5	90.6	27.0	31304	19.4	12.5	0.1	0.023	0.045	0.78	0.22	0.138	3.8	24	160
25-May-94	21	0749	B			5.8	73.0	27.0	771	0.3										
25-May-94	21	0749	S	1979	40	6.2	78.0	27.0	790	0.3	5.6	0.9	0.021	-0.005	0.7	-0.05	0.009	1.4	18	72
25-May-94	22	0803	B			4.9	62.8	28.0	567	0.2										
25-May-94	22	0803	S	1973	50	5.2	65.4	27.0	588	0.2	21.2	3.2	0.006	-0.005	0.87	0.05	0.006	3.3	52	82

DATE	STATION	TIME	DEPTH	CONTN	COLOR PCU	CORRDO mg/l	PERSAT %	TEMP_FLD C°	CONDCORR µmhos/cm	SALINITY ppt	CHL_A_CORR µg/l	PHEO_A µg/l	NO23N mg/l	NH4N mg/l	TKN mg/l	TOTP mg/l	PO4P mg/l	CORRBOD mg/l	FECALCOLI #/100 ml	FECALSTREP #/100 ml
25-May-94	23	0815	B			4.2	53.8	28.0	653	0.3										
25-May-94	23	0815	S	1972	35	4.0	51.2	28.0	653	0.3	12.1	3.3	0.018	0.043	0.95	0.05	0.014	2.5	18	110
25-May-94	24	0827	M			5.6	69.2	26.0	589	0.2										
25-May-94	24	0827	S	1970	55	5.6	69.2	26.0	589	0.2	18.5	7.0	-0.005	-0.005	0.94	0.06	0.010	4	150	340
25-May-94	25	0557	B			4.9	66.7	26.0	26985	16.5										
25-May-94	25	0557	S	1978	55	5.6	75.4	26.0	26494	16.2	10.3	2.2	0.015	-0.005	0.57	0.35	0.289	3.4	82	400
25-May-94	26	0607	B			2.2	31.5	27.0	37854	24.0										
25-May-94	26	0607	S	1959	55	2.7	38.7	26.5	36164	22.8	5.2	2.5	-0.005	-0.005	0.68	0.09	0.043	3.8	16	270
25-May-94	27	0553	B			4.6	65.5	26.0	38269	24.3										
25-May-94	27	0553	S	1964	35	5.1	71.0	25.5	38235	24.3	5.6	1.6	-0.005	-0.005	0.52	0.16	0.109	2.5	6	360
25-May-94	28	0536	B			4.2	58.8	25.5	39622	25.2										
25-May-94	28	0536	S	1950	35	5.0	71.0	25.5	39622	25.2	4.1	1.9	-0.005	-0.005	0.66	0.16	0.088	1.6	10	-250
25-May-94	29	0709	M			6.8	93.4	25.0	34500	21.7										
25-May-94	29	0709	S	1975	40	6.8	93.4	25.0	34500	21.7	5.2	0.4	-0.005	-0.005	0.42	0.16	0.113	2.6	4	130
25-May-94	30	0657	B			5.4	75.4	26.0	36307	22.9										
25-May-94	30	0657	S	1980	35	5.4	76.6	26.0	36307	22.9	6.8	2.5	0.022	-0.005	0.47	0.17	0.128	1.7	12	-250
25-May-94	31	0644	B			5.3	75.4	26.0	37190	23.5										
25-May-94	31	0644	S	1971	35	5.7	80.3	26.0	35522	22.4	5.8	2.6	-0.005	-0.005	0.39	0.14	0.094	4.4	14	270
25-May-94	32	0625	B			4.3	60.6	26.0	37092	23.5										
25-May-94	32	0625	S	1967	43	5.7	78.9	25.0	35500	22.4	14.2	4.2	0.010	0.135	0.82	0.27	0.207	4	320	260
08-Jun-94	1	0816	B			5.8	71.7	26.0	687	0.3										
08-Jun-94	1	0816	S	1998	58	5.8	71.7	26.0	687	0.3	9.2	2.6	-0.005	0.029	0.97	0.13	0.105	1.6	0	0
