CITY OF FORT MYERS

STORMWATER MASTER PLAN UPDATE

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STORMWATER MASTER PLAN UPDATE

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CITY OF FORT MYERS
STORMWATER MASTER PLAN UPDATE

EXECUTIVE SUMMARY

Environmental Consulting & Technology, Inc. (ECT) was engaged by the City of Fort Myers, Florida in August of 2005 to prepare an update of their existing surface water management plan to address the current regulatory priority of water quality. Herein, ECT provides information relative to the processes and methodologies used in the preparation of this report.

The last citywide stormwater master planning effort undertaken by the City of Fort Myers was completed in 1987 and for the most part only addressed water quantity (flooding) issues. Since this last planning effort there has been a fundamental paradigm shift in the regulatory processes that govern stormwater functions from that solely of flood control and drainage to that of a more comprehensive approach focused primarily on the issues related to water quality and ecological impacts associated therewith. State and Federal initiatives such as the National Pollutant Discharge Elimination System (NPDES) and Total Maximum Daily Load (TMDL) programs have significantly altered stormwater planning priorities. Of interest to the Leaders of the City of Fort Myers as they go forward into the future will be the City's ability to anticipate short and long term capital stormwater needs and cost associated with complying with these state and federal programs.

This report provides an assessment of the current conditions of the City of Fort Myers' primary stormwater management systems at a watershed level from both a water quality and quantity perspective focusing on the most at-risk urbanized watersheds. These watersheds represent the pre-regulatory periods of urbanized development as it relates to environmental resource permitting of today via the South Florida Water Management District (SFWMD). At present, two watersheds within the City, Billy Creek and Manuel's Branch, have been identified as "impaired" by the FDEP. The FDEP is in the process of developing TMDL limits for these watersheds. Once established, municipal effort will be required to bring the water quality in these watersheds into compliance. For the watershed areas within the City limits that are generally east of Interstate 75 and south of Colonial Boulevard, these areas have mostly been or will be developed under the current Environmental Resource Permitting (ERP) provisions of the SFWMD or the FDEP. As such these areas should provide for adequate flood protection and water quality treatment for those lands within these areas.

ECT undertook an extensive archival literature search to identify available reports and studies germane to the City of Fort Myers stormwater system. This report includes a listing of available reports, studies, and related documents reviewed during this effort. Copies of all reviewed documents have been included in a digital portable document format (pdf) on the enclosed compact disk (CD) under Appendix A of this report. Further, this report includes a listing of stormwater and water use permits issued to the City of Fort Myers by the South Florida Water Management District (SFWMD) and pollutant storage tank registrations by the Florida Department of Environmental Protection (FDEP). These documents are also included in a digital portable document format (pdf) on the enclosed compact disk (CD) under Appendix B.

An important aspect of this document was the intent of providing the City of Fort Myers with a comprehensive archive of past studies and reports that could be utilized by both the planner and engineer, as well as by the layman and the citizen alike. Herein, ECT has compiled available studies and reports and has appended them in digital format for electronic access and distribution over the internet.

The modeling element of this report utilized the Environmental Protection Agency's (EPA) public domain model Stormwater Management Model (SWMM) to assess the watershed's hydrologic responsiveness and timing, conveyance capacities, storage, capabilities, and water quality issues for the primary stormwater system for the City.

In addition to physical documentation, ECT compiled a geographically based information database using ArcGIS© 9.2 that was populated with the previously noted regulatory permit information. A geodatabase consisting of the watershed boundaries, sub-watersheds, and the major waterways was also created and includes limited pertinent information. This aspect of the project is intended to provide the City with an initial GIS stormwater framework to further its ongoing stormwater program and to meet internal operational needs related to the requirements of their NPDES permit.

Following ECT's initial review of available data, it was determined that additional field survey information would be required to supplement the existing available information to insure an acceptable level of accuracy for the proposed modeling effort. Utilizing the services of E. F. Gaines Surveying Services, Inc. (EFG), ECT conducted preliminary assessments on all major waterways within each watershed to identify and locate existing culverts, bridges and weirs. Further, areas of substantial siltation, excessive vegetation and other impediments to flow were identified. Field surveys were taken using state of the art GPS technology and traditional methods to vertically and horizontally locate all relevant appurtenances. It is important to note that all information was gathered using the NGVD of 1929 datum to be consistent with previous information, documents and records of the City of Fort Myers.

Another critical element of assessing the condition of the City's systems is the accurate measurements of stormwater flow and discharge volume in the primary channels of the City. This aspect is essential to nearly all water quality monitoring, forecasting and model calibration. As such, ECT initiated a flow monitoring program as a part of this study, developing rating tables for each of the twelve (12) defined water quality monitoring stations within the City. This information is essential for the City to be able to calculate pollutant loads at each of these twelve stations and will be helpful in ongoing monitoring and calibration efforts by the City. Several recommendations have been made herein that are related to improving the efficiency and effectiveness of the water quality monitoring program.

As noted above, the water quality and quantity models used in preparing this report were developed using the U.S. EPA Stormwater Management Model (SWMM). SWMM is a comprehensive numerical model that simulates urban runoff quantity and quality in stormwater management systems by simulating transport through the drainage network, storage, and treatment areas. Calibration was performed on the SWMM models using rainfall, flow, and quality data to the extent available and representative. The water quantity calibration was completed first in order to quantify the hydrologic and hydraulic characteristics of the watershed, which was followed by the water quality analyses.

Results from the surface water quantity simulations were used to predict flow rates and stages within the watershed during design storm simulations for the 10-year/24 hour, 25-year/72 hour, and 100-year/72 hour storm events under existing land use conditions. The water quality simulations were used to predict the pollutant loading rates within the watershed during the 3-year/24 hour storm (approximate mean annual storm event for regulatory purposes), or the 3/1 Event as discussed in subsequent sections of this report for the existing land use conditions. Based on these modeling results, alternatives can be developed to manage existing water pollution issues and potential flooding. Ultimately, the SWMM model may be used to predict the effects of various management actions on water quality and flood control.

With respects to flooding problems, the most common form experienced in the City is nuisance flooding which generally last less than 24 hours and does not reach the level of impacting structures. Again these areas tend to be in the older more intensely urbanized areas of the City. Several areas within the City experience this form of flooding and are identified herein in Section 11.

The City of Fort Myers is not unique among Florida cities where much of the original drainage system was constructed during the early part of the century with little consideration to water quality impacts. In virtually all cases, construction design criteria used did not include any stormwater quality treatment considerations. A primary goal of this report was to modernize the City's existing stormwater planning situation to address the current regulatory focus on water quality and to a lesser extent address the few remaining flooding issues within the corporate limits.

To develop a plan to improve the City's water quality issues will require the implementation of appropriate stormwater best management practices (BMP's) which are techniques or measures that are used for a given set of circumstances to manage the quantity and improve the quality of stormwater runoff in the most cost-effective manner. BMP's are typically engineered systems ("structural") that improve quality and/or control the quantity of runoff. No one single BMP will be sufficient to adequately address all aspects of any particular set of stormwater circumstances experienced in the City. As such, the system designs must employ a series of BMPs commonly referred to as a "treatment train" to accomplish the design objective. This report provides a brief discussion of several BMP's applicable to Southwest Florida.

Once implemented, all structural BMP's require maintenance. As new and retrofitted BMP's are implemented by the City, each project must include a well developed maintenance plan. While not necessarily intense, the plan must be routine and on a defined cycle.

One quantitative way of assessing the need for maintenance of a particular system or area is to implement Level of Service (LOS) standards within the City. By assessing the LOS of a particular area according to a defined standard, the City will be able to establish priorities and adjust maintenance cycles, thus apply their limited maintenance budget to those areas in need rather than simply implementing action as a function of the calendar.

With respect to the City's water quality condition and on the basis of the impaired designation of two urbanized watersheds within the City, ECT has proposed several water quality improvement projects. It is projected that these water quality enhancement projects should reduce the concentration of pollutants such as nutrients, suspended solids and sediments. Based upon preliminary information, it is anticipated that a pollutant load reduction on the order of 10 - 25% can be reasonably expected in aggregate from these projects. However, in order to quantify these gains, continuation of the ongoing water quality monitoring program will be essential to document success of these systems. These projects in conjunction with a prescribed maintenance program will sustain pollutant removal efficiencies and with proper planning can provide the City with the intangible benefits of additional public benefit elements such as open space, opportunities for environmental educational, recreational activities as well as enhanced groundwater recharge.

A key component for the successful implementation of a City wide water quality improvement program will be the establishment of a dedicated funding source. While there are many choices available to the City such as Ad Valorem, User Fees, Storm Water Utility fees, Impact fees, Capacity Credits, Municipal Bonds, Municipal Services Benefit/Taxing Unit, Pollutant Trading, it is ECT's opinion that in order for the City to effectively implement such a program, strong consideration should be given to the establishment and funding of an equitable Storm Water Utility program. The implementation of a Storm Water Utility will provide the City with a dedicated funding allowing for the funding of planning efforts out to a future horizon that will adequately address the multi-disciplinary retrofit projects of that will be required to restore existing water quality conditions to a reasonable level of compliance.

In conjunction with the establishment of the utility, the City will need to aggressively pursue funding partners. At present there are numerous grant opportunities available for cost sharing arrangements to develop and implement water quality restoration projects at the municipal level. A few examples of such programs include the state of Florida Section 319 Grants, TMDL Water Quality Restoration Grants, State Revolving Fund (SRF) Water Pollution Control Program, The Five Star Restoration Program, Federal Emergency Management Agency's Hazard Mitigation Grant Program (HMGP), USDA Natural Resources Conservation Service's Emergency Watershed Protection and Charlotte Harbor National Estuary Program (CHNEP).

In conclusion, this report provides the City with an established point of beginning in its effort to improve the quality of the surface water within its limits. No single recommendation herein will effectively resolve the many issues that exist. A strong commitment by the leadership and staff will be required to proactively address these issues prior to being mandated by State and Federal action. It has been ECT's pleasure to be in service to the City in initiating this effort.

Respectfully submitted to the Mayor and City Council of the City of Fort Myers, Florida this day, January 21, 2008.

Bradley S. Vance, PE	**Ronald M. Edenfield, PE**
Florida Registration No. 43746	Florida Registration No. 45200

1.0 INTRODUCTION

1.1 AUTHORIZATION

Environmental Consulting & Technology, Inc. (ECT) was engaged by the City of Fort Myers, Florida in August of 2005 to prepare an update of their existing surface water management plan. The Scope of Work outlines a project that can be divided into five (5) primary tasks:

- Data Collection and Review,
- Information Assessment,
- Database Creation (GIS),
- Stormwater Modeling and
- Conclusions and Recommendations

In this report, ECT provides information relative to the processes undertaken in the collection and assimilation of applicable archival information, methodologies used in the gathering of field data, the methodology applied to the modeling of water quantity and quality efforts, development of a regulatory permitting geodatabase, proposed capital improvements, and provides an enumeration of ECT's conclusions and recommendations.

1.2 PURPOSE and OBJECTIVE

The last citywide stormwater master planning effort undertaken by the City of Fort Myers was completed in 1987. Since that time, areas to the east and south have been annexed into the City. These annexed lands were, in some cases, previously evaluated by Lee County Governments' Surface Water Master Planning efforts prior to annexation. Further, during the intervening period since the last planning effort, there has been a fundamental paradigm shift in the regulatory processes that govern stormwater functions from that solely of flood control and drainage, to that of a more comprehensive approach focused primarily on the issues related to water quality and ecological impacts associated therewith. Since the 1987 planning effort, state and federal initiatives such as the National Pollutant Discharge Elimination System (NPDES) and Total Maximum Daily

Load (TMDL) programs have significantly altered stormwater planning priorities. Of paramount concern to the City as it goes forward into the future will be its ability to proactively anticipate the short and long term capital stormwater needs associated with these state and federal mandates and its ability to identify and secure cost sharing partners to reduce the fiscal impact of the capital improvements required to address these issues.

Given these impending fiscal impacts, ECT focused its efforts on the watersheds of the older, core urban areas of the City that were predominately developed during the pre-regulatory era of 1980. Two of these watersheds, Billy Creek and Manuel's Branch, have been identified as "impaired" by the FDEP and thus require the establishment of TMDL's to improve their water quality. In as much as these areas have been targeted by the FDEP for requiring improvement, ECT included similar watersheds as its primary focus for this study.

Therefore, this report primarily provided for an assessment of the current conditions of the City of Fort Myers' primary stormwater management systems at a watershed level from both a water quality and quantity perspective for the most at-risk urbanized watersheds. The modeling element of this report utilized the Environmental Protection Agency's (EPA) public domain model Stormwater Management Model (SWMM) to assess conveyance, capacity and quality issues related to the primary conveyances within the City. The systems evaluated by the Master Plan update include Billy Creek, Manuel's Branch, Carrell Canal, and Winkler Canal. Additionally, Ford Street Canal, Shoemaker Canal (fka Palmetto Canal), and Zapato Canal watersheds are evaluated as sub-watersheds of the Billy Creek watershed system. These watersheds represent the pre-regulatory periods of urbanized development as it relates to environmental resource permitting of today via the South Florida Water Management District (SFWMD). Those areas that have been annexed and developed easterly of Interstate 75 and southerly of Colonial Boulevard were evaluated qualitatively on the basis of jurisdictional and permit conditions contained in their respective environmental resource permits. These portions of the City including the Whiskey Creek watershed can be added to this report as an addendum in the future.

Lastly, this document will serve to provide the City with a comprehensive archive for past studies and reports. ECT has compiled available studies and reports and has appended them herewith in digital format for electronic access and distribution over the internet. Further, in that the citizenry as well as the technical practitioner frequently use these reports for general educational information and technical research, each section of the report contains descriptive information on the various elements that should be of use to the broadest section of the public.

2.0 EXISTING REPORTS and STUDIES

2.1 SURFACE WATER MANAGEMENT STUDIES (City of Fort Myers)

Prior to the initiation of field data collection efforts, ECT undertook an extensive archival literature search to identify available reports and studies germane to the City of Fort Myers stormwater system. The following is a listing of the reports, studies, and related documents involving surface (storm) water management for the City of Fort Myers. These documents, as were made available, are included in a digital portable document format (pdf) on the enclosed compact disk (CD) under Appendix A on an "as is" basis with no warranty expressed or implied and are to be used at one's own risk.

"Dean Park Drainage Study (DRAFT)"
Pitman-Hartenstein & Associates, Inc. January 2007

"Palmetto Avenue Extension - Drainage Report"
By David Morin, PE; August 29, 2002 (revised November 1, 2002)

"Surface Water Management - Fort Myers, Florida"
Johnson Engineering, Inc. December 1987

"Surface Water Management - Fort Myers Planning Area, Addition I"
Johnson Engineering, Inc. September 1987

"Surface Water Management Plan - Galloway Area Watershed"
Johnson Engineering, Inc. July 1987

"Surface Water Management - Fort Myers Planning Area"
Johnson Engineering, Inc. December 1984

"North Colonial Water Management Area"

Johnson Engineering, Inc. March 1984

"Storm Water Management - Fort Myers Florida"

Johnson Engineering, Inc. Circa 1975

2.2 CONSTRUCTION and PERMIT DOCUMEMNTS (City of Fort Myers)

"Broadway Drainage: Phases I, II, and III"

"North Colonial Waterway: Construction & Permit"

"Winkler Canal (Rogers Weir): Construction & Permit"

"Drainage & Parking: Eastwood Golf Course, June 1992"

"Drainage: Billy Creek Maintenance, 1993-1994"

"Drainage: Carillon Woods Drainage Improvements, December 1993"

"Drainage: Central Ave from Carrell Rd to Hanson St, July 1988"

"Drainage: Winkler Canal Improvements, February 1991-1993"

"Sewer & Drainage: Street Improvements for Braman – Rio Vista"

"Sewer & Drainage: West First Street, March 2001"

"Stormwater Pump Station #19" (Dean Park)

"Surface Water Improvements & Pedestrian Trail: Manuel's Branch"

"Surface Water Improvements: Manuel's Branch and Carrell Canal"

2.3 MISCELLANEOUS DOCUMEMNTS

"FTM Maps" (City of Fort Myers)

"Watershed Areas Map 2003" (City of Fort Myers)

"Land Use Map 2006" (City of Fort Myers)

"Iona Drainage District (IDD)" (Lee County)

2.4 SURFACE WATER MANAGEMENT STUDIES (Lee County Unincorporated)

Below is a listing of previous reports and studies involving surface (storm) water management that would involve the interests of the City of Fort Myers.

"Billy Creek Watershed"
(Lee County Surface Water Management Master Plans)
Johnson Engineering, Inc., 1991

"Ten Mile Canal Watershed"
(Lee County Surface Water Management Master Plans)
Johnson Engineering, Inc., 1991

"Whiskey Creek Watershed"
(Lee County Surface Water Management Master Plans)
Johnson Engineering, Inc., 1991

"Six Mile Cypress Watershed"
(Lee County Surface Water Management Master Plans)
Johnson Engineering, Inc., 1990

"Canal 'L' Watershed Water Management Study"
Johnson Engineering, Inc., January 1998

2.5 STATE AND FEDERAL AGENCIES

"Total Maximum Daily Load (TMDL) for Nutrients, Biochemical Oxygen Demand and Dissolved Oxygen in the Caloosahatchee Basin, Billy Creek (WBID 3240J)"
United States Environmental Protection Agency; March 2006

"Integrated Water Quality Assessment for Florida: 2006 305(b) Report and 303(d) List Update"
Florida Department of Environmental Protection; May 2006

2.6 FEMA - FLOOD INSURANCE STUDY

"Flood Insurance Study: City of Fort Myers, Florida"
Federal Emergency Management Agency; October 1984

It is noted that at the time of this report, the Federal Emergency Management Agency (FEMA) is currently proposing a flood insurance restudy of the flood risk for the City of Fort Myers. This restudy will determine the extent and level of the 100-year storm event for both coastal surge (hurricane) and riverine flooding (rainfall).

3.0 INVENTORY of EXISTING FACILITIES

3.1 ENVIRONMENTAL RESOURCE PERMITS

Below is a listing of permits issued to the City of Fort Myers by the South Florida Water Management District (SFWMD) and the Florida Department of Environmental Protection (FDEP) within the corporate limits of the City of Fort Myers. These documents, as were made available, are included in a digital portable document format (pdf) on the enclosed compact disk (CD) under Appendix B on an "as is" basis with no warranty expressed or implied and are to be used at one's own risk.

Stormwater Permits (SFWMD)

(Those listed in lower case indicate multiple projects under a common permit.)

Project Name	Permit #
Eastwood Golf Course Canal Relocation	36-01140-S
Eastwood Golf Course Canal Relocation	36-01140-S
SUNSHINE MASONRY	36-03933-P
LEE CO. MAIN LIBRARY PARKING EXPANSION	36-03939-P
SHADY OAKS PARK/BILLY'S CREEK PARK	36-04225-P
Palmetto Avenue Extension	36-03297-P
FORD STREET EXTENSION	88-36
VERONICA S. SHOEMAKER BLVD	36-04067-P
SUN CITY CENTER PUBLIC SAFETY STATION	36-00678-S
PHASE III - C UTILITY IMPROVEMENTS	36-04745-P
Westbury Industrial Park	36-03297-P
Boston Red Sox Clubhouse Parking Expansion	36-01140-S
WINKLER AVENUE IMPROVEMENTS	88-56
FORUM BLVD - 6 LANING	36-01363-S
Boston Red Sox Minor League Stadium	36-01140-S
Boston Red Sox Major League Stadium	36-02203-S
Boston Red Sox Baseball Stadium	36-02203-S
City of Fort Myers Wellfield Expansion Project	36-01140-S
Eastwood Golf Course Clubhouse Renovation	36-01140-S
Wellfield Expansion Project P15 - P17 Well Pad	36-01140-S
FORT MYERS PARKING STRUCTURE	36-00787-S
City of Palms Stadium	36-02203-S
City of Fort Myers Wellfield Expansion Project	36-01140-S
Eastwood Golf Course Reuse Lake	36-01140-S
BROADWAY STREET IMPROVEMENTS	88-62

WINKLER AVENUE EXTENSION	87-95
GALLOWAY WATER CONTROL STRUCTURE	36-00701-S
DUNBAR INCUBATION FACILITY	36-00832-S
CONVENTION HALL AT HARBORSIDE	36-01087-S
NORTH COLONIAL WATERWAY	36-00540-S
MANGO STREET IMPROVEMENTS	36-01075-S
LEMON STREET IMPROVEMENTS	36-01074-S
Public Works & Water Treatment Plant	36-01140-S
Public Works & Water Treatment Plant	36-01140-S
Fort Myers Water Treatment Plant	36-01140-S
Fort Myers Water Treatment Plant	36-01140-S
EDISON HOME PARKING FACILITIES	36-01162-S
SHADY OAKS COMMUNITY CENTER	36-01246-S
RIVERWALK PARK	36-01232-S
DUNBAR RECREATION CENTER	36-01338-S
SUNSET PLACE IMPROVEMENTS	36-01362-S
ORANGE STREET WIDENING	36-01744-S
WINKLER CANAL DRAINAGE IMPROVEMENTS	36-01921-S
LUVERN STREET EXTENSION	36-01785-S
STARS SOCCER COMPLEX	36-01888-S
Golf Course and Wellfield	36-01140-S
Fort Myers Country Club	36-02253-S
ORTIZ AVE EXTENSION	36-02164-S
MANUELS' BRANCH	36-02205-S
Arcadia Street Extension	36-01140-S
Boston Red Sox Baseball Stadium	36-02203-S
Boston Red Sox Minor League Stadium	36-01140-S
City of Fort Myers Water Treatment Plant	36-01140-S
Eastwood Golf Course Improvements	36-01140-S
Boston Red Sox Major League Stadium Site	36-02203-S
Boston Red Sox Minor League Stadium	36-01140-S
NORTH COLONIAL LINEAR PARK	36-02414-S
Horticultural Reduction Facility	36-01140-S
Edison Avenue Extension Drainage Improvements	36-01140-S
Fort Myers Country Club	36-02253-S
Edison Avenue Extension Drainage Improvements	36-01140-S
CARILLON WOODS DRAINAGE IMPROVEMENTS	36-00704-S
City of Fort Myers Wellfield	36-01140-S
Fort Myers Country Club	36-02253-S
HARBORSIDE PARKING GARAGE	36-02817-S
City of Fort Myers Wellfield	36-01140-S
CALOOSA, WEST RIVERSIDE & OSCEOLA	36-02927-S
PALMETTO AVENUE EXTENSION	36-03124-P
SOUTHWEST FLORIDA ADDICTION SERVICES	36-01954-S
DUNBAR SHOPPING CENTER	36-03629-P
Palmetto Avenue Extension South of Edison	36-03297-P
Fort Myers Skatium	36-02203-S
LIONS PARK	36-03398-P

WEST FIRST STREET REDEVELOPMENT	36-03484-P
City of Fort Myers Wellfield	36-01140-S
Fort Myers Skate Park	36-02203-S
Fort Myers Wellfield Mitigation Modification	36-01140-S
WINKLER AVENUE WIDENING	36-03618-P
BRAODWAY AVENUE IMPROVEMENTS	36-03677-P
CORTEZ BLVD & DEL RIO AVE	36-03636-P
FORT MYERS LITTLE LEAGUE COMPLEX	36-03756-P

Water Use Permits (SFWMD)

Project Name	Permit #
FORT MYERS GOLF & COUNTRY CLUB	36-00019-W
CITY OF FORT MYERS	36-00035-W
HENDERSON LAKE GOLFVIEW TENNIS COURTS	36-00890-W
EASTWOOD GOLF COURSE	36-01102-W
FORT MYERS RACQUET CLUB	36-03095-W
CITY OF FORT MYERS - PARKS	36-03460-W
BEVERLY MANOR NURSING FACILITY	36-03475-W

Pollutant Storage Tank Registration (FDEP)

Project Name	Registration #
Eastwood Golf Course	8519163
Public Works	8626503
Yacht Basin	8626518
AWWTP (Central)	8627192
Wastewater Plant	8627406
Industrial Park	8627541
AWWTP (South)	8627550
Pump Station #4	8732460
Fire Station #2	8732592
Fire Station #1	8732593
Police Department	8732602
Fire Station #3	8732604
Country Club	8837343
Housing Authority	8945478
Golf Course	9103208
Pump Station #3	9300407
Membrane Softening	9300685
Winkler Pump Station	9400561
Public Safety Station #5	9807219
City Pier	9802173

4.0 GIS MAPPING and DATABASES

4.1 GEOGRAPHICAL INFORMATION SYSTEM

As part of the Stormwater Master Plan Update, Environmental Consulting & Technology, Inc. (ECT) reviewed and compiled available regulatory permit information and developed a geographically based information database in ArcGIS© 9.2 format. Similarly, information related to the watersheds was created using the ArcHydro protocol.

A composite digital base map was developed using existing coverages or geodatabases obtained from the City of Fort Myers' GIS Department, Lee County Property Appraiser, and the South Florida Water Management District (SFWMD). The digital map data obtained included aerial photographs, roadway centerlines, municipal boundaries, parcel boundaries, soils classifications, and land use. Watershed and catchment (sub-watershed) boundaries, as well as, the primary stormwater conveyance systems were added to the base map. Consequently, these boundaries were revised and/or further subdivided using available topographic information, available stormwater plans, the City's "FTM" maps, and aerial photographs.

This aspect of the project is intended to provide the City with a preliminary GIS stormwater framework to further its ongoing stormwater program to meet internal operational needs and the requirements of their NPDES permit. These geodatabases and associated electronic data files are available to the user on the enclosed compact disk (CD) under Appendix C on an "as is" basis with no warranty expressed or implied and are to be used at one's own risk.

4.2 REGULATORY PERMIT GEODATABASES

Available data associated with permits issued to the City of Fort Myers was retrieved from the SFWMD and FDEP files. Information from the SFWMD includes permits for those stormwater management systems and consumptive water use permits held by the City. The information from the FDEP includes that for pollutant storage tank registrations. A geodatabase consisting of the most pertinent data from these permits was prepared and included as a hyperlink to the associated scanned portable document format ("pdf") permit documents.

4.3 HYDROLOGIC GEODATABASE

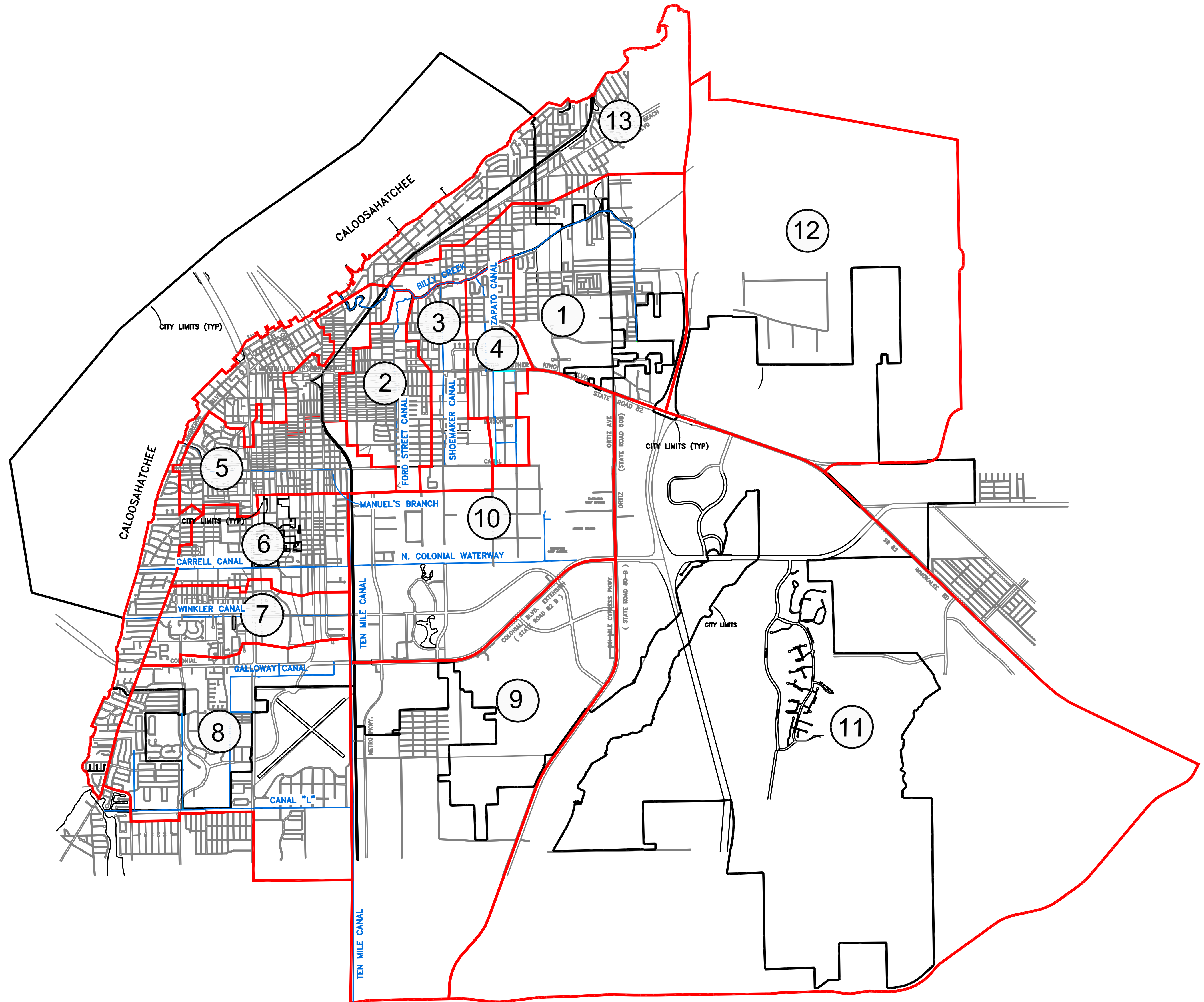
The watershed boundaries ("Watersheds"), sub-watersheds ("Catchments") and major waterways ("HydroEdges") were created in accordance with the ArcHydro schema. These geodatabases include limited pertinent information related to the respective designations by the FDEP, USEPA, and USGS. In addition to that of the ArcHydro protocol, these geodatabases have been developed to allow further expansion and inclusion of related informational databases.

4.4 FIGURES

Figure 4-1: "Watershed Identification"
Figure 4-2: "Billy Creek Watershed"
Figure 4-3: "Ford Street Canal Watershed"
Figure 4-4: "Shoemaker Canal Watershed"
Figure 4-5: "Zapato Canal Watershed"
Figure 4-6: "Manuel's Branch Watershed"
Figure 4-7: "Carrell Canal Watershed"
Figure 4-8: "Winkler Canal Watershed"

I.D. NO.	WATERSHED NAME	TOTAL AREA SQUARE MILES (SQ.MI.)
1	BILLY CREEK	4.84 SQ.MI.
2	FORD STREET CANAL	1.27 SQ.MI.
3	SHOEMAKER CANAL	1.15 SQ.MI.
4	ZAPATO CANAL	1.04 SQ.MI.
5	MANUEL'S BRANCH	1.52 SQ.MI.
6	CARRELL CANAL	1.54 SQ.MI.
7	WINKLER CANAL	1.28 SQ.MI.
8	CANAL "L"	4.69 SQ.MI.
9	SOUTH COLONIAL (PARTIAL)	7.31 SQ.MI.*
10	NORTH COLONIAL	5.02 SQ.MI.
11	SIX MILE CYPRESS (PARTIAL)	26.81 SQ.MI.*
12	ORANGE RIVER (PARTIAL)	9.91 SQ.MI.*
13	TIDAL CALOOSAHATCHEE	4.90 SQ.MI.

* THESE AREAS REPRESENT PORTIONS OF THE OVERALL WATERSHED BOUNDARIES OUTSIDE OF THE LIMITS SHOWN.



LEGEND

CITY LIMITS
WATERSHED
PRIMARY WATERWAY

SCALE
1"=6,000'
0 6000ft 12000ft 18000ft 24000ft

SOURCE: ECT 11-2007, F.M.

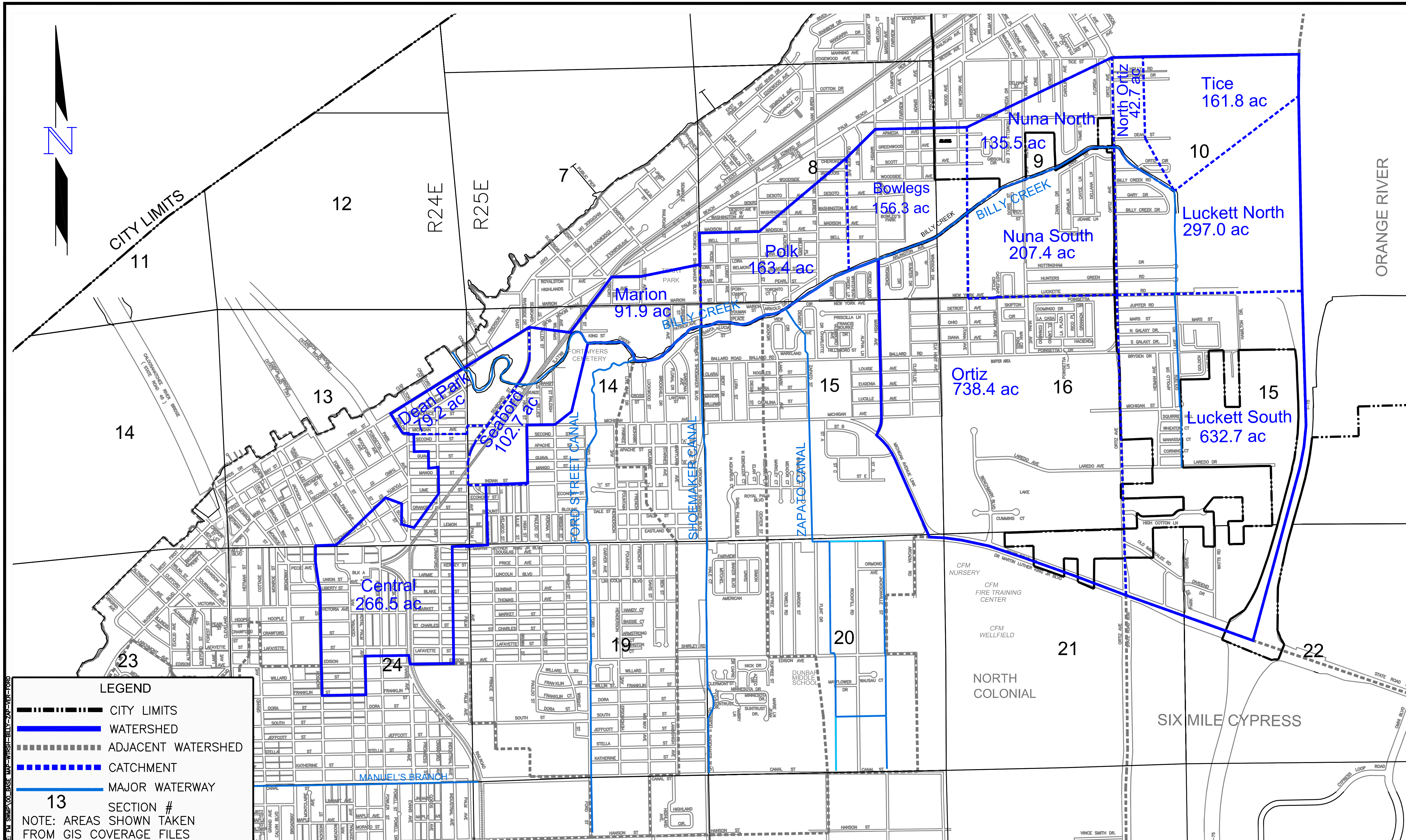
FILE: FM SWMP\00_BASE MAP\MasterWtrsh-FLOOD-REGS.dwg

ECT
4100 Center Pointe Drive, Suite 112
Fort Myers, Florida 33916
Phone: (239) 277-0003 CA#5520

STORMWATER MASTER PLAN UPDATE
WATERSHED IDENTIFICATION

CITY OF FORT MYERS, FL
PUBLIC WORKS DEPT.
ENGINEERING DIVISION

FIGURE
4-1



SCALE
1"=2,000'
0 2000ft 4000ft 6000ft 8000ft
SOURCE: ECT 11-2007, F.M.

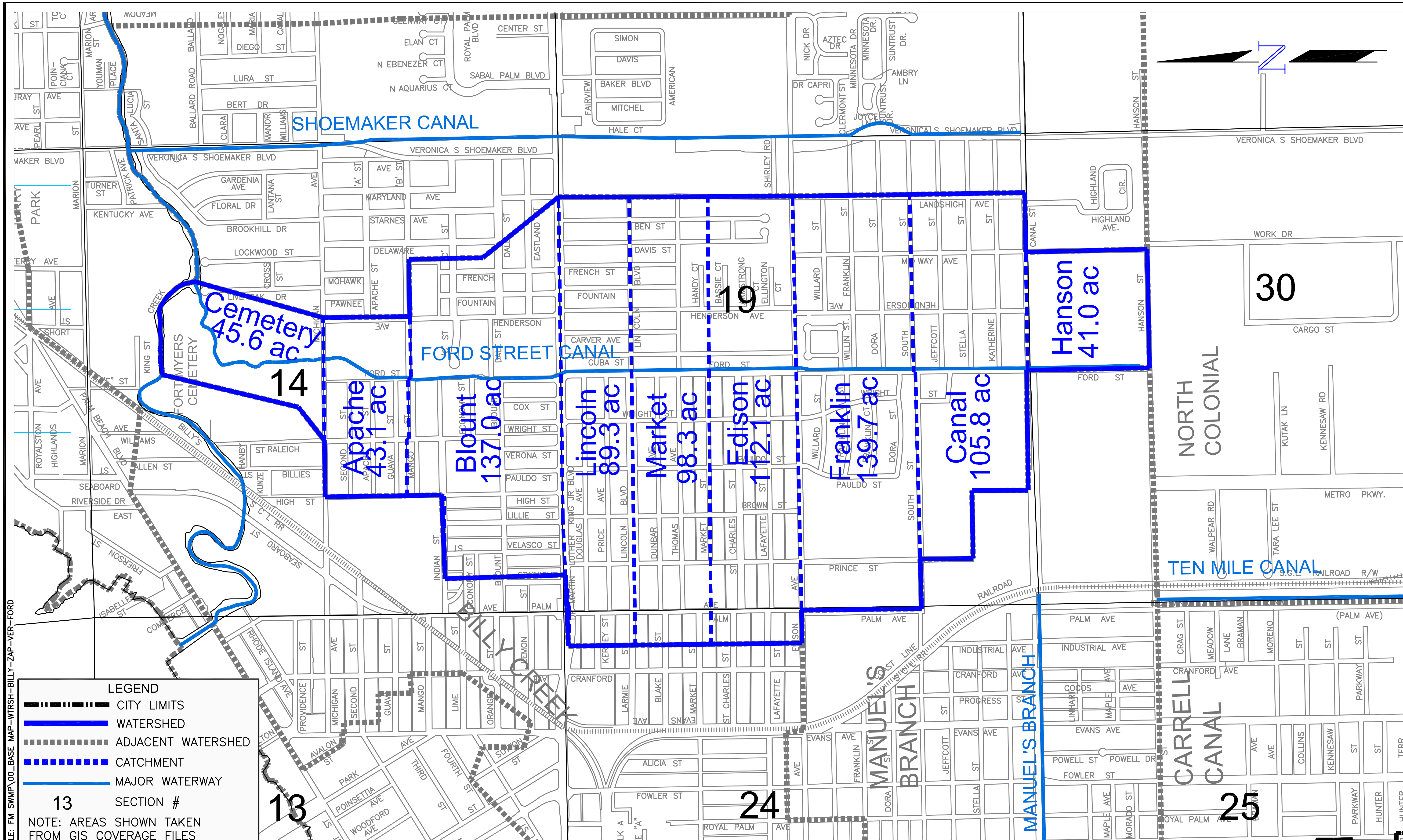
ECT
4100 Center Pointe Drive, Suite 112
Fort Myers, Florida 33916
Phone: (239) 277-0003 CA#5520

STORMWATER MASTER PLAN UPDATE
BILLY CREEK WATERSHED

City of Palms

CITY OF FORT MYERS, FL
PUBLIC WORKS DEPT.
ENGINEERING DIVISION

FIGURE 4-2



SCALE
1"=1,000'
0 1000ft 2000ft 3000ft 4000ft
SOURCE: ECT 11-2007, F.M.

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Fort Myers, Florida 33916
Phone: (239) 277-0003 CA#5520

STORMWATER MASTER PLAN UPDATE

FORD STREET CANAL WATERSHED

City of Palms
CITY OF FORT MYERS, FL
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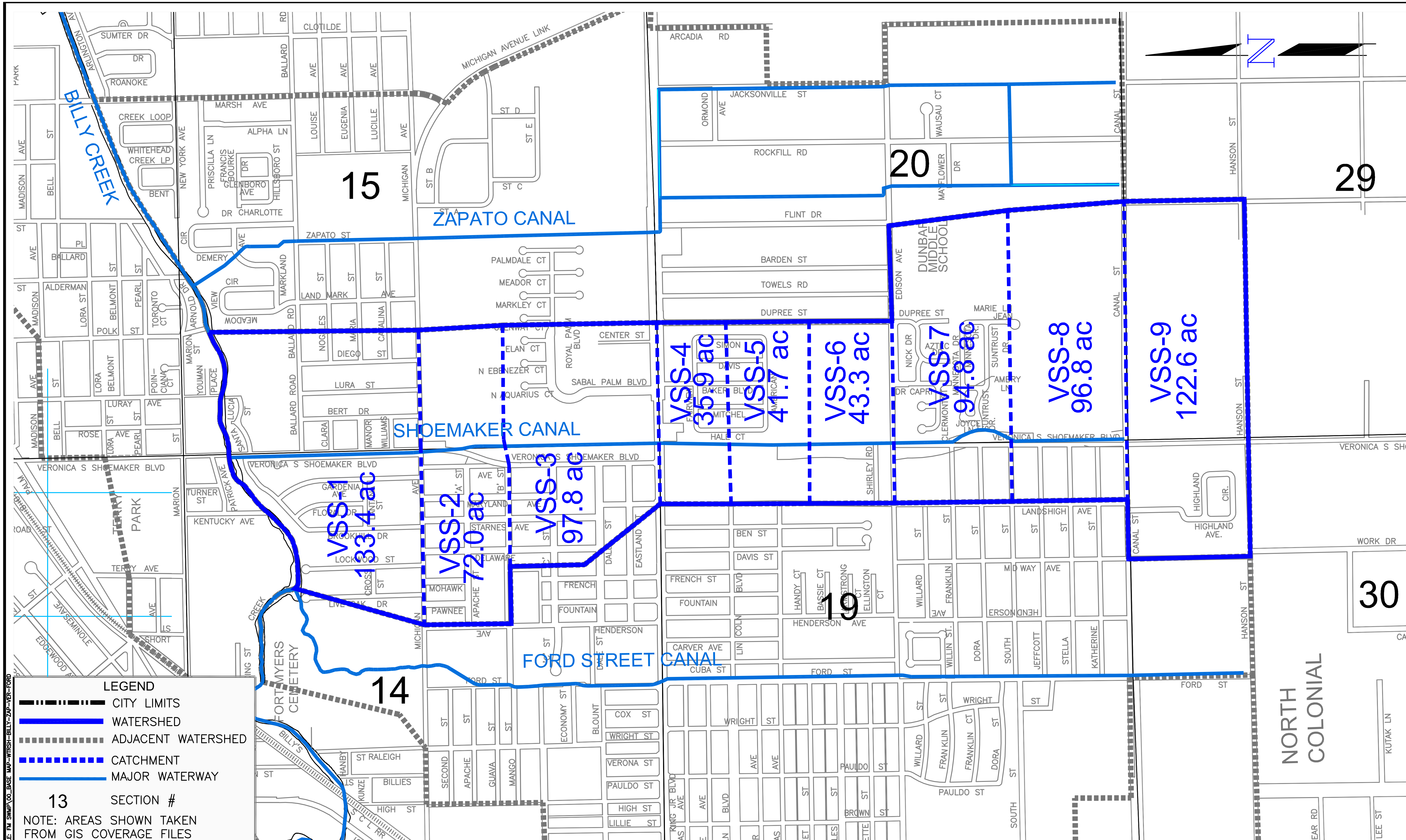
FIGURE
4-3



SCALE
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SOURCE: ECT 11-2007, F.M.

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Fort Myers, Florida 33916
Phone: (239) 277-0003 CA#5520

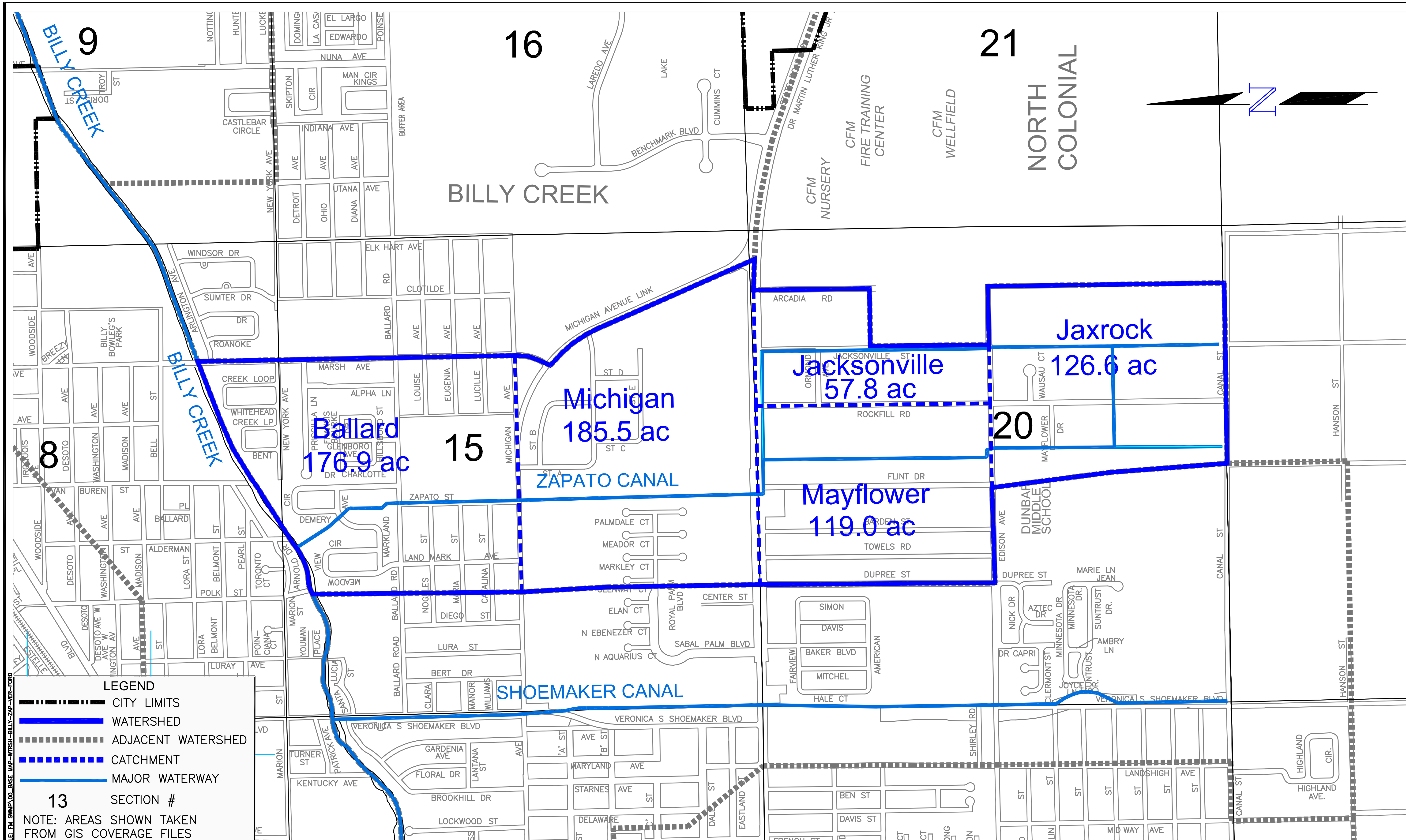
STORMWATER MASTER PLAN UPDATE

SHOEMAKER CANAL WATERSHED

City of Palms

CITY OF FORT MYERS, FL
PUBLIC WORKS DEPT.
ENGINEERING DIVISION

FIGURE
4-4



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4100 Center Pointe Drive, Suite 112
Fort Myers, Florida 33916
Phone: (239) 277-0003 CA#5520

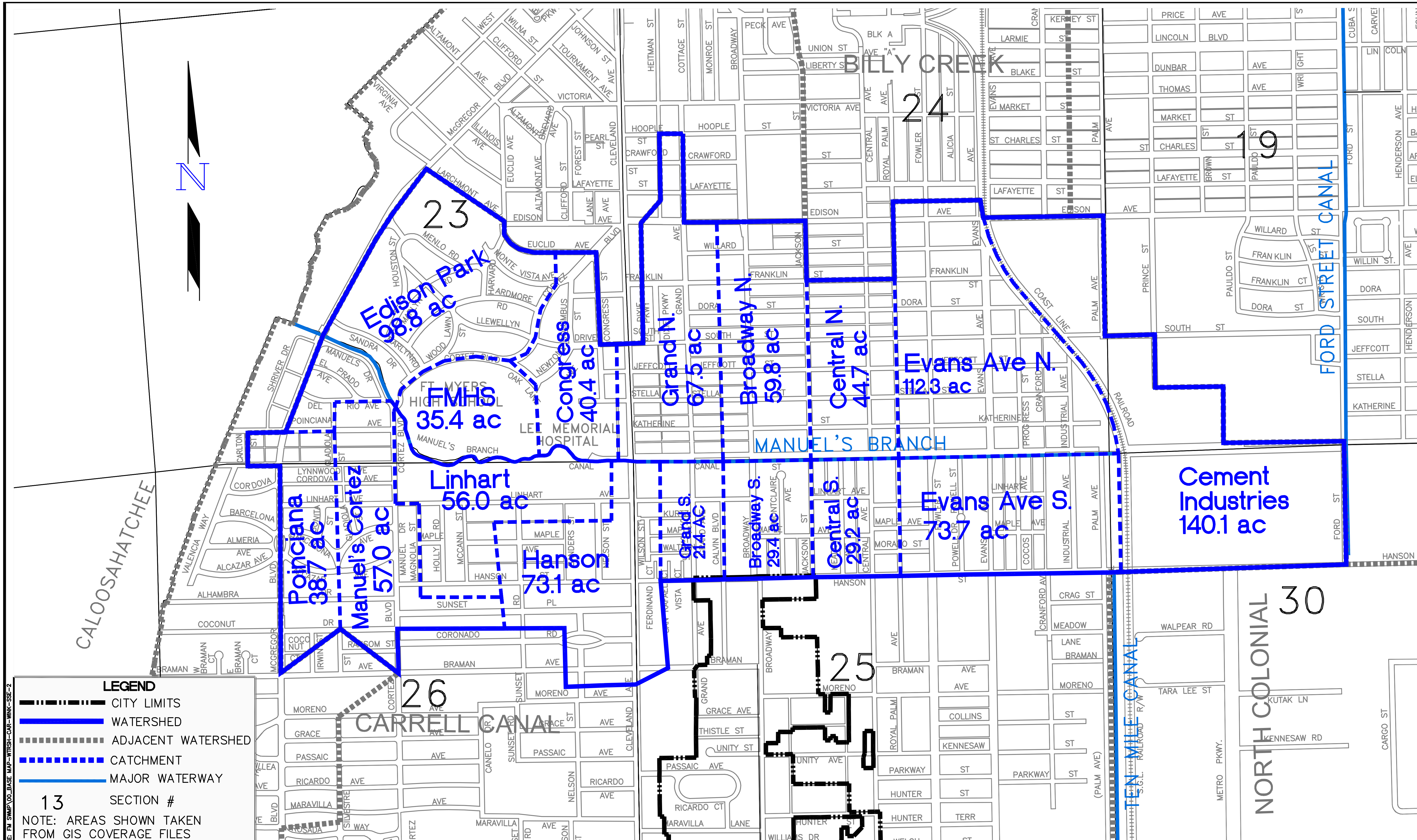
STORMWATER MASTER PLAN UPDATE

ZAPATO WATERSHED

CITY OF FORT MYERS, FL
PUBLIC WORKS DEPT.
ENGINEERING DIVISION

City of Palms

FIGURE 4-5



SCALE 1"=1,000'

0 1000ft 2000ft 3000ft 4000ft

SOURCE: ECT 11-2007, F.M.

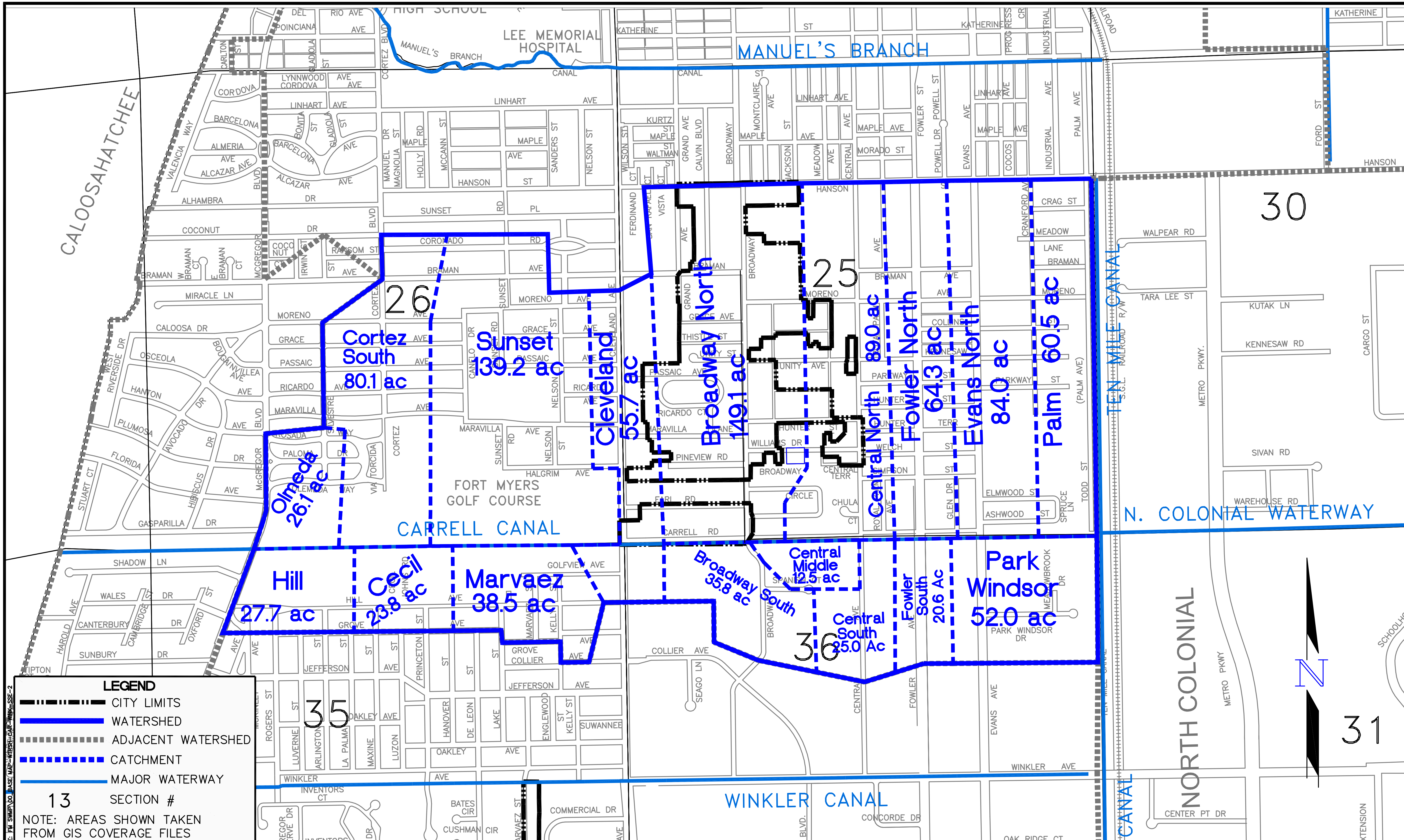
ECT
4100 Center Pointe Drive, Suite 112
Fort Myers, Florida 33916
Phone: (239) 277-0003 CA#5520

STORMWATER MASTER PLAN UPDATE

MANUEL'S BRANCH WATERSHED

CITY OF FORT MYERS, FL
PUBLIC WORKS DEPT.
ENGINEERING DIVISION

FIGURE 4-6



SOURCE: ECT 11-2007, F.M.

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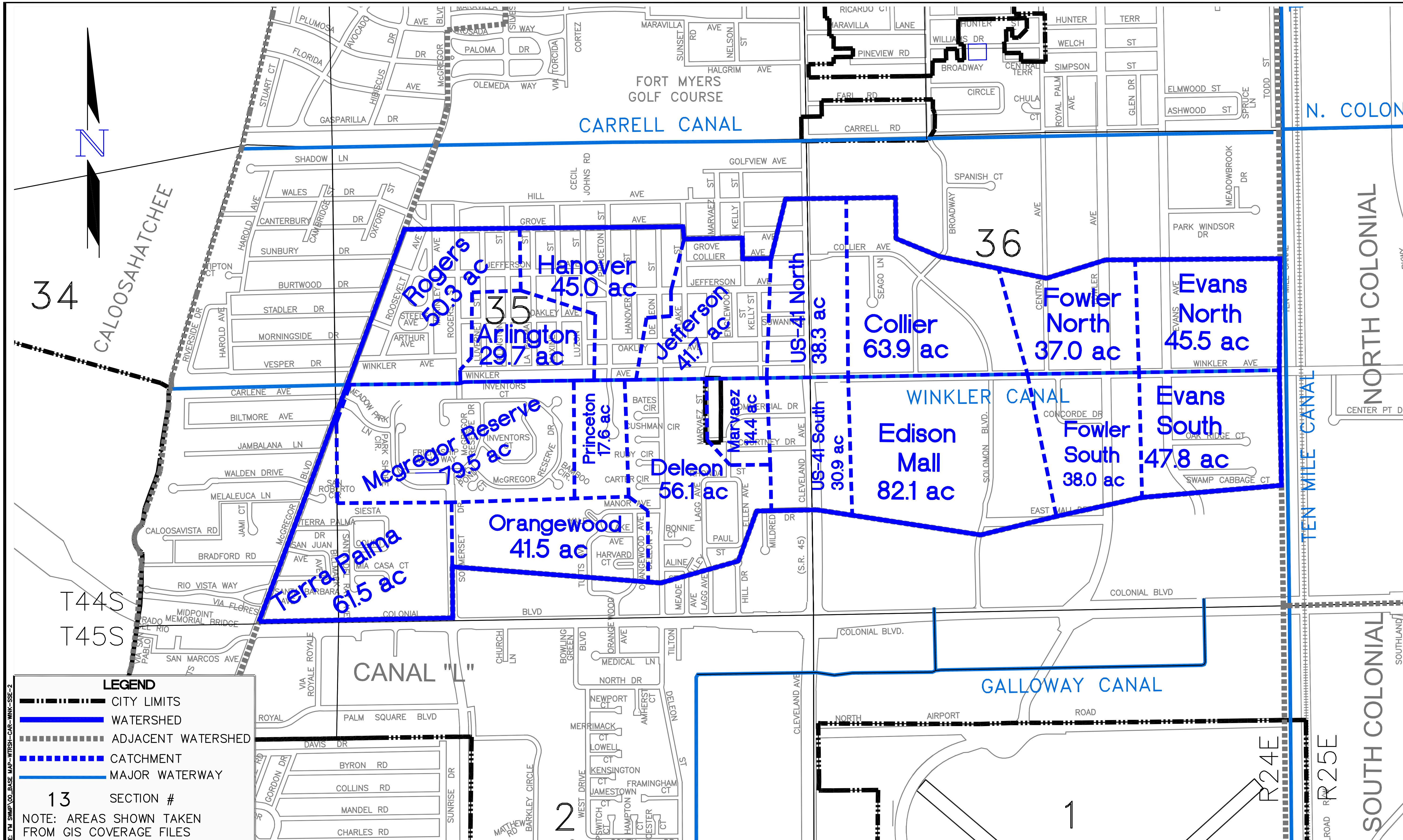
4100 Center Pointe Drive, Suite 112
Fort Myers, Florida 33916
Phone: (239) 277-0003 CA#5520

STORMWATER MASTER PLAN UPDATE
CARRELL CANAL WATERSHED

CITY OF FORT MYERS, FL
PUBLIC WORKS DEPT.
ENGINEERING DIVISION

City of Palms

FIGURE 4-7



SCALE
1"=1,000'
0 1000ft 2000ft 3000ft 4000ft
SOURCE: ECT 11-2007, F.M.

ECT
4100 Center Pointe Drive, Suite 112
Fort Myers, Florida 33916
Phone: (239) 277-0003 CA#5520

STORMWATER MASTER PLAN UPDATE

WINKLER CANAL WATERSHED

CITY OF FORT MYERS, FL
PUBLIC WORKS DEPT.
ENGINEERING DIVISION

FIGURE 4-8

5.0 MODEL SELECTION and CALIBRATION

5.1 SWMM MODEL OVERVIEW

The basic analytical tool used for this report is the U.S. EPA Stormwater Management Model (SWMM). SWMM is a comprehensive numerical model that simulates urban runoff quantity and quality in stormwater management systems by simulating transport through the drainage network, storage, and treatment areas. The model has the capability of performing detailed hydraulic flow routings for the purposes of evaluating improvements and/or alterations. The model can simulate individual events such as critical design storms or continuous long-term hydrologic series of any period of time. Through the simulation of long-term hydrologic series from historic records of rainfall, the model is capable of evaluating discharge conditions associated with either average annual or extreme flooding events.

In order to provide an evaluation under the present and proposed conditions, a continuous simulation model would need to be developed. A continuous simulation approach would allow for an evaluation providing frequency analysis results on actual water surface elevations and flow rates in the drainage system as well as elevation-duration curves. In addition, the use of the SWMM model would allow for the examination of the frequency and duration of frequent events to a much greater extent than would have been possible with steady state or single event models. Where tidal boundary conditions drive flooding, it is often difficult to assess the impacts of proposed flood mitigation alternatives for frequent events without a continuous simulation model. The typical modeling approach is to determine water surface profiles resulting from a synthetic storm event occurring during a specific tidal condition (e.g., flows resulting from the 25-year/72-hour rainfall combined with “spring neap” tidal elevations).

5.2 SWMM EVENT MODELING

The results from the surface water quantity simulations were used to predict flow rates and stages within the watershed during design storm simulations for the 10-year/24 hour, 25-year/72 hour, and 100-year/72 hour storm events under existing land use conditions. The water quality simulations were used to predict the pollutant loading rates within the watershed during the 3-year/24 hour storm (approximate mean annual storm event for regulatory purposes), or the 3/1 Event as discussed in subsequent sections of this report for the existing land use conditions.

Included at the end of this section as Figures 5-1 through 5-16 are the water surface profiles for Billy Creek, Zapato Canal, Shoemaker Canal, Ford Street Canal, Manuel's Branch, Carrell Canal and Winkler Canal. The profiles indicate both the "static" (no flow) condition and the 25-year/3 day event for each watershed. These profiles and simulation models may be used in the permitting of developments for their respective design considerations.

Based on these modeling results, alternatives can be developed to manage existing water pollution issues and potential flooding. Ultimately, the SWMM model may be used to predict the effects of various management actions on water quality and flood control.

The SWMM model input and output electronic data files for each event outlined above are available to the user on the enclosed compact disk (CD) under Appendix D on an "as is" basis with no warranty expressed or implied and are to be used at one's own risk.

5.3 SWMM MODEL CALIBRATION

Calibration was performed on the SWMM models using rainfall, runoff and quality data collected in the field to the extent available and representative. The water quantity calibration was completed first in order to quantify the hydrologic and hydraulic characteristics of the watershed, which was followed by the water quality analyses. Although separate, the two models are similar in that the water quantity SWMM model essentially provides the hydrological loads for the water quality simulation.

Both the water quantity and water quality were calibrated with respect to measured rainfall, stage, flow, and pollutant concentration data obtained from sampling locations within the watershed. Rainfall, stage, and flow data were used to develop stage-discharge relationships at the sampling sites. These calibrated hydrologic input data were then used as input for water quality simulations. Values from the water quality samples and publications for Event Mean Concentrations (EMC's) were used for the following parameters: Total Nitrogen (TN), Total Phosphorous (TP), and Total Suspended Solids (TSS).