08-Jun-94	2	0908	B			0.7	8.7	26.0	746	0.3										
08-Jun-94	2	0908	S	2015	58	1.5	18.5	26.0	716	0.3	15.6	-0.1	0.042	0.114	0.96	0.48	0.395	1.5	0	0
08-Jun-94	3	0900	B			2.0	24.7	26.0	667	0.3										
08-Jun-94	3	0900	S	2004	52	2.7	33.4	26.0	677	0.3	9.8	2.6	-0.005	0.044	0.61	0.1	0.075	2.1	0	0
08-Jun-94	4	0851	B			1.8	22.4	26.5	612	0.2										
08-Jun-94	4	0851	S	2016	43	2.9	35.8	26.0	618	0.2	15.2	-0.1	0.050	0.060	0.80	0.05	0.008	1.2	0	0
08-Jun-94	5	0840	B			2.4	29.7	26.0	599	0.2										

DATE	STATION	TIME	DEPTH	CONTN	COLOR PCU	CORRDO mg/l	PERSAT %	TEMP_FLD C°	CONDCORR µmhos/cm	SALINITY ppt	CHL_A_CORR µg/l	PHEO_A µg/l	NO23N mg/l	NH4N mg/l	TKN mg/l	TOTP mg/l	PO4P mg/l	CORRBOD mg/l	FECALCOLI #/100 ml	FECALSTREP #/100 ml
08-Jun-94	5	0840	S	2014	96	2.6	32.1	26.0	599	0.2	17.0	0.2	0.015	0.081	0.84	0.12	0.034	1.9	0	0
08-Jun-94	6	0833	B			3.0	34.4	22.0	520	-0.2										
08-Jun-94	6	0833	S	1986	84	3.3	37.8	22.0	520	-0.2	92.8	23.5	0.019	0.087	2.46	0.43	0.049	6.3	0	0
08-Jun-94	7	0851	B			3.5	39.3	21.0	964	0.4										
08-Jun-94	7	0851	S	1985	47	4.2	47.2	21.0	964	0.4	9.4	-0.1	0.011	0.013	0.89	0.36	0.317	1.6	0	0
08-Jun-94	8	0901	B			4.2	47.2	21.0	866	0.4										
08-Jun-94	8	0901	S	1988	90	5.2	57.3	20.0	884	0.4	64.3	9.2	-0.005	-0.005	0.95	0.13	0.067	6.1	-1	-1
08-Jun-94	9	0521	B			0.1	1.3	27.0	480	-0.2										
08-Jun-94	9	0521	S	1987	100	4.7	61.9	29.0	335	0	13.5	4.1	0.009	0.018	0.89	0.05	0.037	2.3	0	0
08-Jun-94	10	0709	B			4.1	55.4	27.0	24176	14.6										
08-Jun-94	10	0709	S	2003	55	4.1	55.4	27.0	24080	14.5	53.0	3.1	-0.005	0.006	1.25	0.22	0.095	4.7	0	0
08-Jun-94	11	0700	B			4.8	65.4	27.0	25910	15.8										
08-Jun-94	11	0700	S	2001	45	4.9	66.7	27.0	25814	15.7	18.9	2.3	-0.005	0.006	0.9	0.17	0.083	2.7	0	0
08-Jun-94	12	0645	B			4.1	57.1	27.5	24052	14.5										
08-Jun-94	12	0645	S	2012	50	4.5	61.0	27.0	22924	13.8	100.2	4.3	0.005	-0.005	1.51	0.25	0.070	8.5	0	0
08-Jun-94	13	0637	B			5.7	71.7	26.5	836	0.4										
08-Jun-94	13	0637	S	2010	58	6.0	76.1	27.0	828	0.3	17.3	5.2	-0.005	0.005	0.78	0.07	0.015	2.3	0	0
08-Jun-94	14	0630	B			2.2	29.9	26.5	25470	15.5										
08-Jun-94	14	0630	S	2017	45	2.3	31.2	26.5	25470	15.5	4.5	2.9	0.015	0.102	0.67	0.12	0.056	1.2	0	0
08-Jun-94	15	0623	M			4.9	61.1	26.5	719	0.3										