5.4 RECOMMENDATIONS

It is recommended that continuous rainfall and stage recorders be installed at locations outlined below in order to better calibrate these models in conjunction with the specific stage-duration hydrographs associated with these types of mixed use and urbanized watersheds. This same stage elevation information will be used in the calculation(s) of annualized runoff volumes in conjunction with the appropriate rain gage.

Rain Gage: Equipment and Locations

Install four (4) continuous tipping bucket rainfall gages at each of the existing locations.

Stage Recorder: Equipment and Locations

Install nine (9) continuous stage recorders at the following locations: Billy Creek @ Billy Creek Filter Marsh Weir; Ford Street Canal @ Cemetery control structure; Shoemaker Canal @ Michigan Avenue; Zapato Canal @ Zapato Weir; Manuel's Branch @ Cortez Weir; Carrell Canal @ FMCC Weir; Winkler Canal @ Rogers Weir; Galloway Canal @ Galloway Weir; and North Colonial Waterway @ Seaboard Weir.

5.5 FIGURES

FIGURE 5-1

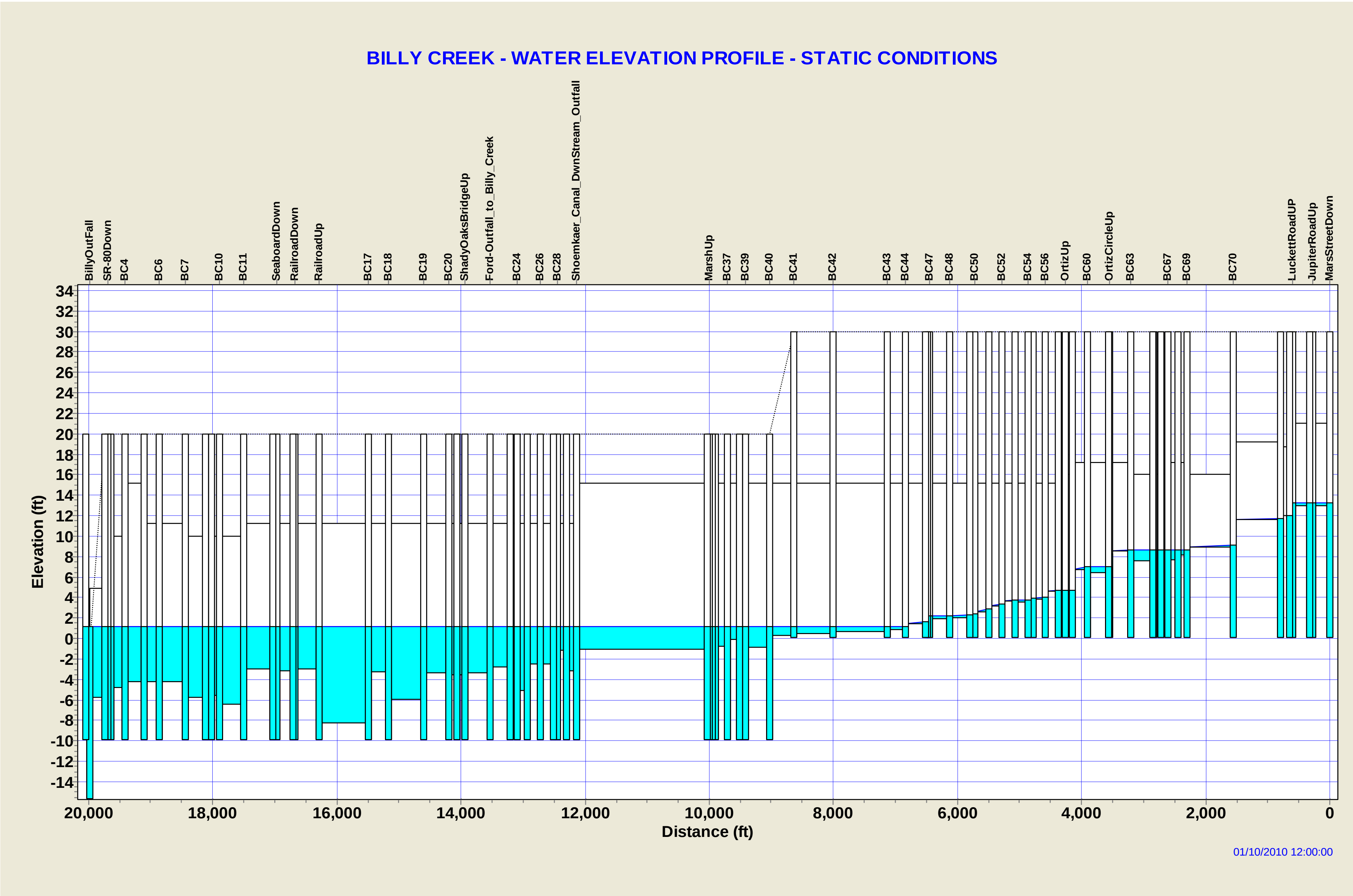
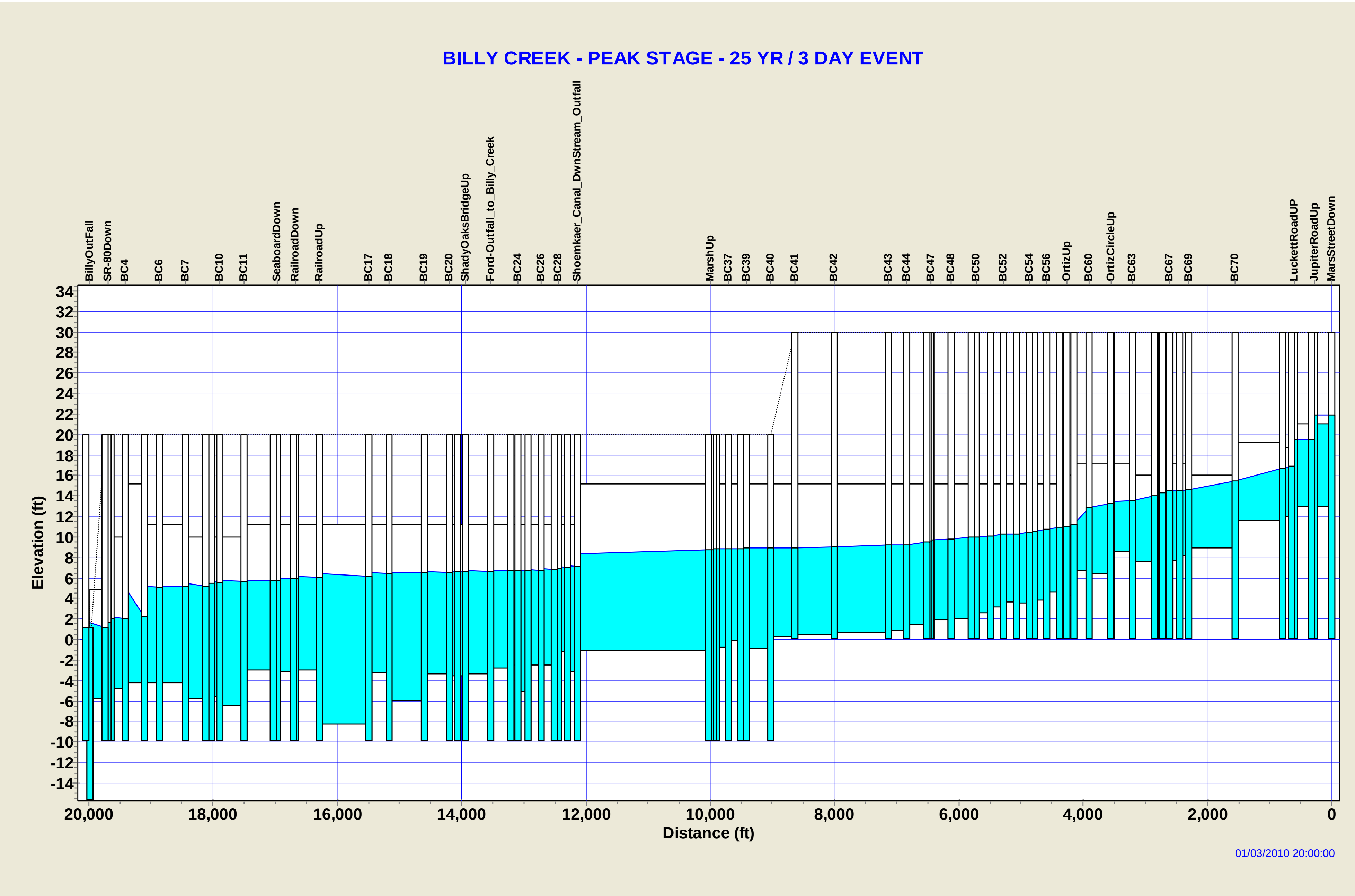
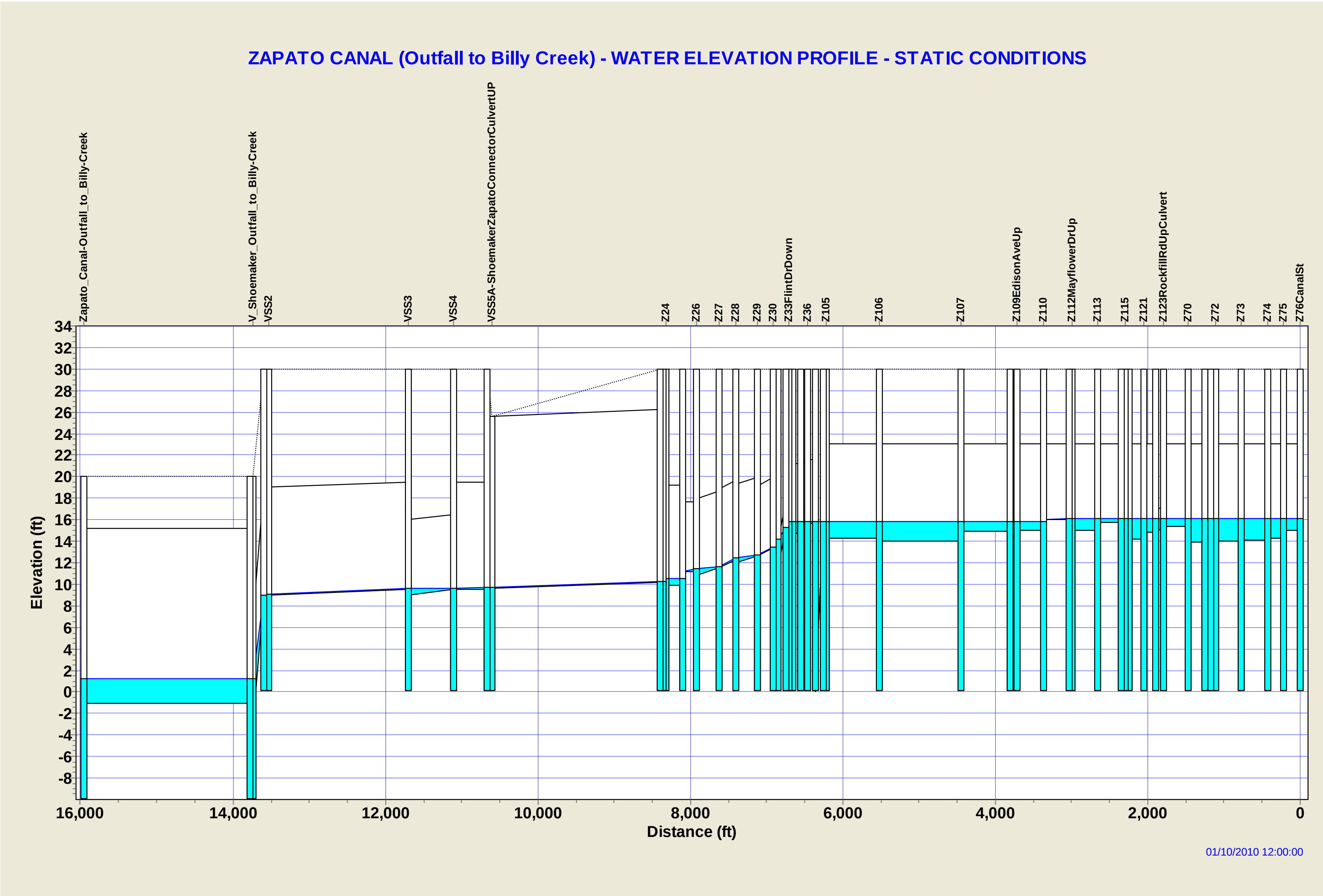

BILLY CREEK - WATER ELEVATION PROFILE - STATIC CONDITIONS
BillyOutFall
SR-80Down
BC4
BC6
BC7
BC10
BC11
SeaboardDown
RailroadDown
RailroadUp
BC17
BC18
BC19
BC20
ShadyOaksBridgeUp
Ford-Outfall_to_Billy_Creek
BC24
BC26
BC28
Shoemkaer_Canal_DwnStream_Outfall
MarshUp
BC37
BC39
BC40
BC41
BC42
BC43
BC44
BC47
BC48
BC50
BC52
BC54
BC56
OrtizUp
BC60
OrtizCircleUp
BC63
BC67
BC69
BC70
LuckettRoadUP
JupiterRoadUp
MarsStreetDown
Elevation (ft)
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
Distance (ft)
01/10/2010 12:00:00

FIGURE 5-2



BILLY CREEK - PEAK STAGE - 25 YR / 3 DAY EVENT
BillyOutFall
SR-80Down
BC4
BC6
BC7
BC10
BC11
SeaboardDown
RailroadDown
RailroadUp
BC17
BC18
BC19
BC20
ShadyOaksBridgeUp
Ford-Outfall_to_Billy_Creek
BC24
BC26
BC28
Shoemkaer_Canal_DwnStream_Outfall
MarshUp
BC37
BC39
BC40
BC41
BC42
BC43
BC44
BC47
BC48
BC50
BC52
BC54
BC56
OrtizUp
BC60
OrtizCircleUp
BC63
BC67
BC69
BC70
LuckettRoadUP
JupiterRoadUp
MarsStreetDown
Elevation (ft)
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
Distance (ft)
01/03/2010 20:00:00

FIGURE 5-3



ZAPATO CANAL (Outfall to Billy Creek) - WATER ELEVATION PROFILE - STATIC CONDITIONS
Zapato_Canal-Outfall_to_Billy-Creek
V_Shoemaker_Outfall_to_Billy-Creek
VSS2
VSS3
VSS4
VSS5A-ShoemakerZapatoConnectorCulvertUP
Z24
Z26
Z27
Z28
Z29
Z30
Z33FlintDrDown
Z36
Z105
Z106
Z107
Z109EdisonAveUp
Z110
Z112MayflowerDrUp
Z113
Z115
Z121
Z123RockfillRdUpCulvert
Z70
Z72
Z73
Z74
Z75
Z76CanalSt
Elevation (ft)
Distance (ft)
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
01/10/2010 12:00:00

FIGURE 5-4

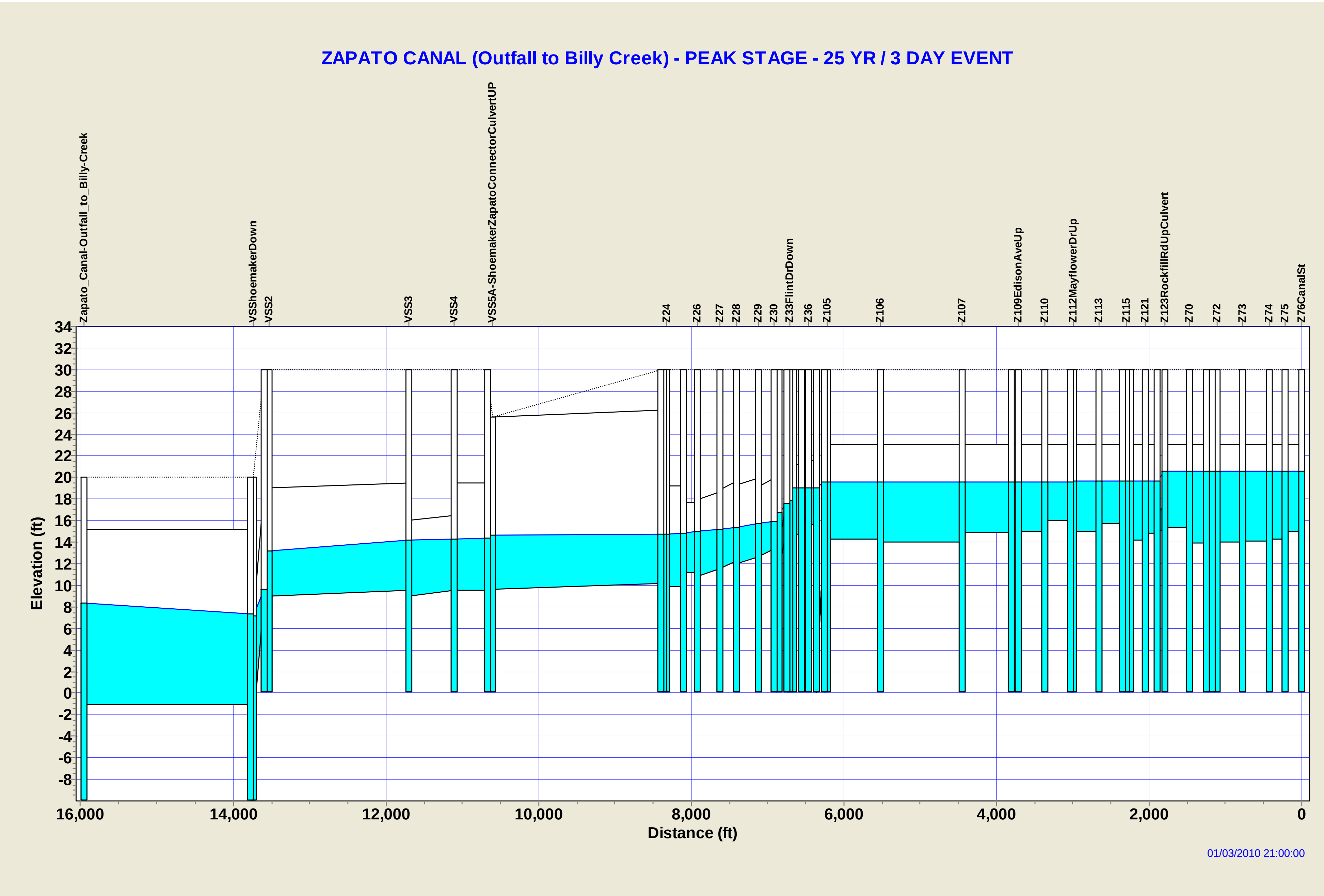

ZAPATO CANAL (Outfall to Billy Creek) - PEAK STAGE - 25 YR / 3 DAY EVENT
Zapato_Canal-Outfall_to_Billy-Creek
VSShoemakerDown
VSS2
VSS3
VSS4
VSS5A-ShoemakerZapatoConnectorCulvertUP
Z24
Z26
Z27
Z28
Z29
Z30
Z33FlintDrDown
Z36
Z105
Z106
Z107
Z109EdisonAveUp
Z110
Z112MayflowerDrUp
Z113
Z115
Z121
Z123RockfillRdUpCulvert
Z70
Z72
Z73
Z74
Z75
Z76CanalSt
Elevation (ft)
Distance (ft)
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
01/03/2010 21:00:00

FIGURE 5-5

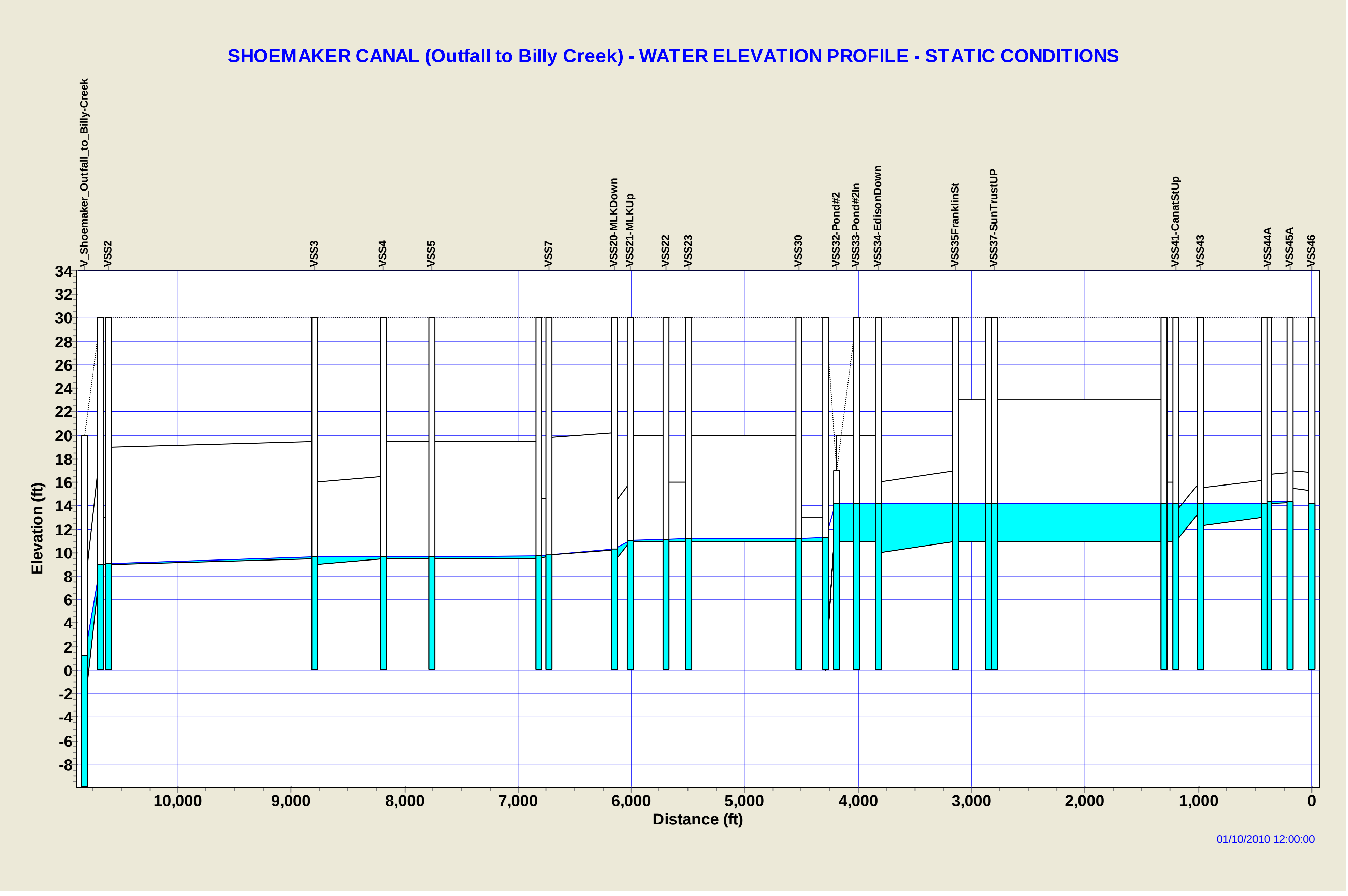
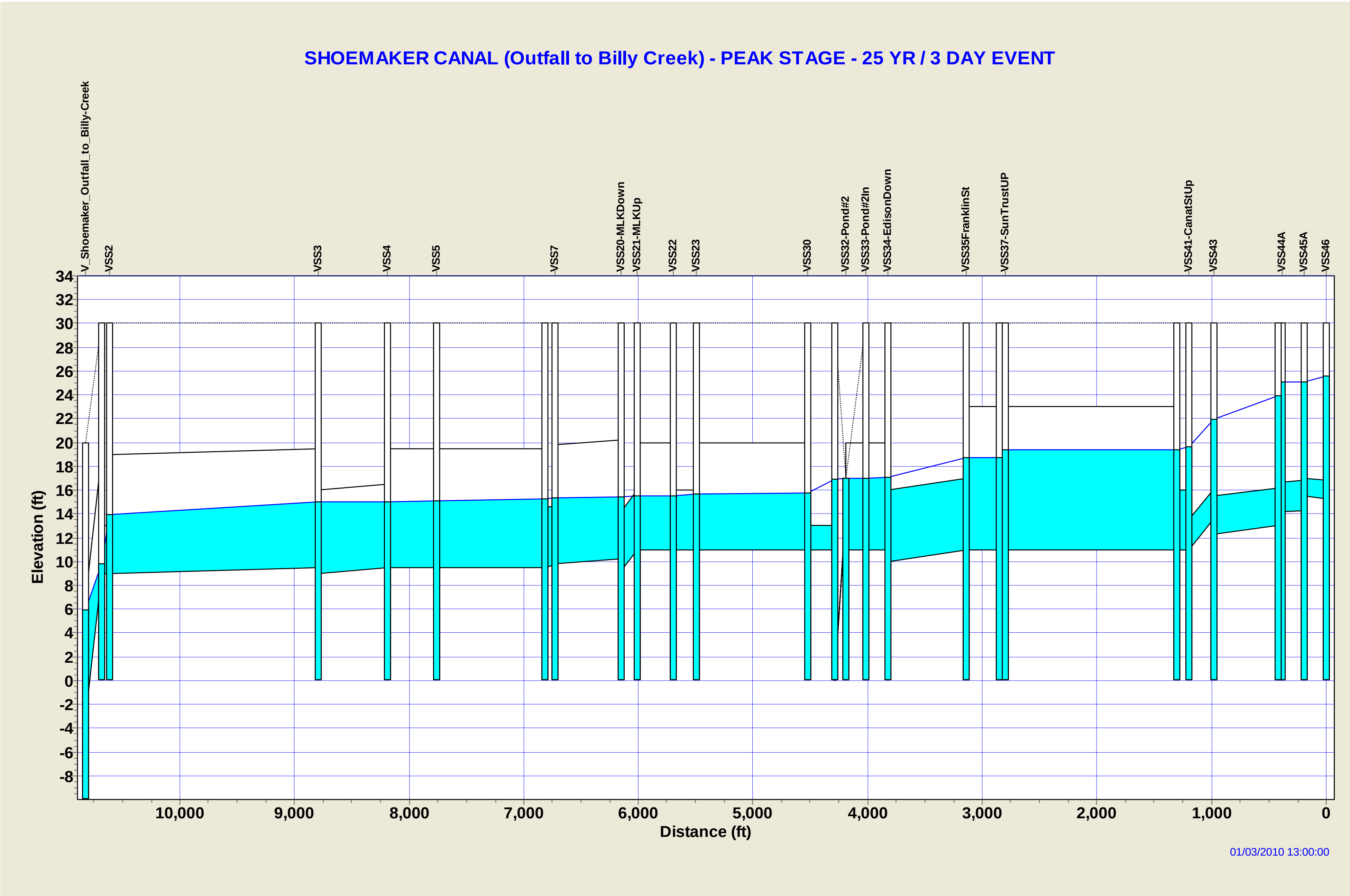

SHOEMAKER CANAL (Outfall to Billy Creek) - WATER ELEVATION PROFILE - STATIC CONDITIONS
V_Shoemaker_Outfall_to_Billy-Creek
VSS2
VSS3
VSS4
VSS5
VSS7
VSS20-MLKDown
VSS21-MLKUp
VSS22
VSS23
VSS30
VSS32-Pond#2
VSS33-Pond#2In
VSS34-EdisonDown
VSS35FranklinSt
VSS37-SunTrustUP
VSS41-CanatStUp
VSS43
VSS44A
VSS45A
VSS46
Elevation (ft)
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Distance (ft)
01/10/2010 12:00:00

FIGURE 5-6



SHOEMAKER CANAL (Outfall to Billy Creek) - PEAK STAGE - 25 YR / 3 DAY EVENT
V_Shoemaker_Outfall_to_Billy-Creek
VSS2
VSS3
VSS4
VSS5
VSS7
VSS20-MLKDown
VSS21-MLKUp
VSS22
VSS23
VSS30
VSS32-Pond#2
VSS33-Pond#2In
VSS34-EdisonDown
VSS35FranklinSt
VSS37-SunTrustUP
VSS41-CanatStUp
VSS43
VSS44A
VSS45A
VSS46
Elevation (ft)
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Distance (ft)
01/03/2010 13:00:00

FIGURE 5-7

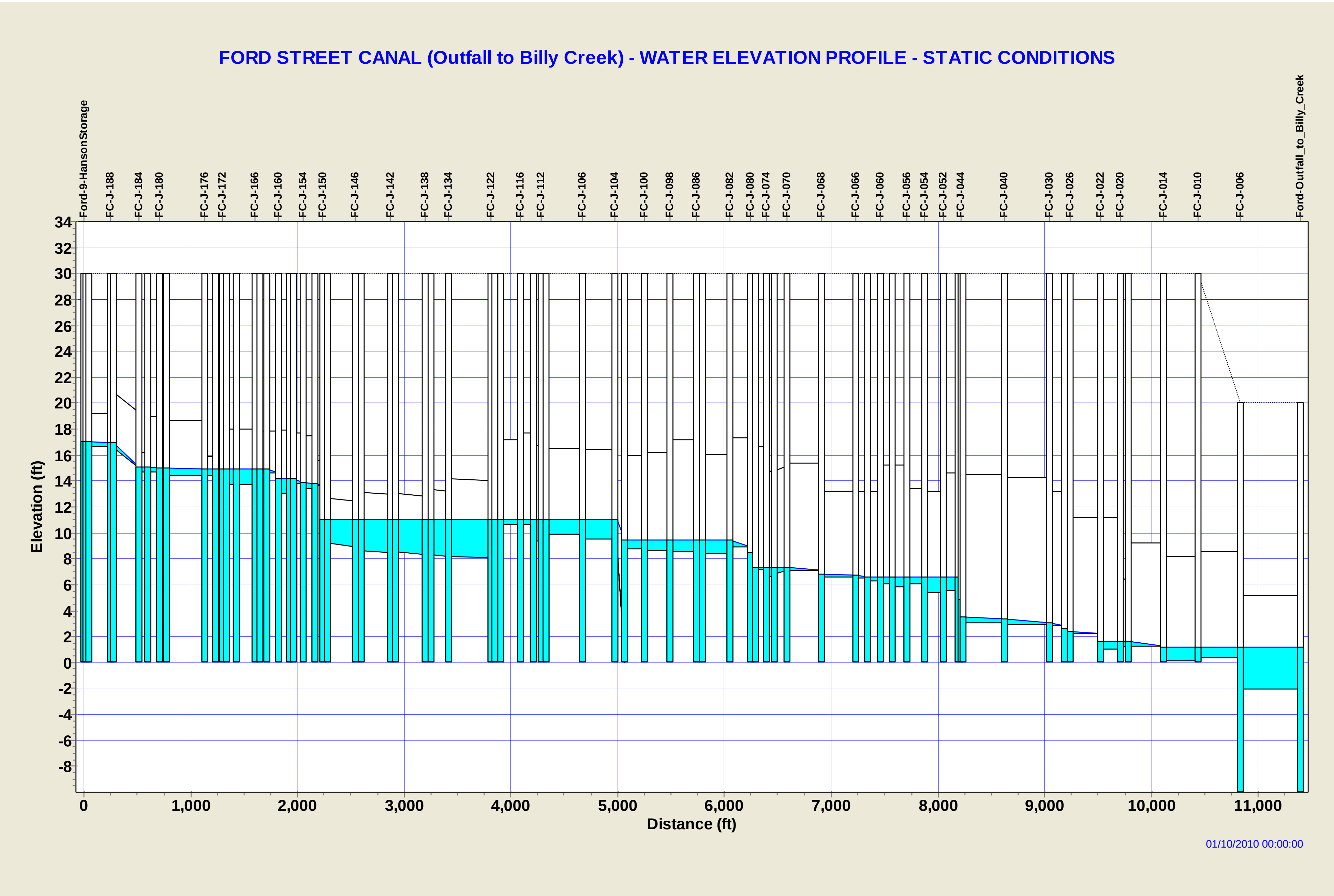
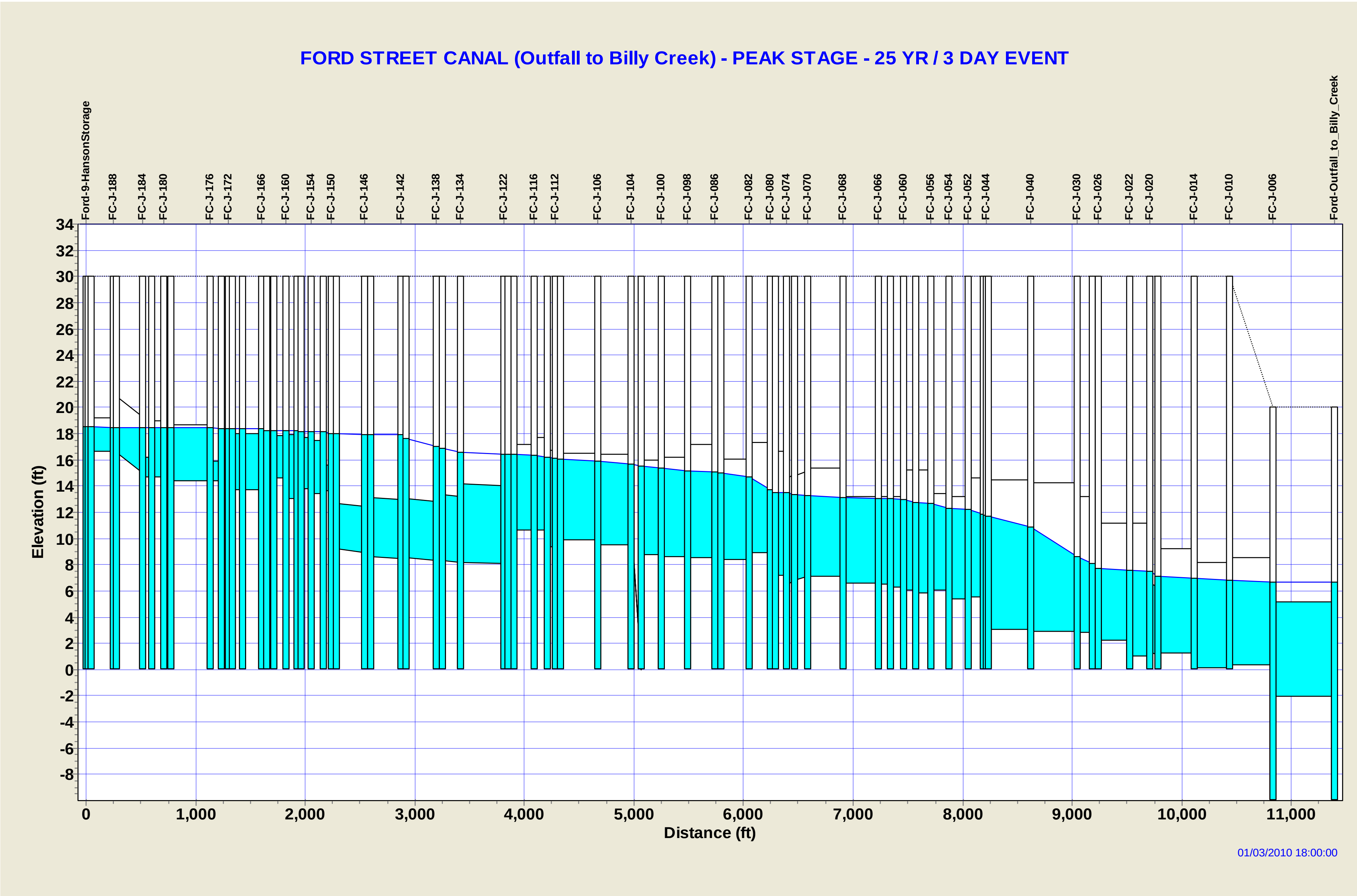
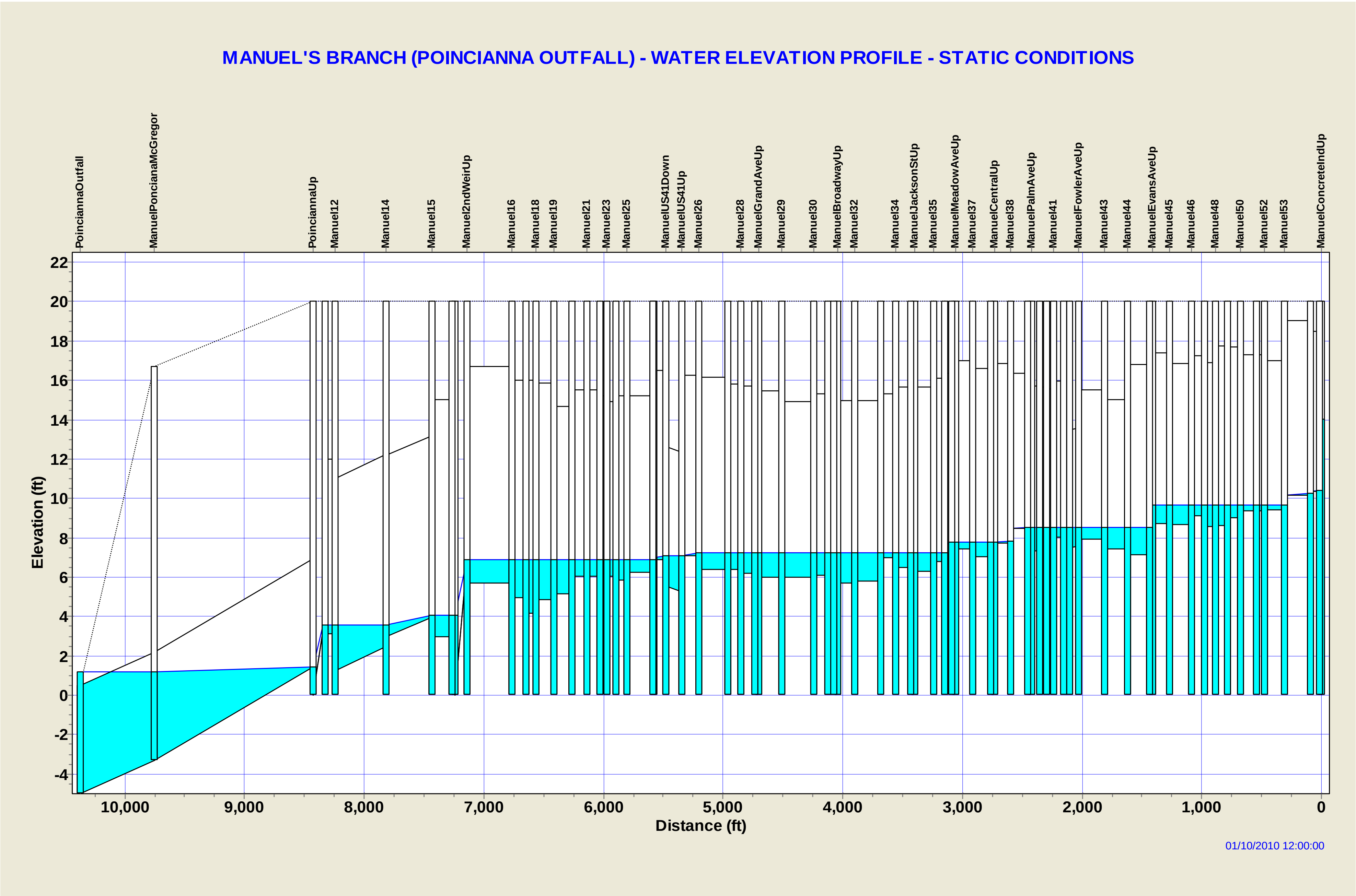

FORD STREET CANAL (Outfall to Billy Creek) - WATER ELEVATION PROFILE - STATIC CONDITIONS
Ford-9-HansonStorage
FC-J-188
FC-J-184
FC-J-180
FC-J-176
FC-J-172
FC-J-166
FC-J-160
FC-J-154
FC-J-150
FC-J-146
FC-J-142
FC-J-138
FC-J-134
FC-J-122
FC-J-116
FC-J-112
FC-J-106
FC-J-104
FC-J-100
FC-J-098
FC-J-086
FC-J-082
FC-J-080
FC-J-074
FC-J-070
FC-J-068
FC-J-066
FC-J-060
FC-J-056
FC-J-054
FC-J-052
FC-J-044
FC-J-040
FC-J-030
FC-J-026
FC-J-022
FC-J-020
FC-J-014
FC-J-010
FC-J-006
Ford-Outfall_to_Billy_Creek
Elevation (ft)
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
0
1,000
2,000
3,000
4,000
5,000
6,000
7,000
8,000
9,000
10,000
11,000
Distance (ft)
01/10/2010 00:00:00

FIGURE 5-8



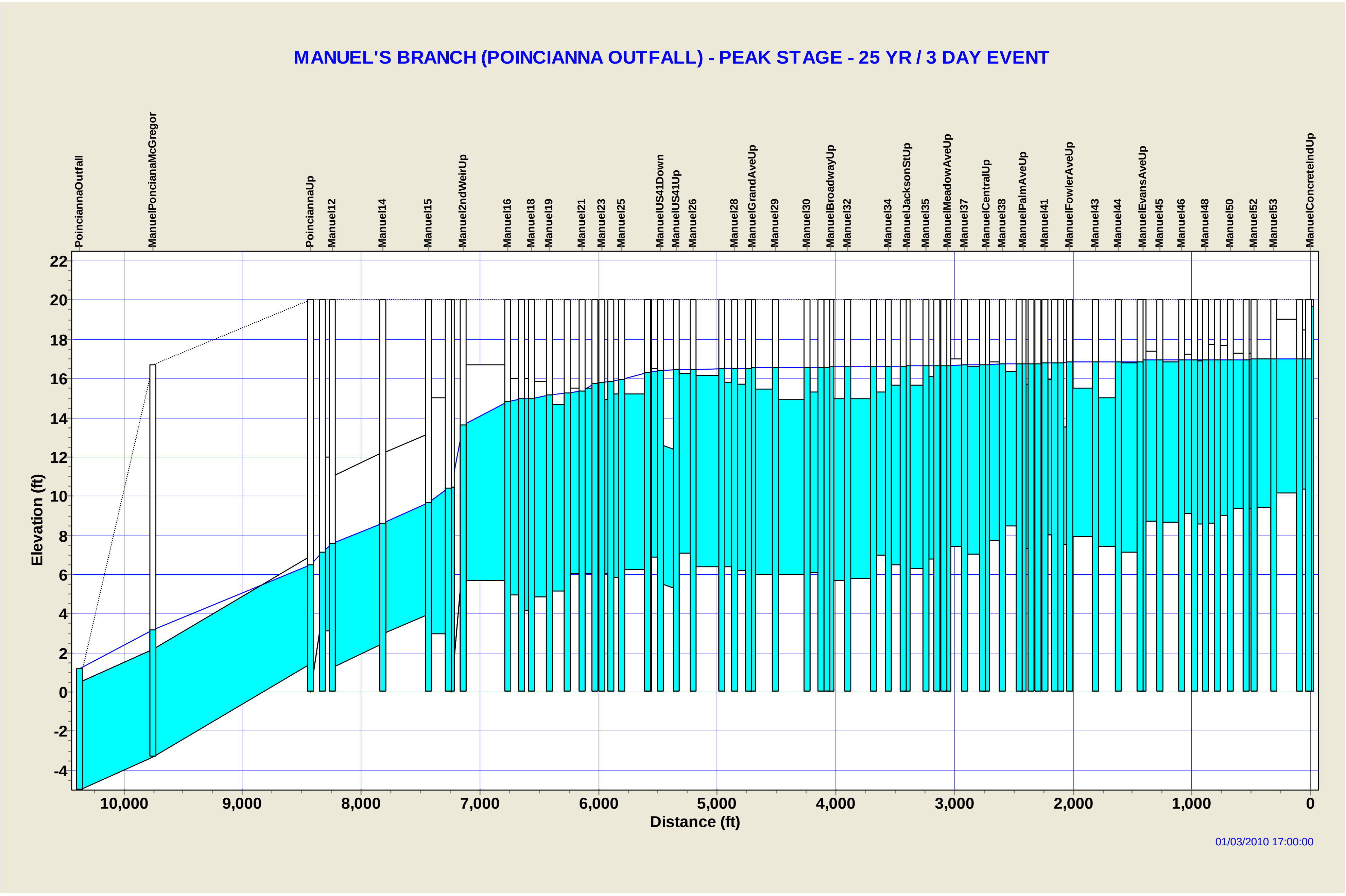
FORD STREET CANAL (Outfall to Billy Creek) - PEAK STAGE - 25 YR / 3 DAY EVENT
Ford-9-HansonStorage
FC-J-188
FC-J-184
FC-J-180
FC-J-176
FC-J-172
FC-J-166
FC-J-160
FC-J-154
FC-J-150
FC-J-146
FC-J-142
FC-J-138
FC-J-134
FC-J-122
FC-J-116
FC-J-112
FC-J-106
FC-J-104
FC-J-100
FC-J-098
FC-J-086
FC-J-082
FC-J-080
FC-J-074
FC-J-070
FC-J-068
FC-J-066
FC-J-060
FC-J-056
FC-J-054
FC-J-052
FC-J-044
FC-J-040
FC-J-030
FC-J-026
FC-J-022
FC-J-020
FC-J-014
FC-J-010
FC-J-006
Ford-Outfall_to_Billy_Creek
Elevation (ft)
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
0
1,000
2,000
3,000
4,000
5,000
6,000
7,000
8,000
9,000
10,000
11,000
Distance (ft)
01/03/2010 18:00:00

FIGURE 5-9



MANUEL'S BRANCH (POINCIANNA OUTFALL) - WATER ELEVATION PROFILE - STATIC CONDITIONS
PoinciannaOutfall
ManuelPoncianaMcGregor
PoinciannaUp
Manuel12
Manuel14
Manuel15
Manuel2ndWeirUp
Manuel16
Manuel18
Manuel19
Manuel21
Manuel23
Manuel25
ManuelUS41Down
ManuelUS41Up
Manuel26
Manuel28
ManuelGrandAveUp
Manuel29
Manuel30
ManuelBroadwayUp
Manuel32
Manuel34
ManuelJacksonStUp
Manuel35
ManuelMeadowAveUp
Manuel37
ManuelCentralUp
Manuel38
ManuelPalmAveUp
Manuel41
ManuelFowlerAveUp
Manuel43
Manuel44
ManuelEvansAveUp
Manuel45
Manuel46
Manuel48
Manuel50
Manuel52
Manuel53
ManuelConcreteIndUp
Elevation (ft)
22
20
18
16
14
12
10
8
6
4
2
0
-2
-4
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Distance (ft)
01/10/2010 12:00:00

FIGURE 5-10



MANUEL'S BRANCH (POINCIANNA OUTFALL) - PEAK STAGE - 25 YR / 3 DAY EVENT
PoinciannaOutfall
ManuelPoncianaMcGregor
PoinciannaUp
Manuel12
Manuel14
Manuel15
Manuel2ndWeirUp
Manuel16
Manuel18
Manuel19
Manuel21
Manuel23
Manuel25
ManuelUS41Down
ManuelUS41Up
Manuel26
Manuel28
ManuelGrandAveUp
Manuel29
Manuel30
ManuelBroadwayUp
Manuel32
Manuel34
ManuelJacksonStUp
Manuel35
ManuelMeadowAveUp
Manuel37
ManuelCentralUp
Manuel38
ManuelPalmAveUp
Manuel41
ManuelFowlerAveUp
Manuel43
Manuel44
ManuelEvansAveUp
Manuel45
Manuel46
Manuel48
Manuel50
Manuel52
Manuel53
ManuelConcreteIndUp
Elevation (ft)
Distance (ft)
01/03/2010 17:00:00

FIGURE 5-11

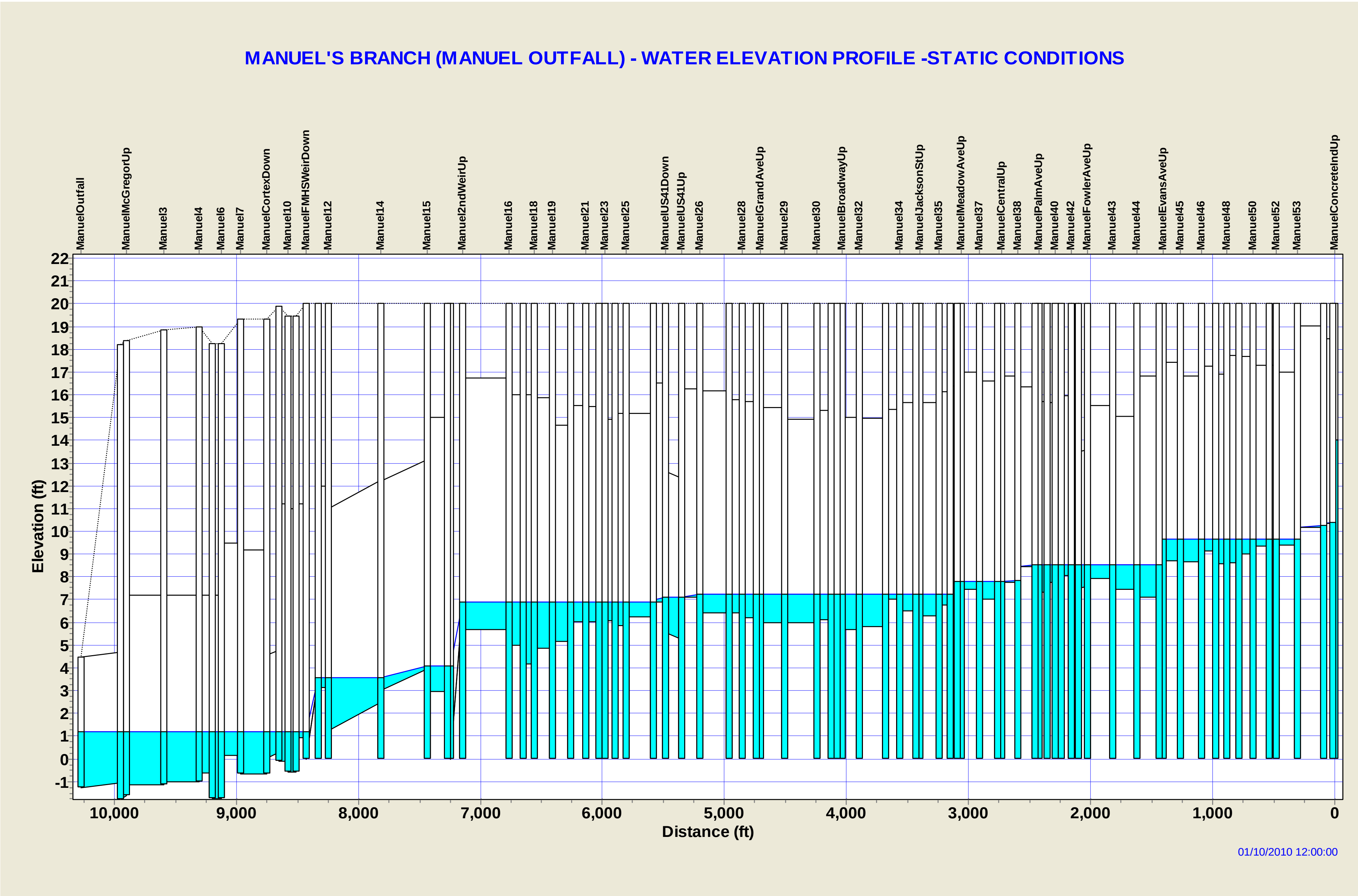
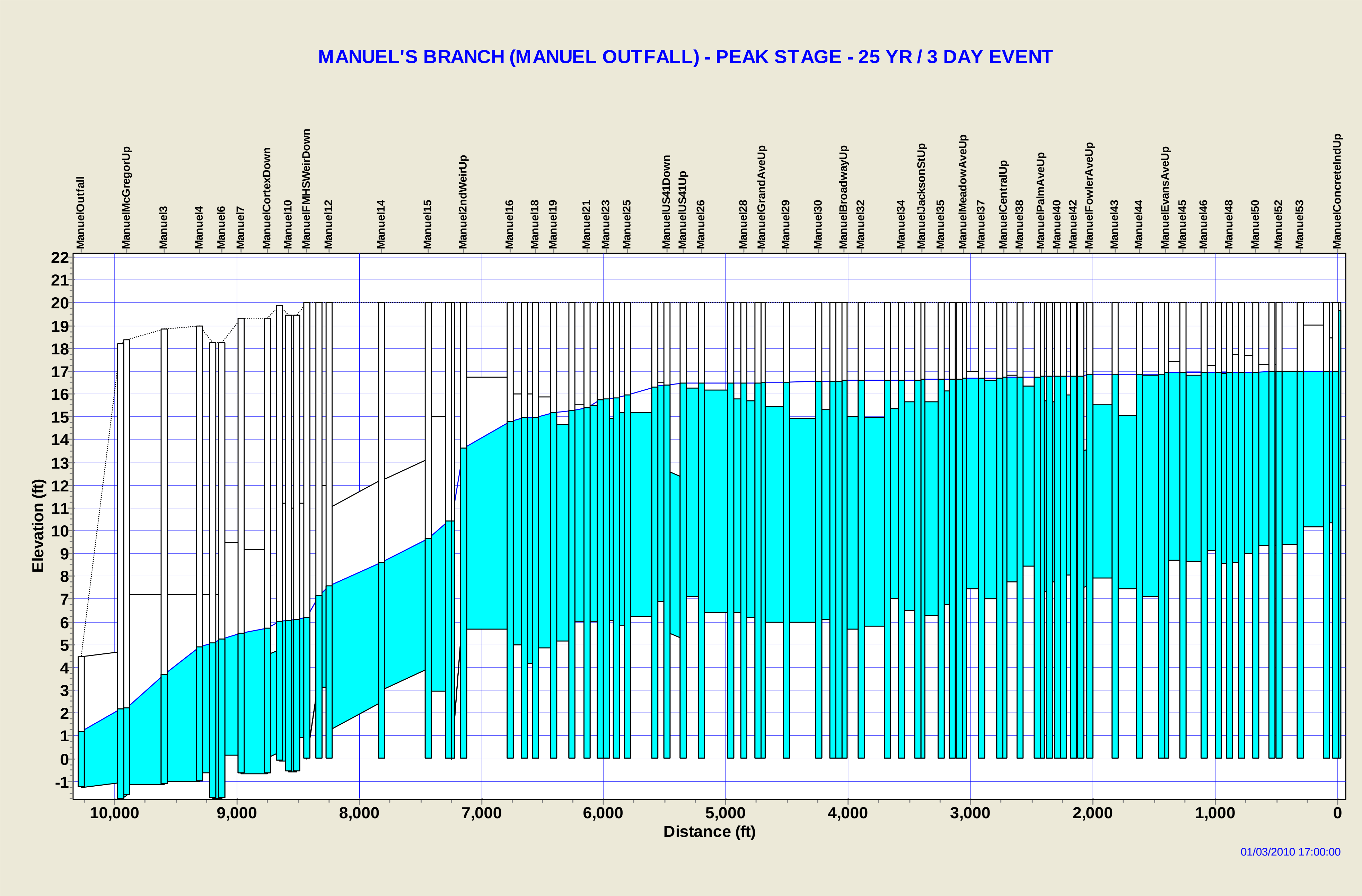
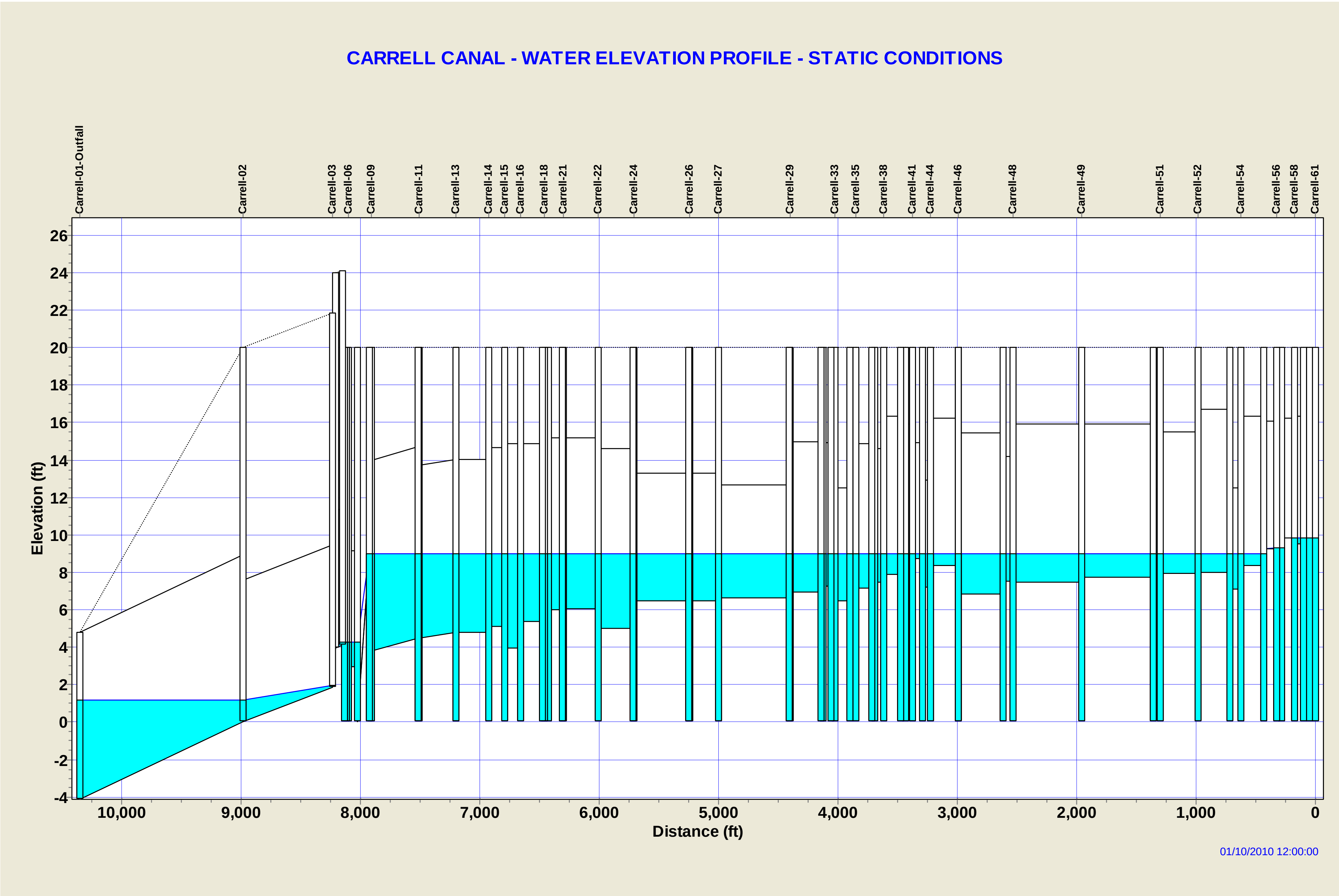

MANUEL'S BRANCH (MANUEL OUTFALL) - WATER ELEVATION PROFILE -STATIC CONDITIONS
ManuelOutfall
ManuelMcGregorUp
Manuel3
Manuel4
Manuel6
Manuel7
ManuelCortexDown
Manuel10
ManuelFMHSWeirDown
Manuel12
Manuel14
Manuel15
Manuel2ndWeirUp
Manuel16
Manuel18
Manuel19
Manuel21
Manuel23
Manuel25
ManuelUS41Down
ManuelUS41Up
Manuel26
Manuel28
ManuelGrandAveUp
Manuel29
Manuel30
ManuelBroadwayUp
Manuel32
Manuel34
ManuelJacksonStUp
Manuel35
ManuelMeadowAveUp
Manuel37
ManuelCentralUp
Manuel38
ManuelPalmAveUp
Manuel40
Manuel42
ManuelFowlerAveUp
Manuel43
Manuel44
ManuelEvansAveUp
Manuel45
Manuel46
Manuel48
Manuel50
Manuel52
Manuel53
ManuelConcreteIndUp
Elevation (ft)
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
-1
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Distance (ft)
01/10/2010 12:00:00

FIGURE 5-12



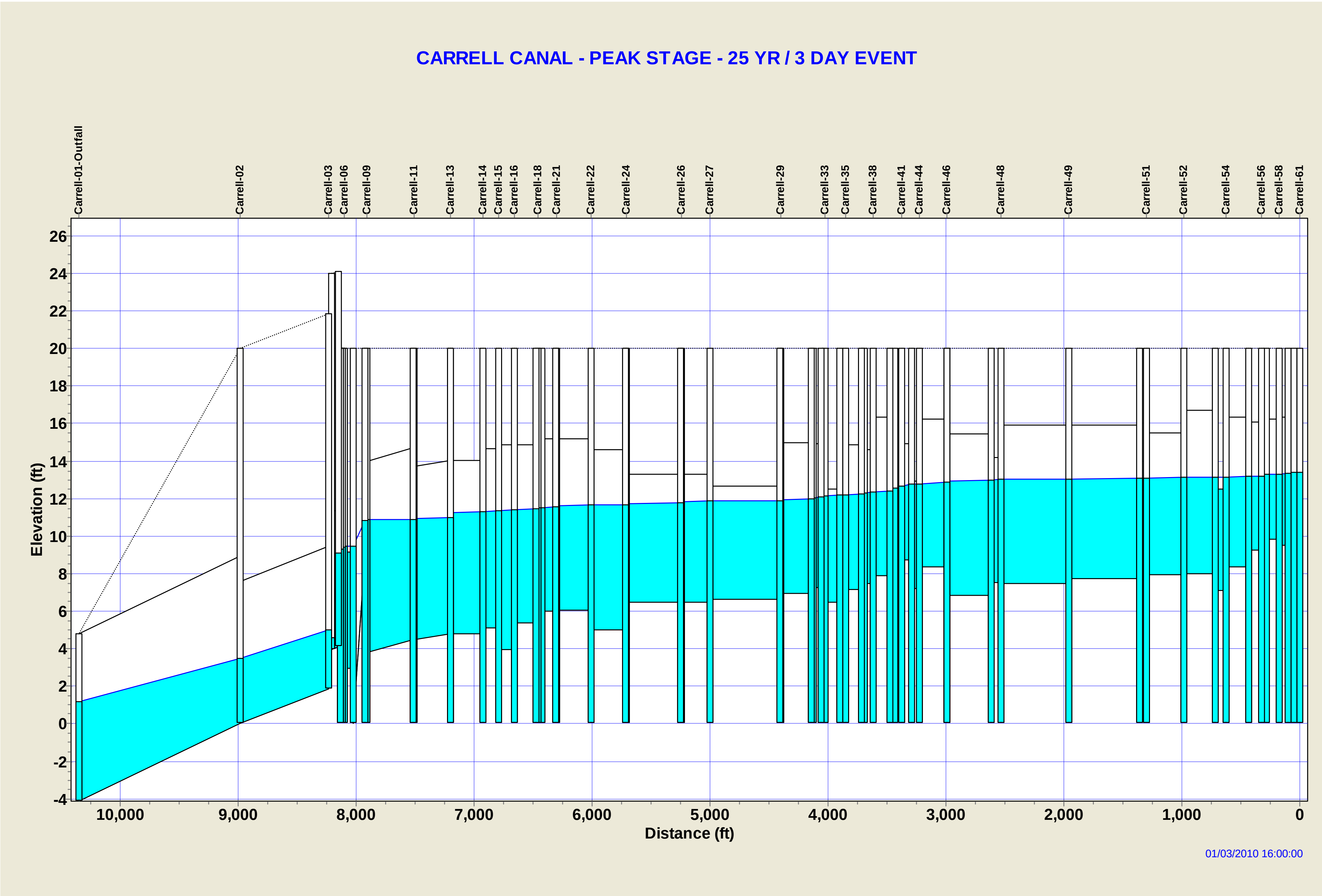
MANUEL'S BRANCH (MANUEL OUTFALL) - PEAK STAGE - 25 YR / 3 DAY EVENT
ManuelOutfall
ManuelMcGregorUp
Manuel3
Manuel4
Manuel6
Manuel7
ManuelCortexDown
Manuel10
ManuelFMHSWeirDown
Manuel12
Manuel14
Manuel15
Manuel2ndWeirUp
Manuel16
Manuel18
Manuel19
Manuel21
Manuel23
Manuel25
ManuelUS41Down
ManuelUS41Up
Manuel26
Manuel28
ManuelGrandAveUp
Manuel29
Manuel30
ManuelBroadwayUp
Manuel32
Manuel34
ManuelJacksonStUp
Manuel35
ManuelMeadowAveUp
Manuel37
ManuelCentralUp
Manuel38
ManuelPalmAveUp
Manuel40
Manuel42
ManuelFowlerAveUp
Manuel43
Manuel44
ManuelEvansAveUp
Manuel45
Manuel46
Manuel48
Manuel50
Manuel52
Manuel53
ManuelConcreteIndUp
Elevation (ft)
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
-1
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Distance (ft)
01/03/2010 17:00:00