08-Jun-94	15	0623	S	2013	29	4.9	61.1	26.5	35941	0.3	3.2	1.6	0.027	-0.005	0.62	-0.05	-0.005	2.2	0	0
08-Jun-94	16	0730	B			0.7	10.3	28.5	28870	17.7										
08-Jun-94	16	0730	S	2006	62	4.0	53.3	27.5	13362	7.6	28.1	4.9	0.022	0.019	0.92	0.20	0.143	3.5	0	0
08-Jun-94	17	0744	B			0.9	12.5	26.5	26442	16.1										
08-Jun-94	17	0744	S	2002	58	2.0	26.2	26.5	14096	8.1	42.6	8.3	-0.005	-0.005	0.93	0.20	0.083	5.4	0	0
08-Jun-94	18	0753	B			0.6	9.0	28.0	31117	19.3										
08-Jun-94	18	0753	S	2007	52	2.3	30.2	27.0	13485	7.7	14.8	3.0	0.011	0.128	0.89	0.24	0.113	2.6	0	0
08-Jun-94	19	0612	B			1.4	20.5	28.0	35941	22.6										
08-Jun-94	19	0612	S	2000	50	3.0	43.6	28.0	34711	21.7	6.2	3.9	-0.005	0.045	0.92	0.14	0.063	1.6	0	0

DATE	STATION	TIME	DEPTH	CONTN	COLOR PCU	CORRDO mg/l	PERSAT %	TEMP_FLD C°	CONDCORR µmhos/cm	SALINITY ppt	CHL_A_CORR µg/l	PHEO_A µg/l	NO23N mg/l	NH4N mg/l	TKN mg/l	TOTP mg/l	PO4P mg/l	CORRBOD mg/l	FECALCOLI #/100 ml	FECALSTREP #/100 ml
08-Jun-94	20	0710	B			1.8	26.1	29.0	36696	23.1										
08-Jun-94	20	0710	S	1991	47	4.4	62.6	29.0	28800	17.7	13.5	4.1	-0.005	-0.005	0.90	0.27	0.158	2.7	0	0
08-Jun-94	21	0723	B			4.2	52.9	27.0	819	0.3										
08-Jun-94	21	0723	S	1992	42	5.3	67.9	28.0	776	0.3	9.9	1.6	-0.005	-0.005	0.70	-0.05	-0.005	2.1	0	0
08-Jun-94	22	0745	B			3.8	45.3	24.0	805	0.3										
08-Jun-94	22	0745	S	1990	42	3.9	46.4	24.0	805	0.3	20.8	7.7	-0.005	-0.005	0.74	-0.05	0.014	2.7	0	0
08-Jun-94	23	0754	B			4.2	51.0	25.0	700	0.3										
08-Jun-94	23	0754	S	1982	60	4.4	52.4	24.0	714	0.3	67.0	35.3	0.021	0.064	2.05	0.15	0.010	7.9	0	0
08-Jun-94	24	0813	M			4.7	57.0	25.0	900	0.4										
08-Jun-94	24	0813	S	1984	49	4.7	57.0	25.0	900	0.4	18.1	6.6	-0.005	-0.005	0.80	-0.05	0.007	2.1	0	0
08-Jun-94	25	0546	B			5.4	74.3	28.0	19862	11.8										
08-Jun-94	25	0546	S	1989	65	5.2	71.7	28.0	19673	11.6	12.5	2.7	0.006	0.019	0.58	0.40	0.334	2.1	0	0
08-Jun-94	26	0600	B			4.8	69.8	27.5	37986	24.0										
08-Jun-94	26	0600	S	2005	52	4.8	69.8	27.5	37700	23.8	10.7	3.2	-0.005	0.005	0.84	0.12	0.053	2.1	0	0
08-Jun-94	27	0546	B			4.0	57.1	27.5	36268	22.8										
08-Jun-94	27	0546	S	1999	43	4.2	60.4	27.0	36409	23.0	6.7	1.8	-0.005	0.014	0.75	0.24	0.129	2.1	0	0
08-Jun-94	28	0535	B			3.7	54.1	27.0	40262	25.7										
08-Jun-94	28	0535	S	2011	37	4.2	61.7	27.0	39780	25.3	7.9	4.2	0.009	0.037	1.04	0.24	0.089	2.2	0	0