FIGURE 5-13



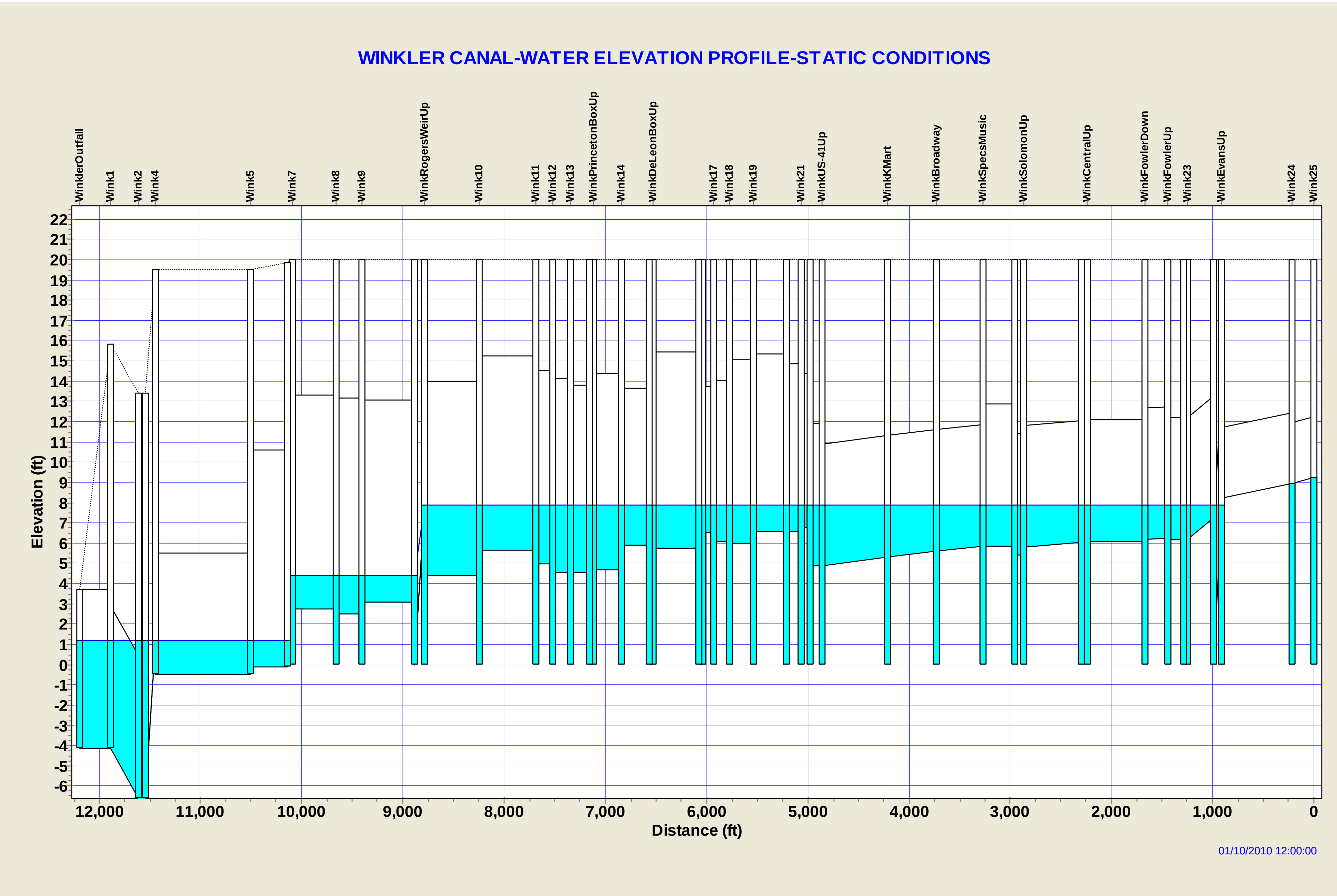
CARRELL CANAL - WATER ELEVATION PROFILE - STATIC CONDITIONS
Carrell-01-Outfall
Carrell-02
Carrell-03
Carrell-06
Carrell-09
Carrell-11
Carrell-13
Carrell-14
Carrell-15
Carrell-16
Carrell-18
Carrell-21
Carrell-22
Carrell-24
Carrell-26
Carrell-27
Carrell-29
Carrell-33
Carrell-35
Carrell-38
Carrell-41
Carrell-44
Carrell-46
Carrell-48
Carrell-49
Carrell-51
Carrell-52
Carrell-54
Carrell-56
Carrell-58
Carrell-61
Elevation (ft)
26
24
22
20
18
16
14
12
10
8
6
4
2
0
-2
-4
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Distance (ft)
01/10/2010 12:00:00

FIGURE 5-14



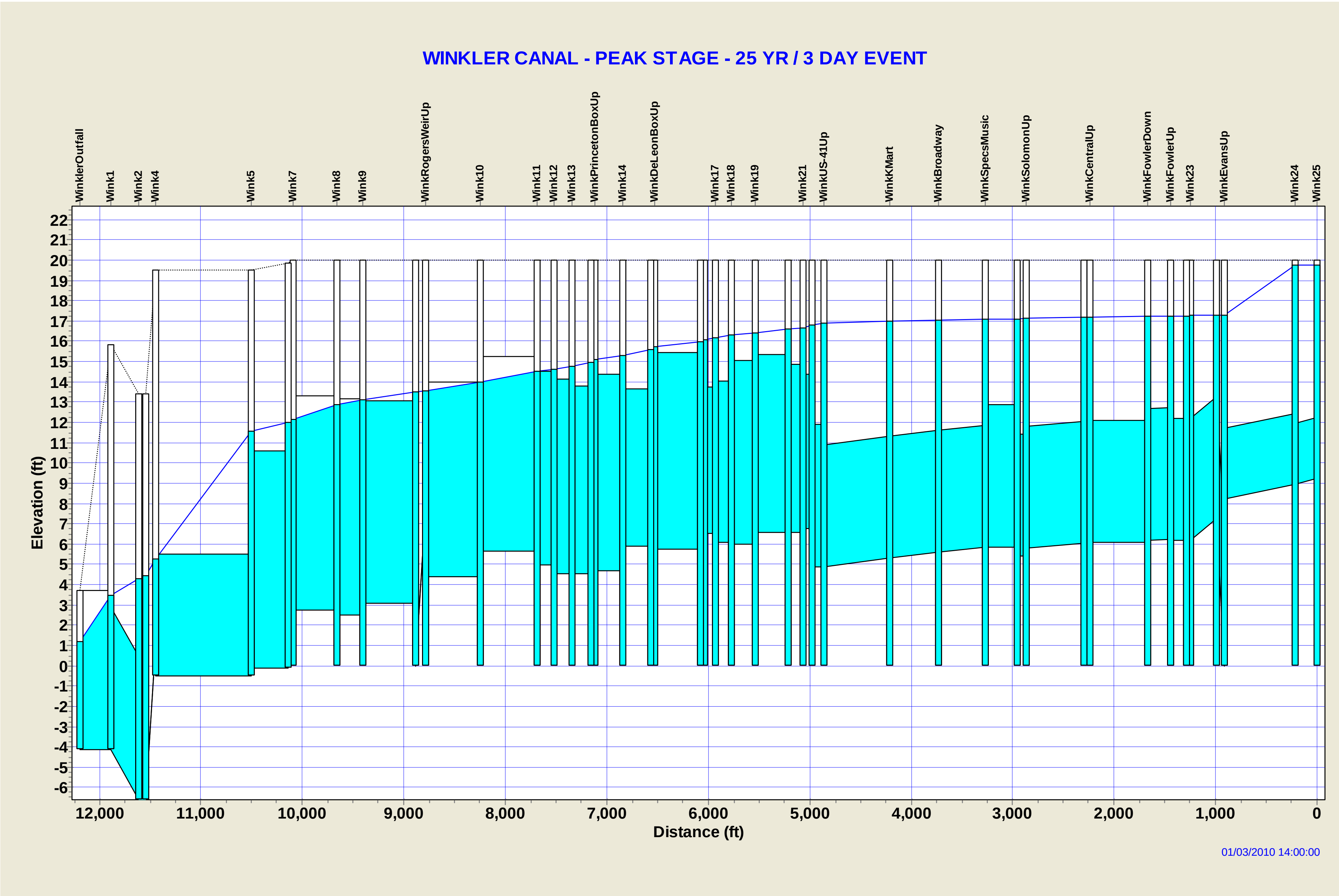
CARRELL CANAL - PEAK STAGE - 25 YR / 3 DAY EVENT
Carrell-01-Outfall
Carrell-02
Carrell-03
Carrell-06
Carrell-09
Carrell-11
Carrell-13
Carrell-14
Carrell-15
Carrell-16
Carrell-18
Carrell-21
Carrell-22
Carrell-24
Carrell-26
Carrell-27
Carrell-29
Carrell-33
Carrell-35
Carrell-38
Carrell-41
Carrell-44
Carrell-46
Carrell-48
Carrell-49
Carrell-51
Carrell-52
Carrell-54
Carrell-56
Carrell-58
Carrell-61
Elevation (ft)
26
24
22
20
18
16
14
12
10
8
6
4
2
0
-2
-4
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Distance (ft)
01/03/2010 16:00:00

FIGURE 5-15



WINKLER CANAL-WATER ELEVATION PROFILE-STATIC CONDITIONS
WinklerOutfall
Wink1
Wink2
Wink4
Wink5
Wink7
Wink8
Wink9
WinkRogersWeirUp
Wink10
Wink11
Wink12
Wink13
WinkPrincetonBoxUp
Wink14
WinkDeLeonBoxUp
Wink17
Wink18
Wink19
Wink21
WinkUS-41Up
WinkKMart
WinkBroadway
WinkSpecsMusic
WinkSolomonUp
WinkCentralUp
WinkFowlerDown
WinkFowlerUp
Wink23
WinkEvansUp
Wink24
Wink25
Elevation (ft)
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
12,000
11,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Distance (ft)
01/10/2010 12:00:00

FIGURE 5-16



WINKLER CANAL - PEAK STAGE - 25 YR / 3 DAY EVENT
WinklerOutfall
Wink1
Wink2
Wink4
Wink5
Wink7
Wink8
Wink9
WinkRogersWeirUp
Wink10
Wink11
Wink12
Wink13
WinkPrincetonBoxUp
Wink14
WinkDeLeonBoxUp
Wink17
Wink18
Wink19
Wink21
WinkUS-41Up
WinkKMart
WinkBroadway
WinkSpecsMusic
WinkSolomonUp
WinkCentralUp
WinkFowlerDown
WinkFowlerUp
Wink23
WinkEvansUp
Wink24
Wink25
Elevation (ft)
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
12,000
11,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Distance (ft)
01/03/2010 14:00:00

6.0 SUPPLEMENTAL FIELD SURVEYS

6.1 FIELD SURVEYS and TOPOGRAPHIC INFORMATION

During ECT's initial review of available data, it was determined that additional field survey information would be required to supplement the existing available information to insure an acceptable level of accuracy for the proposed modeling effort. To that end, ECT teamed with Elizabeth Gaines, PSM of E. F. Gaines Surveying Services, Inc. (EFG). ECT conducted preliminary assessments on all major waterways within each watershed to identify and preliminarily locate existing culverts, bridges and weirs. Further, ECT identified areas of substantial siltation, excessive vegetation and other impediments to flow. EFG conducted the field surveys using state of the art GPS technology and traditional methods to locate vertically and horizontally the appurtenances identified by ECT and others that were subsequently discovered. EFG gathered information on structures and included channel cross sections of the approach and departing channels as well as sections at defined intervals, and any significant change in cross section.

As noted, the field surveys were conducted to supplement the available data and are provided in this report as AutoCad files for select watersheds as listed previously herein. These electronic data files are available to the user on the enclosed compact disk (CD) under Appendix E on an "as is" basis with no warranty expressed or implied and are to be used at one's own risk.

Note that these Specific Purpose surveys were conducted by E. F. Gaines Surveying Services, Inc. (EFG) using the NGVD of 1929 datum to be consistent with previous information, documents and records of the City of Fort Myers.

7.0 STREAM GAGING and SURFACE WATER MONITORING

7.1 CREST STAGE INDICATOR GAGES

Accurate measurements of flow and volume are essential to nearly all aspects of water pollution monitoring, forecasting, and model calibration. The timing and frequency of flow measurements are critical factors in accurately monitoring flows in small urban areas because of the rapid response to rainfall and the wide range of flow values over short periods of time. As a part of this study, rating tables were developed for each of the crest stage indicator gage locations such that the measured water level can be corresponded to a unique flow rate. This information will be helpful in ongoing monitoring and calibration efforts by the City. Rating tables have been provided electronically in Appendix F.

7.2 WATER QUALITY MONITORING STATIONS

As part of its existing NPDES permit, the City of Fort Myers is responsible for the collection of surface water samples at twelve (12) defined stations within the City. The Lee County Environmental Laboratory (LCEL) currently collects flow and grab samples at each of these locations under contract with the City of Fort Myers. The analytical data is provided to the City where it is compiled and provided to the FDEP each year as part of its annual NPDES Report.

The LCEL collects and analyzes grab samples for the following constituents by the pursuant to the requirements of the City's NPDES permit:

Aluminum (Al), Biological Oxygen Demand (BOD), Cadmium (CD), Chloride (CL), Chemical Oxygen Demand (COD), Specific Conductance (COND), Copper (CU), Dissolved Oxygen (DO), Enterococci (ENTERO), Fecal Coliform (FCMF), Ammonia

(NH3), Nitrite (NO2), Nitrate (NO3), Nitrite + Nitrate (NOX), Ortho Phosphorus (O-PO4), Lead (PB), pH, Total Coliform (TCMF), Total Dissolved Solids (TDS), Field Temperature (TEMP), Hardness, Total Kjeldahl Nitrogen (TKN), Total Nitrogen (TN), Inorganic Nitrogen (IN-ORG-N), Organic Nitrogen (ORG-N), Total Phosphorus (T-PO4), Total Suspended Solids (TSS), Turbidity (TURB), Zinc (ZN).

7.3 RECOMMENDATIONS

In addition to the installation of continuous rainfall and stage recorders as outlined in section 5, ECT has identified several issues related to the ongoing sampling program associated with the sampling locations. Below is a listing of water quality sampling monitoring stations that should be relocated to better represent and separate the contributing areas:

Billy Creek - (BILLGR60) upstream of the Billy Creek Filter Marsh Weir
Billy Creek - (CFMBILLY4) upstream of the Marsh Avenue
Billy Creek - (BILLGR20) upstream of the Michigan Avenue (Shoemaker Canal)
Manuel's Branch - (CFMMANUEL) upstream of Cortez Weir
Winkler Canal - (CFMWINKLER) upstream of Rogers Weir
North Colonial - (CFMCOLONIAL) upstream of Seaboard Weir
Downtown - (CFMBROADWAY) modify inlet w/ low level weir at 2.0

7.4 TABLES and FIGURES

Tables including the water quality (laboratory) test result tables and relational graphs are available at the end of this section. Section 7.4 provides a detailed list of the tables and figures attached to this section. The figures 7-25A, 7-25B and 7-25C graphically indicate the locations of water quality monitoring stations, rain and crest stage gages, and the City's major water control structures. Electronic data files for each of the rain gages, field data for the crest stage indicator gages, and the stream flow rating tables are available to the user on the enclosed compact disk (CD) under Appendix F on an "as is" basis with no warranty expressed or implied and are to be used at one's own risk.

Tables

Figures

TABLE 7-1

CREST STAGE INDICATOR GAGE - LOCATIONS / DESCRIPTIONS

Station I.D.	Waterway	Location Coordinates (Northing, Easting) [1]	Description of Location	Corresponding Water Quality Monitoring Station [2]
CG_BIL01	Billy Creek	N847535, E717364 ±	50 feet downstream of Ortiz Avenue Bridge	BILLGR60
CG_BIL02	Billy Creek	N846811, E715531 ±	50 feet upstream of Nuna Avenue Bridge	NONE
CG_ZAP01	Zapato Canal	N843565, E710391 ±	Upstream of weir at Markland Avenue	CFMBILLY3
CG_SHM01	Shoemaker Canal	N841481, E708308 ±	Headwall at Michigan and Veronica Shoemaker	BILLGR20
CG_FRD01	Ford Street Canal	N840080, E705673 ±	East end of Indian Street	CFMBILLY6
CG_MAN01	Manuel's Branch	N833330, E696303 ±	Upstream of weir at Wilbur Moore Bridge	CFMMANUEL
CG_NCL01	N. Colonial Waterway	N828175, E704588 ±	Headwall at Metro Parkway	CFMCOLONIAL
CG_CAR01	Carrell Canal	N827931, E693996 ±	10 feet upstream of weir at golf cart bridge	CFMCARRELL
CG_WNK01	Winkler Canal	N825316, E695768 ±	Headwall at Princeton Street	CFMWINKLER
CG_GAL01	Galloway Canal	N822054, E697418 ±	Upstream of bridge for South Plaza Shopping Center	NONE
CG_CNL01	Canal "L"	N818034, E696714 ±	600 feet upstream of Boy Scout Road	CFML-3

Notes:

1) Location relative to assigned NAD-83 State Plane Coordinates

2) Location of closest Water Quality Monitoring Station. See Table 7-2 for detailed descriptions of Water Quality Monitoring Stations.

TABLE 7-2

WATER QUALITY MONITORING STATIONS

Sample Point I.D.	Waterway	Location Coordinates (Northing, Easting) [1]	Description of Location	Corresponding CSIG Station I.D. [2]
CFMBILLY1	Billy Creek	N842219, E704177 ±	Billy Creek at Seabord Street	N/A
BILLGR20	Billy Creek	N843500, E708285 ±	Billy Creek at Veronica Shoemaker Blvd.	CG_SHM01
CFMBILLY3	Billy Creek	N843370, E710540 ±	Zapato Canal weir at Markland Avenue	CG_ZAP01
CFMBILLY4	Billy Creek	N843841, E709943 ±	Billy Creek at southern end of Arnold Street	N/A
BILLGR60	Billy Creek	N847535, E717364 ±	Billy Creek at Ortiz Avenue Bridge	CG_BIL01
CFMBILLY6	Ford Street Canal	N841935, E705888 ±	Ford Street Canal in Fort Myers Cemetery	CG_FRD01
CFMBROADWAY	Caloosahatchee River	N840471, E698034 ±	Centenial Park Boat Ramp	N/A
CFMMANUEL	Manuel's Branch	N833696, E695357 ±	Manuel's Branch - Upstream of Cortez Blvd.	CG_MAN01
CFMCOLONIAL	North Colonial Waterway	N828138, E703590 ±	North Colonial Waterway at R.R. box culvert	CG_NCL01
CFMCARRELL	Carrell Canal	N827931, E693996 ±	Upstream of weir at Fort Myers Country Club	CG_CAR01
CFMWINKLER	Winkler Canal	N825273, E692914 ±	Winkler Canal box culvert at McGregor Blvd.	CG_WNK01
CFML-3	Canal "L"	N818034, E696714 ±	Upstream of bridge at Boy Scout Road	CG_CNL01

Notes:
1) Location relative to assigned NAD-83 State Plane Coordinates
2) Location of nearest Crest Stage Indicator Gage. See Table 7-1 for detailed descriptions of CSIG locations.

TABLE 7-3

WATER CONTROL STRUCTURES - LOCATIONS / DESCRIPTIONS

Structure I.D.	Waterway	Location Coordinates (Northing, Easting) [1]	Description of Location
EASTWOOD WEIR	N. Colonial Waterway	N828372, E713858 ±	Southwest corner of Eastwood Golf Course
SOUTHSIDE WEIR	N. Colonial Waterway	N828247, E708717 ±	Approx. 150 feet east of Shoemaker Blvd.
SEABOARD WEIR	N. Colonial Waterway	N828166, E703929 ±	Approx. 1,250 feet west of Metro Parkway
CORTEZ WEIR	Manuel's Branch	N833696, E695357 ±	Upstream of Cortez Blvd.
WILBUR MOORE WEIR	Manuel's Branch	N833360, E696041 ±	Wilbur Moore Bridge at Fort Myers High School
FMCC WEIR	Carrell Canal	N827931, E693996 ±	East of McGregor Blvd., near clubhouse
ROGERS WEIR	Winkler Canal	N825353, E694194 ±	South of Winkler, approx. 1,250 feet east of McGregor
FORD STREET WEIR	Ford Street Canal	N837421, E706138 ±	Approx. 200 feet south of Thomas Ave., west of school
SHOEMAKER WEIR	Shoemaker Canal	N837490, E708362 ±	Approx. 1,250 feet south of Martin Luther King, Jr. Blvd.
ZAPATO WEIR	Zapato Canal	N843370, E710540 ±	Upstream of Markland Avenue
GALLOWAY WEIR	Galloway Canal	N822102, E698314 ±	South of Colonial Blvd., approx. 250 feet east of US 41
METRO MALL WEIR	Ten Mile Canal	N824288, E703693 ±	Approx. 1,500 feet north of Colonial Blvd.
CARRELL GATES	Carrell Canal	N828061, E703300 ±	Junction of Carrell Canal and Ten Mile Canal

Notes:
1) Location relative to assigned NAD-83 State Plane Coordinates

TABLE 7-4

WATER QUALITY MONITORING STATION
BILLY CREEK AT SEABORD STREET (CFMBILLY1)

	AL-ICP	BOD	CD	CL	COD	COND Field	CU	DO FIELD	ENTERO 10	FCMF 10	NH3	NO2	NO3	NOX	O-PO4	PB	pH Field	TCMF05	TDS	TEMP Field	Total HARD	TKN	TN	In-Org-N	Org-N	T-PO4	TSS	TURB	ZN
	mg/L	mg/L	ug/L	mg/L	mg/L	UMHOS/CM	ug/L	mg/L	col/ 100ML	col/ 100ML	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	UNITS	col/100ML	mg/L	°C	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	NTU	mg/L
Class III Std.			≤ 1.3	<1500		<1275	≤ 12	> 5	mean<33	mean<200 :max<800	≤ 0.02					< 4.4	6.0>8.5				Need for metals								
LCEL MDL	100	0.3	var.	1	10	1	1	0.1	10	10	0.01	0.002	0.01	0.01	0.008	1	0.1	20	5.5	0.1		0.1	0.11			0.02	0.6	0.2	0.01
Date																													
04/27/05		2.8	0.4	59		474	1.0	5.4	10	10	0.050	0.017	0.10	0.12	0.126	1.0	7.79	5		22		0.650	0.77	0.17	0.60	0.18	9.20	7.40	0.004
05/18/05		2.5	0.4	114		852	1.0	1.9	30	860	0.049	0.009	0.06	0.07	0.119	1.0	7.61	2220		26.7		0.920	0.99	0.12	0.87	0.35	4.00	1.54	0.004
06/08/05		2.2	0.4	59		535	1.5	3.0	2090	10	0.181	0.002	0.01	0.01	0.214	1.0	7.42	5		26.6		0.570	0.58	0.19	0.39	0.28	3.50	3.10	0.010
07/14/05		1.1	0.4	69.6		620	1.0	2.2	350	350	0.129	0.070	0.18	0.25	0.163	1.0	7.23	280		28.9		1.040	1.30	0.38	0.91	0.18	2.80	2.50	0.010
08/09/05		1.7	0.4	24		335	1.0	6.1	10	10	0.074	0.009	0.03	0.04	0.132	1.0	8.00	5		26.2		0.790	0.83	0.11	0.72	0.18	13.00	3.20	0.010
09/14/05		2.5	0.4	50		499	1.0	5.7	300	30	0.022	0.014	0.06	0.07	0.088	1.0	7.75	1000		29.6		1.220	1.30	0.09	1.20	0.12	7.70	25.00	0.010
10/26/05		1.5	0.4	48		442	1.0	5.3	1370	10	0.168	0.016	0.12	0.14	0.131	1.0	7.36	20		20.4		0.930	1.10	0.31	0.76	0.15	4.50	3.90	0.010
11/09/05		2.0	0.4	80		718	1.0	2.8	430	260	0.098	0.035	0.24	0.28	0.134	1.0	7.34	5		24.4		0.890	1.20	0.38	0.79	0.18	4.80	2.30	0.010
12/01/05		1.2	0.4	88		724	1.0	4.8	590	370	0.172	0.031	0.27	0.30	0.135	1.0	7.23	760		20.3		0.960	1.30	0.47	0.79	0.19	5.70	2.90	0.010
01/17/06		1.5	0.4	786		3140	1.0	6.0	1040	530	0.034	0.007	0.21	0.22	0.086	1.0	7.38	5		17		0.810	1.00	0.25	0.78	0.15	4.50	2.60	0.010
02/06/06		1.6	0.4	125		678	1.0	5.6	820	640	0.134	0.018	0.16	0.18	0.173	1.0	7.28	80		16.8		0.720	0.90	0.31	0.59	0.23	4.00	4.00	0.010
03/06/06		2.2	0.4	341		1610	1.0	5.2	170	580	0.050	0.011	0.04	0.05	0.191	1.0	7.73	600		21		1.190	1.20	0.10	1.14	0.29	13.00	3.80	0.010
04/11/06	n/a	5.9	0.4	691	n/a	3230	1.0	5.3	150	400	0.013	0.004	0.00	0.01	0.317	1.0	7.36	440	n/a	23.2		2.370	2.38	0.02	2.36	0.46	5.50	8.10	0.010
05/08/06	n/a	5.6	0.4	2100	n/a	13500	1.0	4.4	90	40	0.026	0.002	0.01	0.01	0.193	1.0	7.36	560	n/a	27.6		1.090	1.10	0.04	1.06	0.29	11.80	1.80	0.010
06/27/06	n/a	2.1	0.4	94	n/a	873	1.0	2.7	270	930	0.128	0.020	0.07	0.09	0.206	1.0	7.31	1400	n/a	28.3		0.810	0.90	0.22	0.68	0.25	2.00	1.56	0.010
07/28/06	n/a	0.7	0.3	42.0	n/a	733	1.0	2.6	270	160	0.122	0.026	0.19	0.22	0.265	1.0	7.34	20	n/a	28.8		0.730	0.95	0.34	0.61	0.29	5.25	1.80	0.010
08/29/06	n/a	2.2	0.3	44	n/a	728	1.0	3.2	200	240	0.085	0.011	0.21	0.22	0.195	1.0	7.77	800	n/a	29.6		0.710	0.93	0.31	0.63	0.21	2.75	1.39	0.010
09/18/06	n/a	1.3	0.3	40	n/a	470	1.0	2.9	1520	1740	0.072	0.021	0.16	0.18	0.153	1.0	7.27	28	n/a	0.69		0.870	0.18	0.25	0.80	8.75	1.90	0.01	0.005
10/26/06	n/a	0.6	0.3	1410	n/a	7170	1.0	4.3	120	220	0.139	0.009	0.10	0.11	0.160	1.0	7.57	(TNTC)	n/a	21.6		0.790	0.90	0.25	0.65	0.21	2.00	1.08	0.005
11/08/06	n/a	1.1	0.3	2950	n/a	14600	1.0	4.1	960	540	0.069	0.006	0.06	0.07	0.149	1.0	7.32	(TNTC)	n/a	23.2		0.510	0.58	0.14	0.44	0.19	7.00	2.07	0.005
12/06/06	n/a	1.2	0.3	2400	n/a	9680	1.0	3.0	240	220	0.180	0.010	0.10	0.11	0.255	1.0	7.42	(TNTC)	n/a	20.7		0.970	1.08	0.29	0.79	0.30	2.25	1.59	0.005
01/25/07	100.000	1.3	0.3	4810	44	18200	1.0	2.1	420	900	0.124	0.002	0.10	0.10	0.212	1.0	7.79	1	9560	21.8		0.780	0.88	0.22	0.66	0.26	5.25	1.77	0.005
02/08/07	100.000	1.1	0.3	4070	76	13900	1.0	6.1	310	400	0.127	0.005	0.10	0.11	0.202	1.0	7.63	3800	8500	17.7		0.830	0.94	0.24	0.70	0.24	11.80	1.07	0.005
03/20/07	100	1.3	0.3	7230	150	21700	10.0	3.0	100	130	0.148	0.020	0.02	0.04	0.210	1.0	7.38	1000	13500	20.5		0.810	0.85	0.19	0.66	0.25	3.00	1.52	0.005
04/24/07	130	1.7	0.3	9760	110	36300	1.0	4.0	120	160	0.088	0.002	0.01	0.01	0.208	1.0	7.71	600	17300	25.1	n/a	0.77	0.78	0.10	0.68	0.28	9.00	1.92	0.005
05/29/07	350	3.0	0.3	12800	260	37200	1.0	3.8	80	90	0.058	0.002	0.01	0.01	0.152	1.0	7.37	5600	24000	26.3	n/a	0.99	1.00	0.07	0.93	0.27	12.80	2.53	0.005
06/19/07	120	4.2	0.3	6680	86	28500	1.0	4.3	360	1500	0.025	0.006	0.01	0.02	0.257	1.0	7.40	1	12000	29.4	n/a	1.30	1.32	0.05	1.28	0.49	7.25	3.42	0.005
07/17/07	100	2.7	0.3	2360.0	288	6900	1.0	1.5	250	160	0.123	0.010	0.01	0.01	0.258	1.3	7.57	6000	3630	29.5	n/a	1.00	1.00	0.13	0.88	0.33	3.75	5.25	0.005

Note 1: Metal standards are based on a total hardness of 130 mg/L as measured in historical data.
Note 2: BMDL = *Below Method Detection Limit*.
Note 3: For detailed site locations, refer to Table 7-2
Sources: Lee County Laboratory, 2005 - 2007.
Florida Department of Environmental Protection, 2006.
ECT, 2006 and 2007.

TABLE 7-5

WATER QUALITY MONITORING STATION
SHOEMAKER CANAL AT MICHIGAN AVE. (BILLGR20)

	$CHL-A	$PHE-A	CD	CL	COND Field	CU	DO FIELD	ENTERO 10	FCMF 10	NH3	NO2	NO3	NOX	O-PO4	PB	pH Field	T-PO4	TEMP Field	TKN	TN	In-Org-N	Org-N	TSS	TURB	ZN	Disch.
	mg/M3	mg/M3	ug/L	mg/L	UMHOS/CM	ug/L	mg/L	col/ 100ML	col/ 100ML	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	UNITS	mg/L	°C	mg/L	mg/L	mg/L	mg/L	mg/L	NTU	mg/L	cfs
Class III Std.	mean<20		≤ 1.3	<1500	<1275	≤ 12	> 5	mean<33	mean<200 :max<800	≤ 0.02					< 4.4	6.0>8.5										
LCEL MDL	0.5	0.5	var.	1	1	1.00	0.1	10	10	0.01	0.002	0.01	0.01	0.008	1	0.1	0.02	0.1	0.10	0.11			0.6	0.2	0.01	
Date																										
04/19/05	23.7	1.8	BMDL	219	922	BMDL	3.5	660	970	0.038	0.008	0.02	0.03	0.143	BMDL	7.24	0.25	21.8	0.97	1.00	0.07	0.93	8.00	7.00	BMDL	
05/25/05	9.9	1.6	BMDL	102	840	BMDL	1.8	360	120	0.051	0.005	BMDL	BMDL	0.248	BMDL	7.37	0.31	27.6	0.53	0.54	0.05	0.48	2.80	n.d.	BMDL	
06/29/05	3.3	BMDL	BMDL	74	604	BMDL	3.4	680	340	0.166	0.076	0.11	0.19	0.209	BMDL	7.36	0.26	27.2	1.30	1.50	0.36	1.13	2.30	2.10	BMDL	
07/22/05	3.9	1.6	BMDL	76	695	BMDL	2.0	900	970	0.178	0.057	0.25	0.31	0.211	BMDL	7.10	0.27	29.5	1.04	1.40	0.49	0.86	3.30	2.70	BMDL	
08/22/05	4.2	2.0	BMDL	49	752	BMDL	3.0	560	560	0.122	0.076	0.19	0.27	0.178	BMDL	7.80	0.26	30	1.08	1.40	0.39	0.96	3.20	3.20	BMDL	
09/08/05	4.5	2.9	BMDL	85	713	BMDL	3.2	710	530	0.083	0.012	0.20	0.21	0.185	BMDL	7.46	0.20	28.4	1.08	1.30	0.29	1.00	5.50	3.60	BMDL	
10/13/05	2.2	1.3	BMDL	63	6	BMDL	6.0	30	230	0.087	0.031	0.27	0.30	0.039	BMDL	7.40	0.09	27.6	1.13	1.40	0.39	1.04	3.30	4.00	BMDL	
11/17/05	1.0	5.4	BMDL	82	788	BMDL	4.2	640	190	0.121	0.125	0.34	0.36	0.208	BMDL	7.48	0.21	24.7	1.13	1.50	0.48	1.01	8.80	5.70	BMDL	
12/13/05	2.0	3.5	BMDL	117	825	BMDL	5.9	890	720	0.092	0.009	0.37	0.38	0.156	BMDL	7.18	0.18	16.7	1.00	1.40	0.47	0.91	4.20	3.20	BMDL	
02/27/06	11.4	10.9	BMDL	103	843	BMDL	4.5	1280	420	0.182	0.008	0.04	0.05	0.281	BMDL	7.62	0.43	17.6	1.07	1.10	0.23	0.89	26.80	6.80	BMDL	
03/23/06	4.8	6.6	BMDL	57	594	BMDL	7.5	240	120	0.025	0.003	0.01	0.01	0.084	BMDL	7.78	0.15	23.1	0.68	0.69	0.04	0.66	6.50	2.90	BMDL	
04/25/06	3.6	1.1	BMDL	246	2090	BMDL	2.3	370	160	0.032	0.007	0.01	0.02	0.563	BMDL	7.15	0.72	26.3	1.53	1.55	0.05	1.50	11.80	4.80	BMDL	
05/16/06	3.4	4.3	BMDL	1320	5670	BMDL	2.0	410	530	0.024	0.011	0.02	0.03	0.552	BMDL	6.79	0.67	26.3	1.32	1.35	0.05	1.30	8.00	3.40	BMDL	
06/12/06	2.6	1.6	BMDL	1030	3650	BMDL	1.1	700		0.147	0.006	0.01	0.02	0.520	BMDL	7.27	0.66	26.9	1.03	1.05	0.17	0.88	1.20	1.60	BMDL	
07/31/06	1.2	1.8	BMDL	43	700	BMDL	4.2	300	170	0.061	0.015	0.12	0.13	0.213	BMDL	7.38	0.24	29.2	0.69	0.82	0.19	0.63		1.61	BMDL	
08/23/06	1.1	1.8	BMDL	30	588	BMDL	3.6	930	1100	0.112	0.021	0.21	0.23	0.198	BMDL	7.55	0.25	27.2	0.87	1.10	0.34	0.76	1.75	2.10	BMDL	
09/21/06	3.2	2.5	BMDL	33	611	BMDL	3.5	430	330	0.081	0.029	0.18	0.21	0.234	BMDL	7.58	0.46	26.3	1.10	1.31	0.29	1.02	5.75	1.90	BMDL	8.4
10/26/06	2.0	4.8	BMDL	51	853	BMDL	4.2	180	150	0.077	0.008	0.12	0.13	0.038	BMDL	7.58	0.19	20.4	0.73	0.86	0.21	0.65	3.25	1.84	BMDL	3.6
11/28/06	2.5	0.7	BMDL	1200	5000	BMDL	4.3	310	290	0.107	0.004	0.12	0.12	0.122	BMDL	7.08	0.24	20.8	1.10	1.22	0.23	0.99	18.00	1.75	BMDL	
12/15/06	3.3	3.8	BMDL	129	1280	BMDL	3.2	500	740	0.084	0.006	0.08	0.09	0.179	BMDL	7.33	0.27	22.3	1.00	1.09	0.17	0.92	5.75	2.50	BMDL	
01/24/07	1.1	1.6	BMDL	2340	7600	BMDL	2.3	550	210	0.094	BMDL	0.08	0.08	0.233	BMDL	7.54	0.29	21.8	0.72	0.80	0.17	0.63	2.00	1.60	BMDL	
02/27/07	20.8	BMDL	BMDL	1750	4010	BMDL	4.6	870	720	0.021	BMDL	BMDL	BMDL	0.188	BMDL	7.71	0.37	22.5	1.30	1.31	0.02	1.28	5.50	4.35	BMDL	
03/27/07	2.9	BMDL	BMDL	3680	11200	BMDL	2.3	800	700	0.107	0.006	0.03	0.04	0.378	BMDL	7.59	0.43	21.7	1.00	1.04	0.15	0.89	3.75	2.20	BMDL	
04/13/07	9.3	2.2	BMDL	5050	15500	BMDL	1.1	410	10	0.262	0.004	0.02	0.02	0.516	BMDL	7.21	0.61	24.5	1.30	1.32	0.28	1.04	1.75	n.d.	BMDL	
05/24/07	57.6	12.5	BMDL	5800	21400	1.18	10.4	780	110	0.040	0.016	BMDL	0.02	0.404	BMDL	7.20	0.61	25.50	1.3	1.32	0.06	1.26	6.75	n.d.	BMDL	0.320
06/21/07	45.0	8.3	BMDL	5200	16400	BMDL	2.2	640	250	BMDL	BMDL	0.01	0.01	0.319	BMDL	7.31	0.50	29.7	1.30	1.31	0.01	0.01	9.50	3.41	BMDL	Est. 1.0
07/18/07	3.9	1.5	BMDL	88	650	BMDL	3.0	610	220	0.095	0.010	0.03	0.04	0.200	3.1	7.17	0.26	28.8	0.62	0.66	0.14	0.53	1.00	1.52	BMDL	
08/22/07	1.8	0.9	BMDL	71	679	BMDL	3.5	760	840	0.071	0.003	0.11	0.11	0.098	BMDL	7.40	0.14	28.4	0.80	0.91	0.18	0.73	0.85	1.18	BMDL	

Note 1: Metal standards are based on a total hardness of 130 mg/L as measured in historical data.
Note 2: BMDL = *Below Method Detection Limit*.
Note 3: For detailed site locations, refer to Table 7-2
Sources: Lee County Laboratory, 2005 - 2007.
Florida Department of Environmental Protection, 2006.
ECT, 2006 and 2007.

TABLE 7-6

WATER QUALITY MONITORING STATION
ZAPATO CANAL WEIR AT MEADOWVIEW CIRCLE (CFMBILLY3)

	AL-ICP	BOD	CD	CL	COD	COND Field	CU	DO FIELD	ENTERO 10	FCMF 10	NH3	NO2	NO3	NOX	O-PO4	PB	pH Field	TCMF05	TDS	TEMP Field	TKN	TN	In-Org-N	Org-N	T-PO4	TSS	TURB	ZN	Disch.
	mg/L	mg/L	ug/L	mg/L	mg/L	UMHOS /CM	ug/L	mg/L	col/ 100ML	col/ 100ML	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	UNITS	col/100ML	mg/L	°C	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	NTU	mg/L	cfs
Class III Std.			≤ 1.3	<1500		<1275	≤ 2.9	> 5	mean<33	mean<200 :max<800	≤ 0.02					< 4.4	6.0>8.5			< 32.2							≤ 29 NTU's	< 0.15	
LCEL MDL	100	0.3	var.	1	10	1	1	0.1	10	10	0.01	0.002	0.01	0.01	0.008	1	0.1	20	5.5	0.1	0.10	0.11			0.02	0.6	0.2	0.01	
DATE																													
04/27/05		1.8	0.4	85		694	1.0	4.7	10	1520	0.020	0.008	0.06	0.07	0.079	1.0	7.61	5		22.8	0.48	0.55	0.09	0.46	0.11	2.50	2.00	0.004	
05/18/05		2.8	0.4	114		898	1.0	3.2	90	190	0.013	0.007	0.01	0.01	0.008	1.0	7.62	480		28	1.43	1.40	0.02	1.42	0.01	7.30	1.02	0.004	
06/08/05		2.4	0.4	65		603	1.0	2.1	1660	10	0.045	0.002	0.03	0.03	0.154	1.0	7.36	5		27.9	0.96	0.99	0.08	0.92	0.22	2.50	1.20	0.010	
07/14/05		1.5	0.4	77.9		704	1.0	0.8	150	320	0.075	0.008	0.01	0.01	0.251	1.0	7.19	220		28.3	1.37	1.40	0.09	1.30	0.29	2.50	1.16	0.010	
08/09/05		2.0	0.4	19		238	1.0	3.9	10	10	0.051	0.006	0.02	0.03	0.072	1.0	7.82	5		26.3	0.56	0.59	0.08	0.51	0.10	2.50	3.10	0.010	
09/14/05		4.8	0.4	98		854	1.0	2.1	120	150	0.013	0.007	0.01	0.01	0.162	1.0	7.55	460		28.6	1.05	1.10	0.02	1.04	0.19	4.00	1.17	0.010	
10/26/05		1.5	0.4	46		443	1.0	1.9	580	1010	0.088	0.008	0.02	0.03	0.161	1.0	7.32	confluent		20.5	0.94	0.97	0.12	0.85	0.19	2.00	1.10	0.010	
11/09/05		3.0	0.4	85		841	1.0	2.2	70	40	0.039	0.006	0.01	0.01	0.125	1.0	7.46	400		24.6	1.08	1.10	0.05	1.04	0.23	4.50	0.94	0.010	
12/01/05		1.0	0.4	92		763	1.0	1.8	420	170	0.112	0.008	0.04	0.05	0.121	1.0	7.32	440		20.5	0.99	1.00	0.16	0.88	0.16	17.00	0.58	0.010	
01/17/06		1.4	0.4	119		952	1.0	3.8	180	60	0.019	0.005	0.02	0.02	0.040	1.0	7.39	140		17	0.84	0.86	0.04	0.82	0.07	1.00	0.47	0.010	
02/06/06		2.0	0.4	77		539	1.0	3.7	510	440	0.067	0.007	0.04	0.05	1.000	1.0	7.26	680		18	0.57	0.62	0.12	0.50	0.12	0.60	0.75	0.010	
03/06/06		2.3	0.4	121		887	1.0	4.3	200	50	0.021	0.007	0.01	0.01	0.055	10.0	7.45	140		21.4	0.87	0.88	0.03	0.85	0.08	2.20	0.79	0.010	
04/11/06	n/a	1.5	0.4	3000	n/a	8170	1.0	4.2	400	110	0.177	0.023	0.14	0.16	0.117	1.0	7.18	5	n/a	24.7	2.24	2.40	0.34	2.06	0.47	111	65.6	0.010	
05/08/06	n/a	3.1	0.4	2900	n/a	16900	1.0	7.2	10	10	0.012	0.003	0.01	0.01	0.076	1.0	7.81	1060	n/a	28.7	1.05	10.60	0.02	1.04	0.15	7.00	2.20	0.010	
06/27/06	n/a	1.5	0.4	2950	n/a	12800	1.0	5.7	10	1240	0.174	0.008	0.04	0.05	0.167	1.0	7.57	5	n/a	29.1	0.91	0.96	0.22	0.74	0.31	4.00	1.46	0.010	
07/28/06	n/a	1.0	0.3	36	n/a	685	1.0	4.0	480	10	0.127	0.023	0.25	0.27	0.137	4.1	7.64	20	n/a	29.8	0.95	1.22	0.40	0.82	0.21	24.30	7.70	0.030	
08/29/06	n/a	2.1	0.3	47	n/a	805	1.0	3.7	660	10	0.125	0.019	0.25	0.27	0.176	1.0	7.72	20	n/a	31	0.91	1.18	0.40	0.79	0.22	7.00	3.20	0.010	
09/18/06	n/a	0.9	0.3	26	n/a	318	1.0	6.0	1490	2280	0.080	0.045	0.18	0.22	0.123	1.0	7.69	confluent	n/a	28.5	0.67	0.89	0.30	0.59	0.14	10.00	2.10	0.005	
10/26/06	n/a	1.1	0.3	4450	n/a	19500	1.0	7.1	10	10	0.077	0.008	0.03	0.04	0.071	1.0	7.87	660	n/a	23.1	0.57	0.61	0.12	0.49	0.11	7.25	1.86	0.005	
11/08/06	n/a	0.8	0.3	5300	n/a	23900	1.0	7.9	280	330	0.055	0.003	0.02	0.02	0.084	1.0	7.49	(TNTC)	n/a	23	0.49	0.51	0.08	0.44	0.14	17.50	4.00	0.005	
12/06/06	n/a	1.7	0.3	6200	n/a	25300	1.0	6.2	10	20	0.073	0.005	0.02	0.02	0.076	1.0	7.68	(TNTC)	n/a	21.9	0.69	0.71	0.09	0.62	0.13	19.30	5.00	0.005	
01/25/07	340	0.9	0.3	10100	110	27200	13.6	5.2	10	80	0.111	0.002	0.06	0.06	0.073	13.4	7.79	2000	19100	21.8	1.20	1.26	0.17	1.09	0.23	37.20	11.80	0.111	
02/08/07	140	1.0	0.3	9250	300	26000	1.0	5.6	10	30	0.097	0.003	0.16	0.16	0.081	1.0	7.65	2300	18200	17.6	0.10	0.26	0.26	0.00	0.11	28.30	1.45	0.005	
03/20/07	100	3.3	0.3	125	55	1010	1.0	6.8	40	80	0.014	0.011	0.01	0.01	0.017	1.0	8.29	200	614	21	1.20	1.21	0.02	1.19	0.10	7.25	3.33	0.005	
04/24/07	120	4.0	0.3	133	75.000	1180	1.0	7.0	440	560	0.033	0.006	0.01	0.01	0.007	1.0	8.33	1600	638	26.4	1.80	1.81	0.04	1.77	0.16	17.50	6.75	0.005	
05/29/07	140	5.2	0.3	112	86.000	867	1.0	3.6	360	250	0.022	0.003	0.01	0.01	0.021	1.0	7.96	3100	575	27	1.60	1.61	0.03	1.58	0.15	13.00	3.74	0.005	
06/19/07	140	3.6	0.3	105	71.000	688	1.0	6.7	170	90	0.015	0.003	0.02	0.02	0.034	1.0	7.70	900	442	29.2	1.40	1.42	0.04	1.39	0.15	9.50	3.60	0.005	0.18
07/17/07	100	7.3	0.3	92.3	31.000	809	1.0	8.9	380	800	0.014	0.009	0.01	0.01	0.004	1.0	8.37	3000	396	32.4	1.70	1.70	0.02	1.69	0.14	6.50	12.80	0.005	

Note 1: Metal standards are based on a total hardness of 130 mg/L as measured in historical data.
Note 2: BMDL = *Below Method Detection Limit* .
Note 3: For detailed site locations, refer to Table 7-2
Sources: Lee County Laboratory, 2005 - 2007.
Florida Department of Environmental Protection, 2006.
ECT, 2006 and 2007.

TABLE 7-7

WATER QUALITY MONITORING STATION
ARNOLD DRIVE (CFMBILLY4)

	AL-ICP	BOD	CD	CL	COD	COND Field	CU	DO FIELD	ENTERO 10	FCMF 10	NH3	NO2	NO3	NOX	O-PO4	PB	pHF	TCMF05	TDS	TEMP Field	TKN	TN	In-Org-N	Org-N	T-PO4	TSS	TURB	ZN
	mg/L	mg/L	ug/L	mg/L	mg/L	UMHOS/CM	ug/L	mg/L	col/ 100ML	col/ 100ML	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	UNITS	col/100ML	mg/L	°C	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	NTU	mg/L
Class III Std.			≤ 1.3	<1500		<1275	≤ 2.9	> 5	mean<33	mean<200 :max<800	≤ 0.02					< 4.4	6.0>8.5			< 32.2							≤ 29 NTU's	< 0.15
LCEL MDL	100	0.3	var.	1	10	1	1	0.1	10	10	0.01	0.002	0.01	0.01	0.008	1	0.1	20	5.5	0.1	0.1	0.11			0.02	0.6	0.2	0.01
Date																												
04/27/05		2.8	0.4	66		437	1.0	4.6	10	10	0.037	0.021	0.22	0.24	0.176	1.0	7.8	5		21.2	0.560	0.80	0.28	0.52	0.24	7.50	10.80	0.004
05/18/05		3.7	0.4	117		906	1.0	2.8	610	150	0.041	0.008	0.02	0.03	0.008	1.0	7.6	840		26.8	1.390	1.40	0.07	1.35	0.49	14.30	3.30	0.004
06/08/05		3.2	0.4	54		483	2.5	4.1	1210	10	0.169	0.002	0.01	0.01	0.301	1.0	7.6	5		27.2	1.000	1.00	0.18	0.83	0.49	6.70	2.20	0.010
07/14/05		1.4	0.4	68.6		558	1.0	3.9	520	320	0.171	0.076	0.09	0.17	0.256	1.0	7.2	380		28.5	1.440	1.60	0.34	1.27	0.53	5.50	2.00	0.010
08/09/05		2.5	0.4	35		318	1.0	6.7	10	10	0.030	0.015	0.09	0.11	0.212	1.0	7.8	5		26.8	0.810	0.92	0.14	0.78	0.32	8.30	5.30	0.010
09/14/05		1.6	0.4	77		757	1.0	2.9	450	550	0.078	0.024	0.22	0.24	0.160	1.0	7.6	10		28.8	0.850	1.10	0.32	0.77	0.18	5.50	18.10	0.010
10/26/05		1.8	0.4	44.6		431	1.0	6.2	10	10	0.195	0.017	0.07	0.09	0.122	1.0	7.4	confluent		20.8	0.820	0.91	0.29	0.63	0.18	8.20	4.90	0.010
11/09/05		3.0	0.4	79		736	1.0	3.2	780	620	0.185	0.102	0.27	0.37	0.186	1.0	7.5	5		23.7	0.850	1.20	0.56	0.67	0.33	8.50	6.10	0.010
12/01/05		1.4	0.4	76		713	1.0	5.3	870	1140	0.255	0.049	0.33	0.38	0.204	1.0	7.3	confluent		18.2	1.480	1.90	0.64	1.23	0.29	6.50	2.70	0.010
01/17/06		2.8	0.4	107		905	1.0	5.2	10	10	0.332	0.016	0.09	0.11	0.185	1.0	7.6	confluent		16.9	2.020	2.10	0.44	1.69	0.34	5.20	3.90	0.010
02/06/06		1.8	0.4	74		583	1.0	6.9	1020	510	0.261	0.037	0.21	0.25	0.216	1.0	7.3	520		15.6	1.000	1.20	0.51	0.74	0.31	5.70	3.10	0.010
03/06/06		2.6	0.4	111		884	1.0	5.4	400	920	0.080	0.012	0.02	0.03	0.217	1.0	7.8	1200		20.7	1.340	1.40	0.11	1.26	0.39	15.30	6.00	0.010
04/11/06	n/a	3.3	0.4	102	n/a	923	1.0	4.9	460	410	0.185	0.012	0.01	0.02	0.305	1.0	7.51	880	n/a	20.2	1.540	1.56	0.21	1.36	0.51	17.00	18.50	0.010
05/08/06	n/a	4.7	0.4	308	n/a	3770	1.0	3.7	confluent	270	0.021	0.009	0.01	0.01	0.556	1.0	7.50	5	n/a	27.3	1.240	1.25	0.03	1.22	0.75	23.00	4.70	0.010
06/27/06	n/a	1.8	0.4	26	n/a	476	1.0	3.2	490	620	0.209	0.037	0.07	0.11	0.248	1.0	7.09	5	n/a	27.1	1.040	1.15	0.32	0.83	0.36	22.80	3.40	0.010
07/28/06	n/a	1.1	0.3	39.0	n/a	707	1.0	3.5	310	210	0.280	0.076	0.23	0.31	0.229	1.0	7.36	20	n/a	27.2	1.100	1.41	0.59	0.82	0.30	7.00	3.90	0.010
08/29/06	n/a	1.6	0.3	43	n/a	716	1.0	3.4	700	640	0.072	0.013	0.30	0.31	2.110	1.0	7.73	20	n/a	29.2	0.950	1.26	0.38	0.88	0.28	3.50	3.00	0.010
09/18/06	n/a	1.6	0.3	53	n/a	580	1.0	3.5	510	740	0.109	0.052	0.21	0.26	0.195	1.0	7.32	confluent	n/a	27.4	0.920	1.18	0.37	0.81	0.24	7.50	1.84	0.005
10/26/06	n/a	1.7	0.3	46.0	n/a	827	1.0	4.1	330	160	0.137	0.011	0.09	0.10	0.123	1.0	7.62	(TNTC)	n/a	20.4	1.100	1.20	0.24	0.96	0.27	4.75	3.50	0.005
11/08/06	n/a	1.4	0.3	472	n/a	2240	1.0	3.6	730	740	0.081	0.008	0.11	0.12	0.159	1.0	7.53	(TNTC)	n/a	23.5	0.820	0.94	0.20	0.74	0.32	18.30	6.94	0.005
12/06/06	n/a	1.4	0.3	41	n/a	760	1.0	6.6	600	10	0.069	0.008	0.04	0.05	0.149	1.0	7.78	(TNTC)	n/a	19.9	1.000	1.05	0.12	0.93	0.24	7.00	2.50	0.005
01/25/07	100	1.4	0.3	199	40	1160	1.0	3.9	690	950	0.075	0.002	0.08	0.08	0.229	1.0	8.12	2000	1370	18.2	0.850	0.93	0.16	0.78	0.29	3.25	3.00	0.005
02/08/07	100	1.2	0.3	164	40	1129	1.0	6.1	1570	1550	0.049	0.002	0.04	0.04	0.211	1.0	7.69	5300	899	18.7	0.660	0.70	0.09	0.61	0.29	5.75	3.25	0.005
03/20/07	140	2.2	0.3	2380	81	7490	4.1	4.5	1220	1300	0.082	0.019	0.02	0.04	0.353	1.0	7.67	1700	4360	19.7	1.200	1.24	0.12	1.12	0.51	5.25	3.36	0.005
04/24/07	110	1.2	0.3	4570	70	16500	1.0	1.9	230	50	0.109	0.002	0.01	0.01	0.568	1.0	7.41	1100	8300	23.0	0.980	0.99	0.12	0.87	0.68	3.00	2.88	0.005
05/29/07	130	5.1	0.3	7250	190	20800	1.0	1.3	400	240	0.085	0.007	0.01	0.01	0.596	1.0	7.32	1400	13400	26.1	1.300	1.31	0.10	1.22	0.85	8.00	6.51	0.005
06/19/07	100	3.3	0.3	2130	130	5800	1.0	2.4	680	390	0.173	0.008	0.02	0.03	0.592	1.0	7.60	4000	3970	27.9	1.100	1.13	0.20	0.93	0.74	3.00	4.82	0.005
07/17/07	130	3.4	0.3	61.5	47	422	1.0	3.0	10	10	0.021	0.021	0.09	0.11	0.255	1.0	7.41	2000	202	27.7	0.820	0.93	0.13	0.80	0.36	3.75	6.74	0.005

Note 1: Metal standards are based on a total hardness of 130 mg/L as measured in historical data.
Note 2: BMDL = *Below Method Detection Limit* .
Note 3: For detailed site locations, refer to Table 7-2
Sources: Lee County Laboratory, 2005 - 2007.
Florida Department of Environmental Protection, 2006.
ECT, 2006 and 2007.

TABLE 7-8

WATER QUALITY MONITORING STATION
BILLY CREEK AT ORTIZ AVE. (BILLGR60)

	$CHL-A	$PHE-A	CD	CL	COND Field	CU	DO FIELD	ENTERO 10	FCMF 10	NH3	NO2	NO3	NOX	O-PO4	PB	pH Field	T-PO4	TEMP Field	TKN	TN	In-Org-N	Org-N	TSS	TURB	ZN	Disch.
	mg/M3	mg/M3	ug/L	mg/L	UMHOS /CM	ug/L	mg/L	col/ 100ML	col/ 100ML	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	UNITS	mg/L	°C	mg/L	mg/L	mg/L	mg/L	mg/L	NTU	mg/L	cfs
Class III Std.	mean<20		≤ 1.3	<1500	<1275	≤ 12	> 5	mean<33	mean<200 :max<800	≤ 0.02					< 4.4	6.0>8.5										
LCEL MDL	0.5	0.5	var.	1	1	1.00	0.1	10	10	0.01	0.002	0.01	0.01	0.008	1	0.1	0.02	0.1	0.10	0.11			0.6	0.2	0.01	
Date																										
04/19/05	2.2	1.4	BMDL	56	689	BMDL	5.6	850	370	0.069	0.025	0.23	0.26	0.13	BMDL	7.39	0.17	20	1.01	1.3	0.329	0.941	1.5	2.2	BMDL	
05/25/05	3.3	2.4	BMDL	54	657	BMDL	4.3	520	720	0.074	0.01	0.03	0.04	0.187	BMDL	7.5	0.28	26.3	0.5	0.54	0.114	0.426	4.7	n.d.	BMDL	
06/29/05	3.7	BMDL	BMDL	57.4	468	BMDL	6.8	350	380	0.425	0.055	0.01	0.07	0.116	BMDL	7.16	0.17	27.5	1.75	1.8	0.495	1.325	3	1.7	BMDL	
07/22/05	3.7	0.7	BMDL	72	559	BMDL	5.1	TNTC	400	0.748	0.05	0.15	0.2	0.086	BMDL	7.21	0.14	28	1.76	2	0.948	1.012	3.5	2.1	BMDL	
08/22/05	3.9	2.5	BMDL	83	621	BMDL	6.8	440	850	1.09	0.027	0.29	0.32	0.098	BMDL	7.94	0.18	28	1.8	2.1	1.41	0.71	4.5	3.5	BMDL	
09/08/05	3.3	2.4	BMDL	46	569	BMDL	5.8	780	640	0.67	0.06	0.23	0.29	0.117	BMDL	7.66	0.15	26.9	1.59	1.9	0.96	0.92	2.2	2.7	BMDL	
10/13/05	3.1	BMDL	BMDL	69	556	BMDL	5.6	150	380	0.747	0.074	0.23	0.3	0.068	BMDL	7.55	0.13	26.8	1.98	2.3	1.047	1.233	1.7	1.9	BMDL	
11/17/05	1	3.3	BMDL	50.5	673	BMDL	4.8	580	290	1.13	0.08	0.23	0.31	0.153	BMDL	7.53	0.19	23	0.14	0.45	1.44	-0.99	2.5	3	BMDL	
12/13/05	2	1.0	BMDL	98	678	BMDL	5.9	600	380	0.772	0.064	0.56	0.62	0.099	BMDL	7.26	0.17	16.3	1.17	1.8	1.392	0.398	2.5	3.3	BMDL	
02/27/06	1.9	3.0	BMDL	51.5	643	BMDL	6.3	780	210	0.113	0.014	0.33	0.34	0.179	BMDL	7.61	0.25	16.6	0.89	1.2	0.453	0.777	2	3.8	BMDL	
03/23/06	2.5	1.7	BMDL	45	619	BMDL	4.3	220	210	0.06	0.005	0.04	0.04	0.197	BMDL	7.48	0.33	22.7	0.91	0.95	0.1	0.85	4	3.4	BMDL	
04/25/06	2.8	BMDL	BMDL	31	647	BMDL	3.6	970	910	0.067	0.006	0.04	0.05	0.157	BMDL	7.44	0.28	24.4	1.06	1.11	0.117	0.993	3	3	BMDL	
05/16/06	1.8	7.3	BMDL	67	680	BMDL	2.4	TNTC	TNTC	0.063	0.009	0.06	0.07	0.202	BMDL	7.31	0.3	24.3	0.86	0.93	0.133	0.797	7	3.1	BMDL	
06/12/06	1.9	1.7	BMDL	28	551	BMDL	4	840	n.d.	0.072	0.009	0.06	0.07	0.204	BMDL	7.44	0.31	25.4	0.81	0.88	0.142	0.738	5.5	3.2	BMDL	
07/31/06	1.5	3.2	BMDL	37	646	BMDL	6.8	150	130	0.73	0.086	0.16	0.25	0.113	BMDL	6.98	0.16	27.8	1.5	1.75	0.98	0.77	1.5	2.2	BMDL	
08/23/06	2	3.0	BMDL	29.5	502	BMDL	5.6	530	300	0.332	0.039	0.18	0.22	0.102	BMDL	7.56	0.16	28.3	1.1	1.32	0.552	0.768	2	2.3	BMDL	
09/21/06	1.1	2.4	BMDL	29.5	528	BMDL	5.3	750	510	0.238	0.045	0.14	0.19	0.095	BMDL	7.64	0.14	25.9	1.3	1.49	0.428	1.062	3	1.32	BMDL	
10/26/06	1.2	2.8	BMDL	38.5	657	BMDL	5.8	450	390	0.103	0.016	0.39	0.41	0.119	BMDL	7.38	0.26	19.9	0.82	1.23	0.513	0.717	13	3.9	BMDL	>1
11/28/06	4.5	BMDL	BMDL	36	694	BMDL	5.5	480	640	0.132	0.032	0.34	0.37	0.152	BMDL	7.49	0.28	20.6	1.2	1.57	0.502	1.068	5	3.8	BMDL	
12/15/06	2.9	6.3	BMDL	33	578	BMDL	4.4	350	150	0.09	0.019	0.18	0.2	0.189	BMDL	7.45	0.31	21.8	0.86	1.06	0.29	0.77	1.5	3.9	BMDL	
01/24/07	1.2	1.4	BMDL	36.6	595	BMDL	4.7	760	520	0.052	0.003	0.15	0.15	0.208	BMDL	7.58	0.38	20.2	0.94	1.09	0.202	0.888	2	3.83	BMDL	>1
02/27/07	1.1	BMDL	BMDL	50	523	1.17	4.4	1150	680	0.062	BMDL	0.08	0.08	0.206	BMDL	7.67	0.33	21.9	0.63	0.71	0.142	0.568	2.75	2.68	BMDL	
03/27/07	1.1	BMDL	BMDL	49	759	BMDL	2.8	670	110	0.061	0.007	0.07	0.08	0.128	BMDL	7.55	0.38	20.6	0.95	1.03	0.141	0.889	3.5	4.62	BMDL	
04/13/07	0.7	0.6	BMDL	47	761	BMDL	2.4	1050	390	0.241	0.009	0.09	0.1	0.127	BMDL	7.31	0.23	22.3	1.1	1.2	0.341	0.859	2.75	n.d.	BMDL	
05/24/07	1	0.5	BMDL	52	729	BMDL	9.1	TNTC	TNTC	0.026	0.006	0.05	0.06	0.197	BMDL	7.5	0.25	22.5	0.76	0.82	0.086	0.734	BMDL	n.d.	BMDL	Est. >0.1
06/21/07	1.9	BMDL	BMDL	47.5	624	BMDL	4	1110	310	0.049	BMDL	0.05	0.05	0.254	BMDL	7.58	0.36	26.7	0.96	1.01	0.099	0.911	2.75	2.07	BMDL	
07/18/07	6.9	BMDL	BMDL	36.5	490	BMDL	5.8	870	650	0.052	0.007	0.05	0.06	0.168	BMDL	7.26	0.27	27.1	0.72	0.78	0.112	0.668	1.75	2.31	BMDL	
08/22/07	1.7	0.7	BMDL	48.2	672	BMDL	3.8	1200	880	0.333	0.057	0.1	0.16	0.13	BMDL	7.3	0.2	27.2	1.1	1.3	0.493	0.767	BMDL	2.86	BMDL	

Note 1: Metal standards are based on a total hardness of 130 mg/L as measured in historical data.
Note 2: BMDL = *Below Method Detection Limit* .
Note 3: For detailed site locations, refer to Table 7-2
Sources: Lee County Laboratory, 2005 - 2007.
Florida Department of Environmental Protection, 2006.
ECT, 2006 and 2007.