08-Jun-94	29	0652	B			4.1	58.2	25.0	42000	27.0										
08-Jun-94	29	0652	S	1994	40	5.2	74.2	27.0	36602	23.1	6.8	1.9	-0.005	0.007	0.68	0.20	0.132	1.9	0	0
08-Jun-94	30	0640	B			3.6	52.5	28.0	40197	25.6										
08-Jun-94	30	0640	S	1996	42	5.0	73.0	28.0	38778	24.6	10.8	4.1	-0.005	-0.005	0.58	0.23	0.160	2.1	0	0
08-Jun-94	31	0627	B			1.7	25.6	28.0	37832	23.9										
08-Jun-94	31	0627	S	1993	42	2.9	42.3	28.0	38305	24.3	8.7	1.1	0.008	0.015	0.71	0.19	0.119	1.9	0	0
08-Jun-94	32	0614	B			2.1	30.7	28.0	40670	25.9										
08-Jun-94	32	0614	S	1995	38	4.4	64.1	28.0	38778	24.6	21.7	12.0	-0.005	0.065	0.88	0.30	0.214	2.5	0	0
06-Jul-94	1	1343	S	3088															4	92
06-Jul-94	2	1350	S	3079															28	48
06-Jul-94	3	1337	S	3080															60	16

DATE	STATION	TIME	DEPTH	CONTN	COLOR PCU	CORRDO mg/l	PERSAT %	TEMP_FLD C°	CONDCORR µmhos/cm	SALINITY ppt	CHL_A_CORR µg/l	PHEO_A µg/l	NO23N mg/l	NH4N mg/l	TKN mg/l	TOTP mg/l	PO4P mg/l	CORRBOD mg/l	FECALCOLI #/100 ml	FECALSTREP #/100 ml
06-Jul-94	4	1333	S	3093															8	28
06-Jul-94	5	1328	S	3092															170	20
06-Jul-94	6	1324	S	3085															16	140
06-Jul-94	7	1318	S	3082															44	72
06-Jul-94	8	1313	S	3083															-1	220
06-Jul-94	9	0853	S	3095															12	-1600
06-Jul-94	10	1104	S	3105															8	48
06-Jul-94	11	1056	S	3096															8	80
06-Jul-94	12	1048	S	3077															16	60
06-Jul-94	13	1040	S	3107															-4	-4
06-Jul-94	14	1035	S	3089															-4	56
06-Jul-94	15	1029	S	3090															-4	36
06-Jul-94	16	1452	S	3097															4	84
06-Jul-94	17	1448	S	3103															16	24
06-Jul-94	18	1442	S	3100															96	76
06-Jul-94	19	1020	S	3108															8	24
06-Jul-94	20	1429	S	3098															4	150
06-Jul-94	22	1416	S	3081															4	4
06-Jul-94	22	1250	S	3086															180	290
06-Jul-94	23	1257	S	3087															20	60
06-Jul-94	24	1305	S	3076															4	32
06-Jul-94	25	0904	S	3106															24	340
06-Jul-94	26	1011	S	3094															16	200
06-Jul-94	27	0957	S	3091															4	430
06-Jul-94	28	0947	S	3084															48	450
06-Jul-94	29	0936	S	3078															8	710
06-Jul-94	30	0931	S	3102															4	-1800
06-Jul-94	31	0924	S	3109															36	160
06-Jul-94	32	0917	S	3099															220	260