TABLE 7-9

WATER QUALITY MONITORING STATION
FORD STREET CANAL AT CITY OF FORT MYERS CEMETERY (CFMBILLY6)

	AL-ICP	BOD	CD	CL	COD	COND Field	CU	DO FIELD	ENTERO 10	FCMF 10	NH3	NO2	NO3	NOX	O-PO4	PB	pH Field	TCMF05	TDS	TEMP Field	Total HARD	TKN	TN	In-Org-N	Org-N	T-PO4	TSS	TURB	ZN	Disch.
	mg/L	mg/L	ug/L	mg/L	mg/L	UMHOS/CM	ug/L	mg/L	col/ 100ML	col/ 100ML	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	UNITS	col/100ML	mg/L	°C	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	NTU	mg/L	cfs
Class III Std.			≤ 1.3	<1500		<1275	≤ 12	> 5	mean<33	mean<200 :max<800	≤ 0.02					< 4.4	6.0>8.5				Need for metals									
LCEL MDL	100	0.3	var.	1	10	1	1	0.1	10	10	0.01	0.002	0.01	0.01	0.008	1	0.1	20	5.5	0.1		0.1	0.11			0.02	0.6	0.2	0.01	
DATE																														
04/27/05		2.5	0.4	21		245	1.0	5.4	10	10	0.071	0.017	0.14	0.16	0.071	5.5	7.70	5		22.2		0.34	0.50	0.23	0.27	0.10	4.20	7.50	0.004	
05/18/05		1.6	0.4	90		781	1.0	4.1	280	400	0.031	0.005	0.01	0.01	0.008	1.0	7.59	1000		26.8		0.60	0.61	0.04	0.57	0.25	2.00	1.43	0.004	
06/08/05		1.7	0.4	55		638	1.0	5.5	690	440	0.266	0.002	0.01	0.01	0.142	1.0	7.42	860		29		0.31	0.32	0.28	0.04	0.21	0.70	2.30	0.010	
07/14/05		2.0	0.4	64.7		705	1.0	5.6	680	1870	0.228	0.100	0.15	0.25	0.134	1.0	7.28	300		28.5		1.12	1.40	0.48	0.89	0.18	3.80	3.70	0.010	
08/09/05		2.5	0.4	26.5		378	1.0	2.5	10	10	0.132	0.012	0.07	0.08	0.121	1.0	7.63	5		27.2		0.89	0.97	0.21	0.76	0.17	4.20	3.00	0.010	
09/14/05		1.3	0.4	67		730	1.0	6.1	370	250	0.037	0.010	0.11	0.12	0.119	1.0	7.60	740		28.7		0.44	0.56	0.16	0.40	0.13	1.30	2.00	0.010	
10/26/05		1.5	0.4	49.5		607	1.0	5.6	860	1510	0.300	0.011	0.03	0.04	0.142	1.0	7.25	20		23.4		0.94	0.98	0.34	0.64	0.20	0.80	2.00	0.010	
11/09/05		2.9	0.4	73		689	1.0	5.6	520	1280	0.114	0.047	0.18	0.23	0.164	1.0	7.45	5		25.6		0.77	1.00	0.34	0.66	0.21	10.80	2.10	0.010	
12/01/05		0.8	0.4	81		639	1.0	5.8	170	70	0.131	0.038	0.04	0.19	0.230	0.1	1.00	180		7.37		0.70	0.93	0.32	0.57	0.13	1.70	1.25	0.010	
01/17/06		1.7	0.4	89.3		782	1.0	5.4	530	30	0.033	0.004	0.08	0.08	0.047	1.0	7.36	80		18.5		0.84	0.92	0.11	0.81	0.16	5.50	1.10	0.010	
02/06/06		1.5	0.4	73		546	1.0	5.2	670	420	0.166	0.019	0.08	1.00	0.119	1.0	7.26	320		18		0.55	0.65	1.17	0.38	0.18	1.30	1.86	0.010	
03/06/06		2.4	0.4	90.4		737	1.0	4.8	80	20	0.047	0.006	0.02	0.03	0.113	1.0	7.62	320		20.2		0.84	0.87	0.08	0.79	0.20	3.20	1.52	0.010	
04/11/06	n/a	0.9	0.4	105	n/a	874	1.0	4.5	330	10	0.032	0.002	0.01	0.01	0.122	1.0	7.50	440	n/a	20.9		0.63	0.64	0.04	0.60	0.18	1.00	2.60	0.010	
05/08/06	n/a	1.6	0.4	99	n/a	994	1.0	2.4	500	230	0.015	0.002	0.01	0.01	0.209	1.0	7.38	5	n/a	25.7		0.48	0.49	0.03	0.47	0.32	2.20	2.50	0.010	
06/27/06	n/a	1.2	0.4	26.0	n/a	542	1.0	3.9	380	860	0.331	0.043	0.08	0.12	0.163	1.0	7.23	5	n/a	27.1		0.87	0.99	0.45	0.54	0.25	1.70	1.90	0.010	
07/28/06	n/a	0.7	0.3	38	n/a	697	1.0	3.9	300	190	0.261	0.057	0.11	0.17	0.136	1.0	7.35	20	n/a	27.5		0.71	0.88	0.43	0.45	0.21	3.25	3.20	0.010	
08/29/06	n/a	1.6	0.3	38.5	n/a	668	1.0	6.5	330	800	0.130	0.055	0.16	0.22	0.115	1.0	7.81	20	n/a	30.2		0.65	0.87	0.35	0.52	0.17	7.75	2.50	0.010	
09/18/06	n/a	1.4	0.3	28.3	n/a	455	1.0	5.3	1460	1750	0.145	0.017	0.09	0.11	0.115	1.0	7.36	confluent	n/a	27.1		0.77	0.88	0.26	0.63	0.15	3.00	2.70	0.005	
10/26/06	n/a	0.7	0.3	40.5	n/a	798	1.0	9.8	140	70	0.105	0.005	0.08	0.09	0.089	10.0	7.71	(TNTC)	n/a	26		0.44	0.53	0.20	0.34	0.14	0.75	1.92	0.005	>1.0
11/08/06	n/a	7.2	0.3	39	n/a	689	1.0	7.7	940	890	0.058	0.004	0.07	0.07	0.148	1.0	7.62	(TNTC)	n/a	26.2		1.80	1.87	0.13	1.74	1.12	2.00	2.05	0.005	
12/06/06	n/a	1.1	0.3	36.5	n/a	681	1.0	9.6	400	40	0.041	0.007	0.05	0.06	0.103	1.0	7.81	(TNTC)	n/a	23.2		0.74	0.80	0.10	0.70	0.16	2.25	1.47	0.005	
01/25/07	100	1.3	0.3	88.9	21	717	1.0	4.8	700	40	0.071	0.002	0.12	0.12	0.113	1.0	8.03	1700	479	17.9		0.69	0.81	0.19	0.62	0.18	0.60	1.94	0.005	
02/08/07	100	0.7	0.3	109	23	799	1.0	6.1	380	10	0.020	0.002	0.01	0.01	0.089	1.0	7.86	400	198	20		0.38	0.39	0.03	0.36	0.13	3.25	2.19	0.005	
03/20/07	100	1.3	0.3	7230	150	21700	10.0	3.0	100	130	0.148	0.020	0.02	0.04	0.210	1.0	7.38	1000	13500	20.5		0.810	0.85	0.19	0.66	0.25	3.00	1.52	0.005	
04/24/07	140	0.7	0.3	142	22	1150	1.0	8.9	50	10	0.029	0.002	0.01	0.01	0.075	1.0	8.13	300	479	25.9	n/a	0.62	0.63	0.04	0.59	0.17	8.75	3.23	0.005	
05/29/07	100	1.3	0.3	122	60	896	1.0	5.5	730	360	0.021	0.002	0.01	0.01	0.086	1.0	7.77	700	467	23.5	n/a	0.57	0.58	0.03	0.55	0.21	20.80	1.83	0.005	
06/19/07	100	1.6	0.3	99.0	26	546	1.0	4.0	580	330	0.026	0.002	0.01	0.01	0.124	1.0	7.60	1300	426	27.4	n/a	0.32	0.33	0.04	0.29	0.18	2.25	1.18	0.005	0.38
07/17/07	100	2.4	0.3	85.6	33	743	1.0	6.6	320	1100	0.014	0.004	0.01	0.01	0.111	1.3	7.65	1100	336	30	n/a	0.48	0.49	0.02	0.47	0.17	3.00	2.47	0.005	

Note 1: Metal standards are based on a total hardness of 130 mg/L as measured in historical data.
Note 2: BMDL = *Below Method Detection Limit*.
Note 3: For detailed site locations, refer to Table 7-2
Sources: Lee County Laboratory, 2005 - 2007.
Florida Department of Environmental Protection, 2006.
ECT, 2006 and 2007.

TABLE 7-10

WATER QUALITY MONITORING STATION
BROADWAY CANAL AT CENTENNIAL PARK BOAT RAMP (CFMBROADWAY)

	AL-ICP	BOD	CD	CL	COD	COND Field	CU	DO FIELD	ENTERO 10	FCMF 10	NH3	NO2	NO3	NOX	O-PO4	PB	pH Field	TCMF05	TDS	TEMP Field	Total HARD	TKN	TN	In-Org-N	Org-N	T-PO4	TSS	TURB	ZN
	mg/L	mg/L	ug/L	mg/L	mg/L	UMHOS/CM	ug/L	mg/L	col/ 100ML	col/ 100ML	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	UNITS	col/100ML	mg/L	°C	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	NTU	mg/L
Class III Std.			≤ 1.3	<1500		<1275	≤ 12	> 5	mean<33	mean<200 :max<800	≤ 0.02					< 4.4	6.0>8.5				Need for metals								
LCEL MDL	100	0.3	var.	1	10	1	1	0.1	10	10	0.01	0.002	0.01	0.01	0.008	1	0.1	20	5.5	0.1		0.1	0.11			0.02	0.6	0.2	0.01
Date																													
04/27/05		1.4	0.4	30.0		345	1.0	8.1	10	10	0.016	0.011	0.13	0.14	0.074	1.0	8.31	5		22.4		0.360	0.50	0.16	0.34	0.09	1.20	3.80	0.004
05/18/05		2.0	0.4	530.0		1480	1.0	6.3	70	1070	0.046	0.016	0.30	0.32	0.121	10.0	7.75	3020		27.6		1.550	1.90	0.37	1.50	0.18	22.80	6.30	0.004
06/08/05		2.2	0.4	33.0		340	3.1	3.8	10	10	0.140	0.002	0.01	0.01	0.107	1.0	7.52	5		28.1		1.040	1.00	0.15	0.90	0.18	3.20	4.20	0.010
07/14/05		0.8	0.4	29.4		314	1.0	3.4	100	130	0.059	0.067	0.13	0.20	0.083	1.0	7.42	340		30		0.950	1.20	0.26	0.89	0.09	3.80	3.40	0.010
08/09/05		1.3	0.4	18.5		170	1.0	7.5	10	10	0.066	0.016	0.13	0.15	0.055	1.0	7.98	5		28.7		0.570	0.72	0.22	0.50	0.13	7.50	5.10	0.010
09/14/05		1.5	0.4	40.0		430	1.0	7.3	20	50	0.026	0.025	0.14	0.16	0.080	1.0	7.79	40		29.9		1.040	1.20	0.19	1.01	0.08	1.80	3.70	0.010
10/26/05		1.7	0.4	54.5		636	1.0	5.6	10	10	0.068	0.039	0.32	0.36	0.093	1.0	7.30	20		23.4		1.680	2.00	0.43	1.61	0.26	46.80	24.00	0.010
11/09/05		2.2	0.4	42.0		431	1.0	4.7	60	160	0.061	0.054	0.26	0.31	0.083	1.0	7.54	5		25.1		0.810	1.10	0.37	0.75	0.12	4.70	3.60	0.010
12/01/05		1.0	0.4	54.5		549	1.0	4.7	2200	740	0.037	0.021	0.28	0.30	0.045	1.0	7.12	380		23.2		1.170	1.50	0.34	1.13	0.11	24.00	17.00	0.010
01/17/06		1.5	0.4	3160		9690	1.0	8.8	30	80	0.017	0.008	0.32	0.33	0.018	1.0	6.93	5		18		0.850	1.20	0.35	0.83	0.09	7.30	3.30	0.010
02/06/06		0.9	0.4	3320		8230	1.0	6.8	490	390	0.070	0.019	0.28	0.30	0.059	1.0	6.82	Confluent		20.1		0.800	1.10	0.37	0.73	0.12	19.50	6.30	0.010
03/06/06		1.3	0.4	1220		4220	1.0	8.4	50	210	0.040	0.017	0.24	0.24	0.048	1.0	7.95	20		21.4		1.010	1.30	0.28	0.97	0.09	3.80	4.40	0.010
04/11/06	n/a	1.5	0.4	3000	n/a	8170	1.0	4.2	400	110	0.177	0.023	0.14	0.16	0.117	1.0	7.18	5	n/a	24.7		2.240	2.40	0.34	2.06	0.47	111.00	65.60	0.010
05/08/06	n/a	3.1	0.4	2900	n/a	16900	1.0	7.2	10	10	0.012	0.003	0.01	0.01	0.076	1.0	7.81	1060	n/a	28.7		1.050	10.60	0.02	1.04	0.15	7.00	2.20	0.010
06/27/06	n/a	1.5	0.4	2950	n/a	12800	1.0	5.7	10	1240	0.174	0.008	0.04	0.05	0.167	1.0	7.57	5	n/a	29.1		0.910	0.96	0.22	0.74	0.31	4.00	1.46	0.010
07/28/06	n/a	1.0	0.3	36	n/a	685	1.0	4.0	480	10	0.127	0.023	0.25	0.27	0.137	4.1	7.64	20	n/a	29.8		0.950	1.22	0.40	0.82	0.21	24.30	7.70	0.030
08/29/06	n/a	2.1	0.3	47	n/a	805	1.0	3.7	660	10	0.125	0.019	0.25	0.27	0.176	1.0	7.72	20	n/a	31		0.910	1.18	0.40	0.79	0.22	7.00	3.20	0.010
09/18/06	n/a	0.9	0.3	26	n/a	318	1.0	6.0	1490	2280	0.080	0.045	0.18	0.22	0.123	1.0	7.69	confluent	n/a	28.5		0.670	0.89	0.30	0.59	0.14	10.00	2.10	0.005
10/26/06	n/a	1.1	0.3	4450	n/a	19500	1.0	7.1	10	10	0.077	0.008	0.03	0.04	0.071	1.0	7.87	660	n/a	23.1		0.570	0.61	0.12	0.49	0.11	7.25	1.86	0.005
11/08/06	n/a	0.8	0.3	5300	n/a	23900	1.0	7.9	280	330	0.055	0.003	0.02	0.02	0.084	1.0	7.49	(TNTC)	n/a	23		0.490	0.51	0.08	0.44	0.14	17.50	4.00	0.005
12/06/06	n/a	1.7	0.3	6200	n/a	25300	1.0	6.2	10	20	0.073	0.005	0.02	0.02	0.076	1.0	7.68	(TNTC)	n/a	21.9		0.690	0.71	0.09	0.62	0.13	19.30	5.00	0.005
01/25/07	340	0.9	0.3	10100	110	27200	13.6	5.2	10	80	0.111	0.002	0.06	0.06	0.073	13.4	7.79	2000	19100	21.8		1.200	1.26	0.17	1.09	0.23	37.20	11.80	0.111
02/08/07	140	1.0	0.3	9250	300	26000	1.0	5.6	10	30	0.097	0.003	0.16	0.16	0.081	1.0	7.65	2300	18200	17.6		0.100	0.26	0.26	0.00	0.11	28.30	1.45	0.005
03/20/07	130	0.3	0.3	11400	230	29100	81.9	5.5	160	10	0.027	0.014	0.02	0.03	0.043	1.0	7.71	1800	17900	21.6		0.890	0.92	0.06	0.86	0.08	5.25	2.04	0.115
04/24/07	320	1.0	0.3	14600	140	45300	2.7	6.6	10	10	0.097	0.008	0.02	0.03	0.077	1.0	7.59	1000	25500	23.5	5290	0.800	0.83	0.13	0.70	0.16	31.30	8.54	0.007
05/29/07	150	2.5	0.3	14900	410	40400	1.7	7.8	10	40	0.037	0.002	0.01	0.01	0.062	1.0	7.78	900	27600	25.6	n/a	0.660	0.67	0.05	0.62	0.10	8.25	1.66	0.005
06/19/07	170	2.6	0.3	12600	130	28300	1.1	6.8	160	50	0.037	0.005	0.02	0.02	0.099	1.0	7.30	700	22200	28.9	4150	0.700	0.72	0.06	0.66	0.15	6.50	2.53	0.005
07/17/07	120	5.1	0.3	8510	180	26600	1.0	2.4	1950	900	0.337	0.005	0.01	0.01	0.288	1.66	7.42	4000	17000	31.4	n/a	1.100	1.10	0.35	0.76	0.37	4.50	16.60	0.005

Note 1: Metal standards are based on a total hardness of 130 mg/L as measured in historical data.
Note 2: BMDL = *Below Method Detection Limit* .
Note 3: For detailed site locations, refer to Table 7-2
Sources: Lee County Laboratory, 2005 - 2007.
Florida Department of Environmental Protection, 2006.
ECT, 2006 and 2007.

TABLE 7-11

WATER QUALITY MONITORING STATION
MANUEL'S BRANCH CANAL AT WILBUR MOORE BRIDGE (FORT MYERS HIGH SCHOOL) (CFMMANUEL)

	AL-ICP	BOD	CD	CL	COD	COND Field	CU	DO FIELD	ENTERO 10	FCMF 10	NH3	NO2	NO3	NOX	O-PO4	PB	ph Field	TCMF05	TDS	TEMP Field	Total HARD	TKN	TN	In-Org-N	Org-N	T-PO4	TSS	TURB	ZN	Disch.
	mg/L	mg/L	ug/L	mg/L	mg/L	UMHOS/CM	ug/L	mg/L	col/ 100ML	col/ 100ML	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	UNITS	col/100ML	mg/L	°C	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	NTU	mg/L	cfs
Class III Std.			≤ 1.3	<1500		<1275	≤ 12	> 5	mean<33	mean<200 :max<800	≤ 0.02					< 4.4	6.0>8.5				Need for metals									
LCEL MDL	100	0.3	var.	1	10	1	1	0.1	10	10	0.01	0.002	0.01	0.01	0.008	1	0.1	20	5.5	0.1		0.1	0.11			0.02	0.6	0.2	0.01	
Date																														
04/27/05		5.2	0.4	23		264	1.0	7.2	10	10	0.124	0.344	0.33	0.67	0.071	1.0	8.77	5		21.4		0.340	1.00	0.79	0.22	0.13	28.80	28.00	0.018	
05/18/05		2.1	0.4	91		749	1.0	4.0	900	1950	0.098	0.013	0.10	0.11	0.008	1.0	7.56	3780		26.2		0.740	0.85	0.21	0.64	0.18	3.50	4.10	0.004	
06/08/05		1.6	0.4	62		579	1.0	5.0	10	10	0.195	0.002	0.01	0.01	0.102	7.4	7.42	5		26.5		0.840	0.85	0.21	0.65	0.16	2.00	2.90	0.010	
07/14/05		0.7	0.4	64		649	1.0	4.4	740	960	0.213	0.040	0.17	0.21	0.092	1.0	7.21	540		26.4		0.710	0.92	0.42	0.50	0.12	1.20	3.60	0.010	
08/09/05		2.4	0.4	35		400	1.0	6.7	10	10	0.099	0.015	0.09	0.11	0.065	1.0	7.72	5		26.5		0.600	0.71	0.21	0.50	0.10	6.50	8.00	0.010	
09/14/05		1.5	0.4	74		726	1.0	6.3	800	990	0.109	0.016	0.11	0.13	0.109	1.0	7.45	20		26.5		0.660	0.79	0.24	0.55	0.13	0.60	3.40	0.010	
10/26/05		1.2	0.4	62		601	1.0	4.7	10	10	0.319	0.020	0.16	0.18	0.129	1.0	7.06	20		22.5		0.750	0.93	0.50	0.43	0.16	1.70	2.00	0.010	
11/09/05		1.8	0.4	73		665	1.0	4.5	10	140	0.117	0.021	0.20	0.22	0.094	1.0	7.36	5		24.1		0.630	0.85	0.34	0.51	0.12	1.80	3.60	0.010	
12/01/05		1.0	0.4	64		653	1.0	5.4	1120	410	0.173	0.021	0.25	0.27	0.089	1.0	6.95	520		19.3		0.620	0.89	0.44	0.45	0.12	52.50	4.10	0.010	
01/17/06		2.2	0.4	83		717	1.0	5.3	980	400	0.070	0.008	0.15	0.16	0.042	1.0	7.15	5		18.4		0.570	0.73	0.23	0.50	0.15	2.00	3.40	0.010	
02/06/06		0.8	0.4	72		552	1.0	6.3	1140	490	0.198	0.019	0.17	0.19	0.089	1.0	6.85	180		17		0.560	0.75	0.39	0.36	0.15	1.20	4.20	0.010	
03/06/06		2.5	0.4	107		747	1.0	4.8	10	10	0.382	0.078	0.32	0.40	0.110	1.0	7.53	20		20.7		1.340	1.70	0.78	0.96	0.20	2.50	3.40	0.010	
04/11/06	n/a	1.0	0.4	145	n/a	898	1.0	7.0	1000	10	0.102	0.009	0.10	0.11	0.092	1.0	7.11	5	n/a	21.6		0.780	0.89	0.21	0.68	0.17	1.50	4.90	0.010	
05/08/06	n/a	0.7	0.4	103	n/a	996	1.0	4.9	710	420	0.053	0.006	0.07	0.08	0.142	1.0	7.54	5	n/a	26.5		0.750	0.83	0.13	0.70	0.20	0.70	1.47	0.010	
06/27/06	n/a	1.2	0.4	30	n/a	559	1.0	3.7	1370	900	0.278	0.036	0.13	0.17	0.107	1.0	7.24	5	n/a	26.7		0.780	0.95	0.45	0.50	0.15	0.60	2.30	0.010	3.7
07/28/06	n/a	0.3	0.3	35	n/a	643	1.0	4.1	440	10	0.248	0.024	0.18	0.20	0.116	1.0	7.37	20	n/a	26.5		0.590	0.79	0.45	0.34	0.14	0.60	2.60	0.010	
08/29/06	n/a	2.3	0.3	36	n/a	655	1.0	6.2	720	550	0.149	0.031	0.24	0.27	0.123	1.0	7.63	20	n/a	27.3		0.550	0.82	0.42	0.40	0.13	4.50	2.70	0.010	
09/18/06	n/a	1.4	0.3	27	n/a	383	1.0	5.8	1760	2370	0.109	0.017	0.15	0.17	0.085	1.0	7.60	confluent	n/a	26.4		0.590	0.76	0.28	0.48	0.11	13.50	4.40	0.005	6.3
10/26/06	n/a	0.7	0.3	40	n/a	730	1.0	5.9	270	40	0.121	0.013	0.25	0.26	0.102	1.0	7.76	(TNTC)	n/a	21.6		0.500	0.76	0.38	0.38	0.14	0.75	3.10	0.005	2.4
11/08/06	n/a	2.6	0.3	31	n/a	492	1.0	4.3	10	10	0.031	0.007	0.10	0.11	0.071	1.0	7.30	(TNTC)	n/a	23.6		0.420	0.53	0.14	0.39	0.13	3.75	8.27	0.009	
12/06/06	n/a	1.4	0.3	36	n/a	686	1.0	5.4	1100	580	0.157	0.027	0.28	0.31	0.093	1.0	7.49	(TNTC)	n/a	20.2		0.079	1.10	0.47	0.08	0.16	1.50	5.60	0.005	
01/25/07	110	2.8	0.3	118	27	708	3.0	4.8	10	10	0.075	0.002	0.30	0.30	0.098	1.2	7.77	1	500	19.4		0.780	1.08	0.38	0.71	0.17	3.50	5.31	0.005	
02/08/07	100	0.8	0.3	104	21	723	1.0	6.4	1010	1300	0.066	0.008	0.17	0.18	0.086	1.0	7.73	6100	399	18.8		0.560	0.74	0.25	0.49	0.16	0.60	4.16	0.005	
03/20/07	100	1.9	0.3	109	40	851	1.0	2.4	1500	500	0.651	0.089	0.07	0.16	0.171	1.0	7.49	100	474	19.4		1.200	1.36	0.81	0.55	0.26	1.50	3.82	0.005	
04/24/07	100	2.6	0.3	188	26	1230	1.0	4.2	600	600	0.839	0.055	0.06	0.11	0.263	1.0	7.60	100	620	22.6	n/a	1.500	1.61	0.95	0.66	0.42	1.25	4.04	0.005	
05/29/07	100	1.9	0.3	100	34	778	1.0	4.7	990	990	0.071	0.004	0.10	0.10	0.098	1.0	7.48	5900	384	25.1	0.67	0.670	0.77	0.17	0.60	0.18	1.50	2.46	0.005	
06/19/07	100	1.1	0.3	71	34	497	1.0	5.3	1340	740	0.249	0.020	0.13	0.15	0.141	1.0	7.10	3000	356	26.7	n/a	0.580	0.73	0.40	0.33	0.21	2.75	3.97	0.005	2.0
07/17/07	120	1.6	0.3	64	33	719	1.0	5.1	1750	1430	0.014	0.022	0.07	0.09	0.062	1.9	7.60	1100	393	27.3	258	0.470	0.56	0.10	0.46	0.13	2.00	6.51	0.005	

Note 1: Metal standards are based on a total hardness of 130 mg/L as measured in historical data.
Note 2: BMDL = *Below Method Detection Limit* .
Note 3: For detailed site locations, refer to Table 7-2
Sources: Lee County Laboratory, 2005 - 2007.
Florida Department of Environmental Protection, 2006.
ECT, 2006 and 2007.

TABLE 7-12

WATER QUALITY MONITORING STATION
NORTH COLONIAL WATERWAY AT RAILROAD BOX CULVERT, WEST OF METRO PARKWAY (CFMCOLONIAL)

	AL-ICP	BOD	CD	CL	COD	COND Field	CU	DO FIELD	ENTERO 10	FCMF 10	NH3	NO2	NO3	NOX	O-PO4	PB	pH Field	TCMF05	TDS	TEMP Field	Total HARD	TKN	TN	In-Org-N	Org-N	T-PO4	TSS	TURB	ZN	Disch.
	mg/L	mg/L	ug/L	mg/L	mg/L	UMHOS/CM	ug/L	mg/L	col/ 100ML	col/ 100ML	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	UNITS	col/100ML	mg/L	°C	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	NTU	mg/L	cfs
Class III Std.			≤ 1.3	<1500		<1275	≤ 12	> 5	mean<33	mean<200 :max<800	≤ 0.02					< 4.4	6.0>8.5				Need for metals									
LCEL MDL	100	0.3	var.	1	10	1	1	0.1	10	10	0.01	0.002	0.01	0.01	0.008	1	0.1	20	5.5	0.1		0.1	0.11			0.02	0.6	0.2	0.01	
Date																														
04/27/05		1.3	0.4	79		703	1.0	7.5	480	10	0.019	0.004	0.03	0.03	0.013	1.0	7.72	5		24.2		0.390	0.42	0.05	0.37	0.04	3.00	2.40	0.004	
05/18/05		1.9	0.4	74		675	1.0	5.1	10	10	0.074	0.006	0.01	0.01	0.008	1.0	7.81	100		28.2		0.620	0.63	0.08	0.55	0.03	1.80	1.05	0.004	
06/08/05		2.1	0.4	70		612	2.0	5.2	60	100	0.076	0.002	0.01	0.01	0.008	1.0	7.70	400		29.3		0.350	0.36	0.09	0.27	0.03	3.80	2.20	0.010	
07/14/05		1.3	0.4	59		611	1.0	5.4	10	20	0.080	0.022	0.03	0.05	0.004	1.0	7.48	200		30.2		0.870	0.92	0.13	0.79	0.02	1.70	1.27	0.010	
08/09/05		2.6	0.4	53		533	1.0	7.4	380	410	0.047	0.007	0.03	0.04	0.005	1.0	7.95	5		28.7		0.920	0.04	0.09	0.87	0.04	31.50	6.20	0.010	
09/14/05		1.1	0.4	63		717	1.0	7.5	10	10	0.065	0.008	0.04	0.05	0.004	1.0	7.48	260		30.6		0.820	0.87	0.12	0.76	0.02	1.00	1.24	0.010	
10/26/05		2.7	0.4	36		381	1.0	5.5	130	1340	0.062	0.009	0.05	0.06	0.004	1.0	7.46	1680		21.4		0.120	0.18	0.12	0.06	0.02	4.50	3.80	0.010	
11/09/05		2.1	0.4	66		657	1.0	5.6	10	10	0.101	0.008	0.05	0.06	0.004	1.0	7.45	100		25.7		1.020	1.10	0.16	0.92	0.02	6.00	1.76	0.010	
12/01/05		1.4	0.4	57		674	1.0	6.1	70	40	0.151	0.011	0.09	0.10	0.004	1.0	7.39	300		20.4		0.980	1.10	0.25	0.83	0.02	3.80	1.62	0.010	
01/17/06		1.7	0.4	84		790	1.0	8.0	10	10	0.063	0.006	0.02	0.03	0.004	1.0	7.58	220		17.4		80.000	0.83	0.09	79.94	0.02	2.00	0.73	0.010	
02/06/06		2.6	0.4	86		631	1.0	8.2	110	110	0.035	0.007	0.01	0.02	0.004	1.0	7.39	30		18.2		0.490	0.51	0.06	0.46	0.02	2.50	1.58	0.010	
03/06/06		0.8	0.4	105		798	1.0	7.5	10	10	0.060	0.005	0.02	0.02	0.004	1.0	8.06	40		23.2		0.850	0.87	0.08	0.79	0.02	1.80	0.81	0.010	
04/11/06	n/a	1.1	0.4	109	n/a	857	1.0	80.0	10	10	0.050	0.002	0.02	0.02	0.004	1.0	7.59	220	n/a	23.9		0.870	0.89	0.07	0.82	0.02	1.50	2.60	0.010	
05/08/06	n/a	1.6	0.4	95	n/a	953	1.0	5.2	60	60	0.077	0.002	0.05	0.05	0.006	1.0	7.90	360	n/a	28.9		0.910	0.96	0.13	0.83	0.04	3.30	1.24	0.010	
06/27/06	n/a	1.9	0.4	26	n/a	530	1.0	5.9	90	210	0.090	0.008	0.01	0.02	0.004	1.0	7.46	520	n/a	28.9		0.650	0.67	0.11	0.56	0.05	5.00	3.10	0.010	
07/28/06	n/a	0.3	0.3	33	n/a	713	1.0	5.4	30	20	0.097	0.005	0.04	0.05	0.004	1.0	7.46	180	n/a	29.6		0.700	0.75	0.15	0.60	0.03	3.25	1.60	0.010	
08/29/06	n/a	2.2	0.3	34	n/a	598	1.0	6.8	1300	50	0.063	0.002	0.04	0.04	0.004	1.0	7.75	260	n/a	31		0.670	0.71	0.10	0.61	0.02	6.50	1.90	0.010	
09/18/06	n/a	1.6	0.3	43	n/a	553	1.0	5.0	150	110	0.073	0.009	0.04	0.05	0.004	1.0	7.25	170	n/a	28.5		0.590	0.64	0.12	0.52	0.02	5.00	1.94	0.005	54
10/26/06	n/a	1.0	0.3	40	n/a	748	1.0	7.0	10	10	0.137	0.004	0.04	0.04	0.004	1.0	7.72	180	n/a	24.6		0.620	0.66	0.18	0.48	0.03	0.60	0.69	0.005	0
11/08/06	n/a	0.8	0.3	43	n/a	761	1.0	3.7	10	50	0.073	0.003	0.03	0.03	0.004	1.0	7.43	(TNTC)	n/a	24.3		0.540	0.57	0.10	0.47	0.02	1.75	1.50	0.005	
12/06/06	n/a	1.1	0.3	40	n/a	672	1.0	6.4	20	10	0.130	0.006	0.02	0.03	0.004	1.0	7.79	(TNTC)	n/a	21.5		0.760	0.79	0.16	0.63	0.02	1.25	0.94	0.005	
01/25/07	100	1.5	0.3	96	13	733	5.4	5.4	60	20	0.213	0.002	0.06	0.06	0.007	1.0	8.17	300	488	20.7		0.960	1.02	0.27	0.75	0.04	3.75	1.61	0.005	
02/08/07	100	0.4	0.3	102	21	780	1.0	6.2	20	10	0.112	0.002	0.02	0.02	0.004	1.0	7.72	200	134	19.3		0.560	0.58	0.13	0.45	0.02	2.75	1.12	0.005	
03/20/07	100	0.7	0.3	115	40	845	1.3	7.1	10	10	0.069	0.002	0.04	0.04	0.004	1.0	8.05	400	572	20.8		0.590	0.63	0.11	0.52	0.02	2.75	1.27	0.005	
04/24/07	100	0.6	0.3	123	26	948	1.0	7.3	10	10	0.072	0.002	0.04	0.04	0.004	1.0	8.14	100	430	24.3	n/a	0.790	0.83	0.11	0.72	0.02	1.50	1.77	0.005	
05/29/07	100	1.6	0.3	55	43	637	1.1	7.5	10	10	0.136	0.002	0.03	0.03	0.005	1.0	7.88	100	384	25.8	n/a	0.930	0.96	0.17	0.79	0.03	4.00	1.78	0.005	
06/19/07	100	2.5	0.3	91	31	520	1.0	5.6	20	30	0.068	0.002	0.02	0.02	0.004	1.0	7.60	200	381	27.4	0.66	0.680	0.03	0.09	0.61	0.03	10.50	1.67	0.005	4.7
07/17/07	100	2.3	0.3	132	36	948	1.0	6.2	30	100	0.014	0.004	0.01	0.01	0.004	1.06	7.82	300	427	31.6	266	0.580	0.59	0.02	0.57	0.03	3.00	1.67	0.005	

Note 1: Metal standards are based on a total hardness of 130 mg/L as measured in historical data.
Note 2: BMDL = *Below Method Detection Limit* .
Note 3: For detailed site locations, refer to Table 7-2
Sources: Lee County Laboratory, 2005 - 2007.
Florida Department of Environmental Protection, 2006.
ECT, 2006 and 2007.

TABLE 7-13

WATER QUALITY MONITORING STATION
CARRELL CANAL, UPSTREAM OF FORT MYERS COUNTRY CLUB WEIR (CFMCARRELL)

	AL-ICP	BOD	CD	CL	COD	COND Field	CU	DO FIELD	ENTERO 10	FCMF 10	NH3	NO2	NO3	NOX	O-PO4	PB	pH Field	TCMF05	TDS	TEMP Field	Total HARD	TKN	TN	In-Org-N	Org-N	T-PO4	TSS	TURB	ZN	Disch.
	mg/L	mg/L	ug/L	mg/L	mg/L	UMHOS/CM	ug/L	mg/L	col/ 100ML	col/ 100ML	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	UNITS	col/100ML	mg/L	°C	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	NTU	mg/L	cfs
Class III Std.			≤ 1.3	<1500		<1275	≤ 12	> 5	mean<33	mean<200 :max<800	≤ 0.02					< 4.4	6.0>8.5				Need for metals									
LCEL MDL	100	0.3	var.	1	10	1	1	0.1	10	10	0.01	0.002	0.01	0.01	0.008	1	0.1	20	5.5	0.1		0.1	0.11			0.02	0.6	0.2	0.01	
Date																														
04/27/05		2.2	0.4	35		375	1.0	3.4	10	10	0.013	0.010	0.07	0.08	0.027	1.0	7.00	5		22.4		0.210	0.29	0.09	0.197	0.05	1.00	2.50	0.004	
05/18/05		2.7	0.4	68		516	1.0	8.9	180	110	0.013	0.003	0.01	0.01	0.008	1.0	7.76	400		26.4		0.890	0.90	0.02	0.877	0.04	2.00	0.74	0.004	
06/08/05		2.4	0.4	52		542	1.0	5.6	710	550	0.029	0.002	0.01	0.01	0.050	1.0	7.23	600		27.7		0.880	0.89	0.04	0.851	0.10	8.50	1.60	0.010	
07/14/05		0.7	0.4	59		638	1.0	0.8	180	190	0.057	0.048	0.07	0.12	0.082	1.0	7.02	440		28.2		0.650	0.77	0.18	0.593	0.10	0.60	1.92	0.010	
08/09/05		1.4	0.0	43		271	1.0	3.1	10	1760	0.039	0.013	0.10	0.11	0.067	1.0	7.73	5		27		0.500	0.61	0.15	0.461	0.11	3.80	5.60	0.010	
09/14/05		2.8	0.4	60		677	1.0	6.4	330	410	0.016	0.006	0.01	0.01	0.106	1.0	7.29	1520		29.4		0.950	0.96	0.03	0.934	0.13	5.50	1.88	0.010	
10/26/05		1.6	0.4	41		494	1.0	3.0	970	10	0.311	0.018	0.17	0.19	0.123	1.0	7.20	20		21.3		0.560	0.75	0.50	0.249	0.16	2.70	1.90	0.010	
11/09/05		2.8	0.4	70		715	1.0	7.2	60	90	0.029	0.014	0.12	0.13	0.017	1.0	7.25	760		24.6		1.180	1.30	0.16	1.151	0.08	3.30	1.49	0.010	
12/01/05		1.2	0.4	33		359	1.0	4.0	120	510	0.193	0.017	0.12	0.14	0.047	1.0	7.02	640		20.4		0.660	0.80	0.33	0.467	0.09	3.30	1.55	0.010	
01/17/06		1.3	0.4	66		730	1.0	7.8	320	200	0.057	0.005	0.04	0.04	0.004	1.0	6.95	320		16.9		0.950	0.99	0.10	0.893	0.06	2.20	0.98	0.010	
02/06/06		1.8	0.4	23		225	1.0	6.0	450	420	0.081	0.015	0.16	0.18	0.087	1.0	7.01	360		17.2		0.430	0.61	0.26	0.349	0.13	3.20	6.10	0.010	
03/06/06		2.7	0.4	70		627	1.0	8.7	140	140	0.033	0.006	0.01	0.01	0.024	1.0	7.93	380		21.6		0.920	0.93	0.04	0.887	0.05	2.30	1.03	0.010	
04/11/06	n/a	1.1	0.4	61	n/a	419	1.0	9.4	730	410	0.048	0.002	0.01	0.01	0.017	1.0	7.24	900	n/a	22.6		1.020	1.03	0.06	0.972	0.05	2.30	2.40	0.010	
05/08/06	n/a	2.5	0.4	29	n/a	560	1.0	6.3	260	190	0.039	0.002	0.01	0.01	0.017	1.0	9.13	680	n/a	27.4		1.320	1.33	0.05	1.281	0.07	2.50	1.72	0.010	
06/27/06	n/a	1.6	0.4	21	n/a	329	1.0	5.1	150	330	0.032	0.016	0.14	0.16	0.065	1.0	7.31	500	n/a	28		0.510	0.67	0.19	0.478	0.10	0.60	1.55	0.010	6.4
07/28/06	n/a	0.9	0.3	34	n/a	661	1.0	2.4	220	210	0.083	0.017	0.18	0.20	0.065	1.0	7.25	20	n/a	28.1		0.600	0.80	0.28	0.517	0.09	2.75	2.70	0.010	
08/29/06	n/a	3.0	0.3	35	n/a	613	1.0	5.4	260	930	0.199	0.033	0.19	0.22	0.064	1.0	7.38	80	n/a	29.1		0.780	1.00	0.42	0.581	0.13	20.00	4.10	0.010	
09/18/06	n/a	2.1	0.3	20	n/a	334	1.0	5.3	1820	1870	0.128	0.016	0.15	0.17	0.119	1.0	7.42	confluent	n/a	26.4		0.970	1.14	0.30	0.842	0.26	79.50	5.20	0.005	
10/26/06	n/a	0.8	0.3	41	n/a	707	1.0	7.2	30	80	0.114	0.006	0.03	0.04	0.023	1.0	7.87	180	n/a	22.2		0.700	0.74	0.15	0.586	0.06	2.25	1.21	0.005	0
11/08/06	n/a	2.4	0.3	39.5	n/a	706	1.0	7.2	1120	1210	0.051	0.004	0.10	0.10	0.046	1.0	7.11	(TNTC)	n/a	23.6		0.740	0.84	0.15	0.689	0.14	5.50	4.43	0.005	
12/06/06	n/a	1.5	0.3	37	n/a	637	1.0	8.3	100	30	0.041	0.010	0.08	0.09	0.019	1.0	7.74	(TNTC)	n/a	20.6		0.830	0.92	0.13	0.789	0.06	2.50	1.28	0.005	
01/25/07	100	1.4	0.3	77	21	621	1.0	7.5	720	200	0.027	0.002	0.02	0.02	0.022	1.0	7.87	9800	440	20.8		1.000	1.02	0.05	0.973	0.07	2.00	1.26	0.005	
02/08/07	100	1.3	0.3	81	36	628	1.0	6.1	50	10	0.022	0.002	0.01	0.01	0.012	1.0	7.61	100	383	17.4		0.840	0.85	0.03	0.818	0.05	1.75	1.48	0.005	
03/20/07	150	1.7	0.3	99	35	770	1.0	9.7	410	220	0.014	0.007	0.01	0.01	0.006	1.0	8.10	100	500	20.8		0.940	0.95	0.02	0.926	0.05	1.00	2.85	0.005	
04/24/07	140	1.0	0.3	77.9	34	583	1.0	10.1	80	220	0.022	0.002	0.01	0.01	0.010	1.0	8.85	600	279	24.6	n/a	0.720	0.73	0.03	0.698	0.04	0.60	1.79	0.005	
05/29/07	100	1.7	0.3	52.9	30	408	1.0	9.2	170	180	0.034	0.002	0.01	0.01	0.013	1.0	8.48	100	189	26	n/a	0.760	0.77	0.04	0.726	0.04	1.75	0.84	0.005	
06/19/07	180	1.9	0.3	8.4	26	245	1.0	3.3	800	130	0.570	0.002	0.03	0.03	0.029	1.0	7.10	400	254	27.6	n/a	0.470	0.50	0.60	0.100	0.066	10.00	1.52	0.005	1.63
07/17/07	200	5.6	0.3	46.2	42	387	1.0	0.5	1140	10	0.014	0.050	0.01	0.01	0.028	1.6	7.92	1500	255	28.5	124	1.100	1.10	0.02	1.086	0.52	14.50	3.17	0.005	

Note 1: Metal standards are based on a total hardness of 130 mg/L as measured in historical data.
Note 2: BMDL = *Below Method Detection Limit* .
Note 3: For detailed site locations, refer to Table 7-2
Sources: Lee County Laboratory, 2005 - 2007.
Florida Department of Environmental Protection, 2006.
ECT, 2006 and 2007.

TABLE 7-14

WATER QUALITY MONITORING STATION
WINKLER CANAL CULVERT AT McGREGOR BLVD. AND ROGERS WEIR (CFMWINKLER)

	AL-ICP	BOD	CD	CL	COD	COND Field	CU	DO FIELD	ENTERO 10	FCMF 10	NH3	NO2	NO3	NOX	O-PO4	PB	pH Field	TCMF05	TDS	TEMP Field	Total HARD	TKN	TN	In-Org-N	Org-N	T-PO4	TSS	TURB	ZN	Disch.
	mg/L	mg/L	ug/L	mg/L	mg/L	UMHOS/CM	ug/L	mg/L	col/ 100ML	col/ 100ML	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	UNITS	col/100ML	mg/L	°C	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	NTU	mg/L	cfs
Class III Std.			≤ 1.3	<1500		<1275	≤ 12	> 5	mean<33	mean<200 :max<800	≤ 0.02					< 4.4	6.0>8.5				Need for metals									
LCEL MDL	100	0.3	var.	1	10	1	1	0.1	10	10	0.01	0.002	0.01	0.01	0.008	1	0.1	20	5.5	0.1		0.1	0.11			0.02	0.6	0.2	0.01	
Date																														
04/27/05		4.1	0.4	43		285	1.0	7.1	10	10	0.124	0.012	0.15	0.16	0.056	1.0	6.97	5		21.9		0.410	0.57	0.28	0.29	0.10	3.50	3.60	0.006	
05/18/05		2.4	0.4	107		722	7.6	1.8	200	330	0.097	0.011	0.01	0.02	0.008	1.0	7.42	1360		26.6		0.700	0.72	0.12	0.60	0.10	2.00	0.90	0.004	2.8
06/08/05		2.8	0.4	69		483	10.1	5.5	1810	10	0.120	0.002	0.01	0.01	0.060	1.0	7.12	5		26.6		0.520	0.53	0.13	0.40	0.11	3.80	2.30	0.010	
07/14/05		1.1	0.4	53		477	1.0	4.4	550	1220	0.133	0.040	0.21	0.25	0.070	1.0	7.08	560		27.7		0.750	1.00	0.38	0.62	0.09	1.00	1.40	0.010	
08/09/05		1.5	0.4	22		374	1.0	7.6	1030	1450	0.048	0.014	0.12	0.13	0.072	1.0	7.68	5		27.5		0.580	0.71	0.18	0.53	0.12	3.50	3.60	0.010	
09/14/05		2.9	0.4	145		977	1.0	4.5	190	270	0.040	0.006	0.01	0.02	0.060	1.0	7.15	1420		28.8		0.630	0.65	0.06	0.59	0.08	4.20	1.78	0.010	
10/26/05		1.9	0.4	76		622	1.0	6.1	1720	10	0.175	0.016	0.10	0.12	0.071	1.0	7.01	20		21.9		0.610	0.73	0.30	0.44	0.13	4.50	3.40	0.010	>2.0
11/09/05		1.9	0.4	90		885	1.0	4.8	160	240	0.049	0.011	0.06	0.07	0.033	1.0	7.06	1780		24.8		0.500	0.57	0.12	0.45	0.06	1.50	1.12	0.010	
12/01/05		1.3	0.4	67		514	10.0	4.6	350	240	0.074	0.012	0.07	0.08	0.052	1.0	6.88	480		20.4		0.600	0.68	0.15	0.53	0.08	1.70	1.04	0.010	
01/17/06		2.4	0.4	169		1080	1.0	3.8	270	800	0.051	0.007	0.02	0.03	0.051	1.0	6.53	260		18		0.530	0.56	0.08	0.48	0.06	1.80	1.90	0.010	
02/06/06		1.7	0.4	81		458	1.0	4.7	230	350	0.080	0.013	0.06	0.07	0.069	1.0	6.88	120		18.2		0.520	0.59	0.15	0.44	0.11	5.00	2.50	0.010	
03/06/06		1.2	0.4	153		931	1.0	2.8	430	160	0.102	0.014	0.05	0.06	0.062	1.0	7.47	300		21.3		0.660	0.72	0.16	0.56	0.07	1.20	0.42	0.010	
04/11/06	n/a	1.7	0.4	199	n/a	1170	1.0	2.3	140	170	0.013	0.002	0.01	0.01	0.040	1.0	6.80	360	n/a	22.7	n/a	0.560	0.57	0.02	0.55	0.07	2.00	0.40	0.010	
05/08/06	n/a	2.2	0.4	149	n/a	1370	1.0	2.1	460	470	0.078	0.004	0.01	0.01	0.061	1.0	7.32	5	n/a	25.6	n/a	0.840	0.85	0.09	0.76	0.12	2.30	1.62	0.010	
06/27/06	n/a	2.3	0.4	28	n/a	540	1.0	5.1	400	940	0.130	0.018	0.09	0.11	0.048	1.0	7.21	5	n/a	27.3	n/a	0.610	0.72	0.24	0.48	0.08	1.00	1.14	0.010	
07/28/06	n/a	1.3	0.3	38	n/a	740	1.0	3.6	330	280	0.114	0.012	0.12	0.13	0.068	1.0	7.31	20	n/a	27.7	n/a	0.400	0.53	0.24	0.29	0.09	2.00	1.32	0.010	
08/29/06	n/a	2.9	0.3	26	n/a	417	1.0	5.6	1180	1120	0.050	0.006	0.20	0.21	0.054	1.0	7.41	20	n/a	28.2	n/a	0.320	0.53	0.26	0.27	0.07	1.00	1.78	0.010	
09/18/06	n/a	1.9	0.3	43	n/a	406	1.0	5.8	1680	2180	0.069	0.017	0.11	0.13	0.083	1.0	7.41	confluent	n/a	26.8	n/a	0.600	0.73	0.20	0.53	0.13	7.50	9.60	0.005	4.11
10/26/06	n/a	0.9	0.3	51	n/a	929	1.0	2.5	80	30	0.088	0.007	0.04	0.05	0.031	1.0	7.53	5	n/a	22.3	n/a	0.460	0.51	0.14	0.37	0.06	1.50	0.64	0.005	
11/08/06	n/a	1.8	0.3	37	n/a	662	1.0	3.9	840	570	0.057	0.010	0.07	0.08	0.051	1.0	6.94	(TNTC)	n/a	24.3	n/a	0.410	0.49	0.14	0.35	0.09	1.25	1.56	0.005	
12/06/06	n/a	2.7	0.3	47	n/a	866	1.0	3.8	20	190	0.030	0.006	0.03	0.04	0.051	1.0	7.39	(TNTC)	n/a	20.7	n/a	0.800	0.84	0.07	0.77	0.09	14.00	0.54	0.005	
01/25/07	100	1.2	0.3	138	10	883	10.0	2.6	1200	1140	0.030	0.002	0.05	0.05	0.084	1.0	7.33	5100	1090	20.8	n/a	0.860	0.91	0.08	0.83	0.18	4.75	0.67	0.005	
02/08/07	100	0.8	0.3	120	11	819	1.7	5.2	430	50	0.026	0.002	0.02	0.02	0.174	1.0	7.52	700	569	18.8	260	0.330	0.35	0.05	0.30	0.19	0.60	0.86	0.005	
03/20/07	100	1.1	0.3	156	31	965	1.0	1.8	120	130	0.014	0.009	0.01	0.01	0.138	1.0	7.47	100	632	20.5	n/a	0.750	0.76	0.02	0.74	0.18	3.50	0.58	0.005	
04/24/07	100	1.8	0.3	127	29	916	1.0	2.0	310	10	0.053	0.002	0.01	0.01	0.275	1.0	7.48	1000	404	23.2	n/a	0.63	0.64	0.06	0.58	0.390	4.50	1.22	0.005	
05/29/07	100	2.0	0.3	155	28	1030	1.0	4.0	250	130	0.060	0.002	0.01	0.01	0.051	1.0	7.47	600	528	25.1	0.640	0.65	0.09	0.07	0.59	0.086	1.00	0.82	0.005	
06/19/07	110	0.7	0.3	121	32	514	1.1	3.9	300	520	0.077	0.013	0.06	0.07	0.048	1.0	7.00	1200	338	27.7	182	0.52	0.59	0.15	0.44	0.100	3.25	2.30	0.005	
07/17/07	100	2.0	0.3	80	24	595	2.5	3.8	330	1220	0.037	0.006	0.01	0.02	0.042	1.0	7.56	2600	285	28.2	166	0.43	0.45	0.06	0.39	0.093	1.75	0.85	0.005	

Note 1: Metal standards are based on a total hardness of 130 mg/L as measured in historical data.
Note 2: BMDL = *Below Method Detection Limit*.
Note 3: For detailed site locations, refer to Table 7-2
Sources: Lee County Laboratory, 2005 - 2007.
Florida Department of Environmental Protection, 2006.
ECT, 2006 and 2007.

TABLE 7-15

WATER QUALITY MONITORING STATION
L-3 CANAL AT BOY SCOUT ROAD (CFML-3)

	AL-ICP	BOD	CD	CL	COD	COND Field	CU	DO FIELD	ENTERO 10	FCMF 10	NH3	NO2	NO3	NOX	O-PO4	PB	pH Field	TCMF05	TDS	TEMP Field	Total HARD	TKN	TN	In-Org-N	Org-N	T-PO4	TSS	TURB	ZN	Disch.
	mg/L	mg/L	ug/L	mg/L	mg/L	UMHOS /CM	ug/L	mg/L	col/ 100ML	col/ 100ML	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	UNITS	col/100ML	mg/L	°C	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	NTU	mg/L	cfs
Class III Std.			≤ 1.3	<1500		<1275	≤ 12	> 5	mean<33	mean<200 :max<800	≤ 0.02					< 4.4	6.0>8.5				Need for metals									Disch from Galloway Canal
LCEL MDL	100	0.3	var.	1	10	1	1	0.1	10	10	0.01	0.002	0.01	0.01	0.008	1	0.1	20	5.5	0.1		0.1	0.11			0.02	0.6	0.2	0.01	
Date																														
04/27/05		2.3	0.4	100		582	1.0	5.4	10	10	0.031	0.009	0.10	0.11	0.019	1.0	6.76	5		22.2		0.330	0.44	0.14	0.30	0.04	1.50	2.40	0.004	
05/18/05		107.0	0.4	224		1300	1.6	1.4	40	80	0.013	0.003	0.01	0.01	0.008	1.0	6.95	340		26.1		0.450	0.46	0.02	0.44	0.02	0.60	0.40	0.004	
06/08/05		0.3	0.4	81		664	1.0	2.7	290	320	0.067	0.020	0.02	0.02	0.012	1.0	6.72	1040		27.4		0.620	0.64	0.09	0.55	0.03	0.60	0.55	0.010	
07/14/05		0.4	0.4	93.1		682	1.0	1.6	370	210	0.086	0.030	0.01	0.04	0.011	1.0	6.85	720		27.7		0.510	0.55	0.13	0.42	0.02	0.60	0.63	0.010	
08/09/05		1.4	0.4	38		476	1.0	3.3	1110	10	0.027	0.005	0.04	0.04	0.013	1.0	7.63	5		27.8		0.480	0.52	0.07	0.45	0.05	18.50	1.89	0.010	
09/14/05		1.9	0.4	162		1157	1.0	1.5	40	30	0.060	0.004	0.02	0.02	0.011	1.0	7.21	220		27.3		0.410	0.43	0.08	0.35	0.05	0.70	0.53	0.010	
10/26/05		1.4	0.4	89		674	1.0	3.3	440	1800	0.095	0.012	0.06	0.07	0.018	1.0	6.70	20		21.4		0.670	0.74	0.17	0.58	0.04	6.00	1.12	0.010	
11/09/05		1.7	0.4	103		1010	1.0	2.0	50	50	0.034	0.005	0.04	0.05	0.097	1.0	6.45	660		23.8		0.29	0.34	0.08	0.26	0.13	0.70	0.64	0.010	
12/01/05		1.1	0.4	185		1080	1.0	1.9	220	30	0.033	0.009	0.03	0.04	0.007	1.0	6.66	340		19.1		0.280	0.32	0.07	0.25	0.02	1.30	0.25	0.010	
01/17/06		2.1	0.4	229		1320	1.0	5.2	30	90	0.013	0.002	0.01	0.01	0.008	1.0	6.14	340		16.5		0.400	0.41	0.02	0.39	0.02	6.50	0.57	0.010	
02/06/06		2.8	0.4	294		1250	1.0	1.9	120	90	0.026	0.020	0.05	0.07	0.008	1.0	6.77	80		17.4		0.230	0.30	0.10	0.20	0.02	1.00	2.30	0.010	
03/06/06		1.5	0.4	246		1250	1.0	4.2	60	60	0.036	0.005	0.04	0.05	0.007	1.0	7.34	360		19.9		0.370	0.42	0.09	0.33	0.02	0.60	0.23	0.010	
04/11/06	n/a	0.8	0.4	227	n/a	1290	10.0	2.0	140	300	0.020	0.002	0.01	0.01	0.004	1.0	6.67	780	n/a	20.2		0.550	0.56	0.03	0.53	0.02	0.60	1.90	0.010	
05/08/06	n/a	1.4	0.4	145	n/a	1350	1.0	0.9	20	10	0.051	0.002	0.03	0.03	0.006	1.0	7.09	5	n/a	25.6		1.070	1.10	0.08	1.02	0.03	2.00	0.57	0.010	
06/27/06	n/a	2.8	0.4	82	n/a	735	1.0	1.4	520	350	0.110	0.011	0.04	0.05	0.014	1.0	7.09	760	n/a	27.5		0.480	0.53	0.16	0.37	0.04	0.60	0.58	0.010	
07/28/06	n/a	0.5	0.3	102	n/a	966	1.0	1.2	70	120	0.071	0.006	0.04	0.05	0.015	1.0	7.12	20	n/a	27.7		0.410	0.46	0.12	0.34	0.02	1.75	0.45	0.010	
08/29/06	n/a	3.6	0.3	34	n/a	561	1.0	2.6	1020	610	0.040	0.002	0.05	0.05	0.009	1.0	7.38	260	n/a	28.8		0.410	0.46	0.09	0.37	0.03	0.60	1.04	0.010	
09/18/06	n/a	1.7	0.3	52	n/a	398	1.0	3.6	1980	2060	0.045	0.012	0.08	0.09	0.023	1.0	6.85	confluent	n/a	26.3		0.450	0.54	0.14	0.41	0.05	5.00	5.40	0.005	
10/26/06	n/a	0.7	0.3	62	n/a	1080	1.0	3.3	210	70	0.090	0.030	0.02	0.02	0.004	1.0	6.69	(TNTC)	n/a	20.4		0.290	0.31	0.11	0.20	0.02	0.60	0.28	0.005	>1.0
11/08/06	n/a	1.4	0.3	124	n/a	1190	1.0	1.7	780	740	0.014	0.002	0.01	0.01	0.004	1.0	6.58	(TNTC)	n/a	23.2		0.29	0.30	0.02	0.28	0.03	4.00	2.38	0.005	
12/06/06	n/a	0.9	0.3	116	n/a	1040	1.0	3.4	20	190	0.027	0.005	0.04	0.04	0.004	1.0	7.17	(TNTC)	n/a	18.8		0.450	0.49	0.07	0.42	0.02	0.75	0.20	0.005	
01/25/07	100	1.0	0.3	262	10	1250	1.0	3.4	790	470	0.044	0.002	0.11	0.11	0.004	1.0	6.52	1200	731	19		0.440	0.55	0.15	0.40	0.03	4.75	0.83	0.005	
02/08/07	100	0.5	0.3	250	11	1295	1.0	3.9	100	90	0.024	0.002	0.01	0.01	0.004	1.0	7.29	500	762	17.2		0.220	0.23	0.03	0.20	0.02	0.60	0.51	0.005	
03/20/07	100	0.9	0.3	238	16	1360	1.0	2.0	90	50	0.014	0.002	0.01	0.01	0.004	1.0	7.35	100	736	17.8		0.380	0.39	0.02	0.37	0.01	0.60	0.42	0.005	
04/24/07	100	1.3	0.3	231	11	1430	2.0	1.7	50	80	0.060	0.002	0.01	0.01	0.006	1.0	7.52	200	694	21.7	329	0.35	0.36	0.07	0.29	0.015	0.60	1.15	0.005	
05/29/07	130	2.0	0.3	186	19	1120	1.0	2.5	60	40	0.050	0.002	0.01	0.01	0.009	1.0	7.14	700	570	24.9	n/a	0.38	0.39	0.06	0.33	0.034	3.50	1.02	0.005	
06/19/07	100	1.1	0.3	172	17	686	1.0	1.6	490	270	0.034	0.009	0.02	0.03	0.017	1.0	6.80	1100	457	27.6	n/a	0.39	0.42	0.06	0.36	0.033	1.00	1.09	0.005	0.49
07/17/07	100	1.5	0.3	171	17	1100	1.0	1.8	180	980	0.055	0.007	0.01	0.01	0.004	1.6	7.59	700	721	28.9	270	0.27	0.28	0.07	0.22	0.032	8.50	0.74	0.005	

Note 1: Metal standards are based on a total hardness of 130 mg/L as measured in historical data.
Note 2: BMDL = *Below Method Detection Limit* .
Note 3: For detailed site locations, refer to Table 7-2
Sources: Lee County Laboratory, 2005 - 2007.
Florida Department of Environmental Protection, 2006.
ECT, 2006 and 2007.

FIGURE 7-1

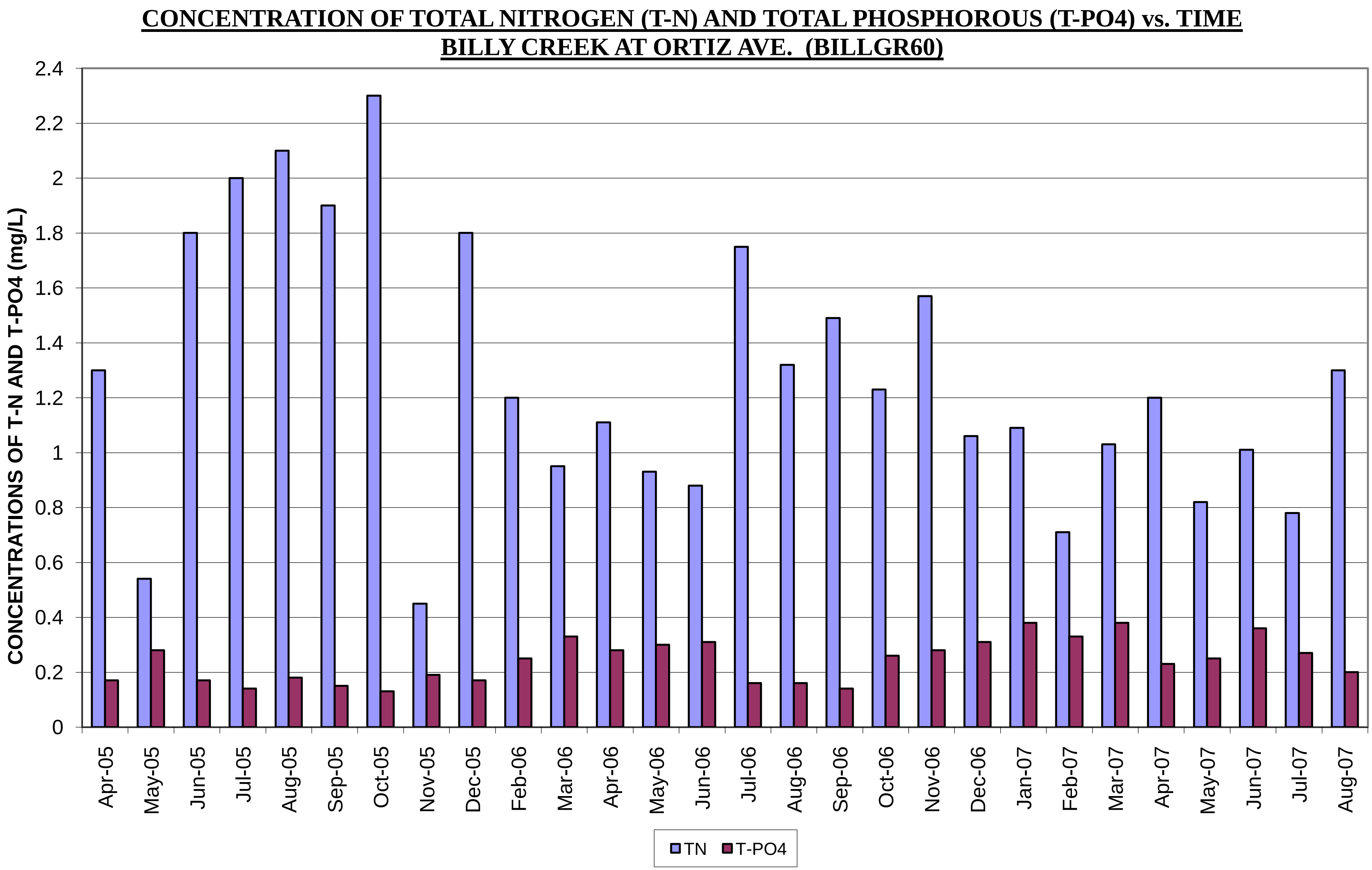

CONCENTRATION OF TOTAL NITROGEN (T-N) AND TOTAL PHOSPHOROUS (T-PO4) vs. TIME
BILLY CREEK AT ORTIZ AVE. (BILLGR60)
CONCENTRATIONS OF T-N AND T-PO4 (mg/L)
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Apr-05
May-05
Jun-05
Jul-05
Aug-05
Sep-05
Oct-05
Nov-05
Dec-05
Feb-06
Mar-06
Apr-06
May-06
Jun-06
Jul-06
Aug-06
Sep-06
Oct-06
Nov-06
Dec-06
Jan-07
Feb-07
Mar-07
Apr-07
May-07
Jun-07
Jul-07
Aug-07
TN
T-PO4

FIGURE 7-2

CONCENTRATION OF TOTAL NITROGEN (T-N) AND TOTAL PHOSPHOROUS (T-PO4) vs. TIME
CARRELL CANAL AT FORT MYERS COUNTRY CLUB WEIR (CFMCARRELL)

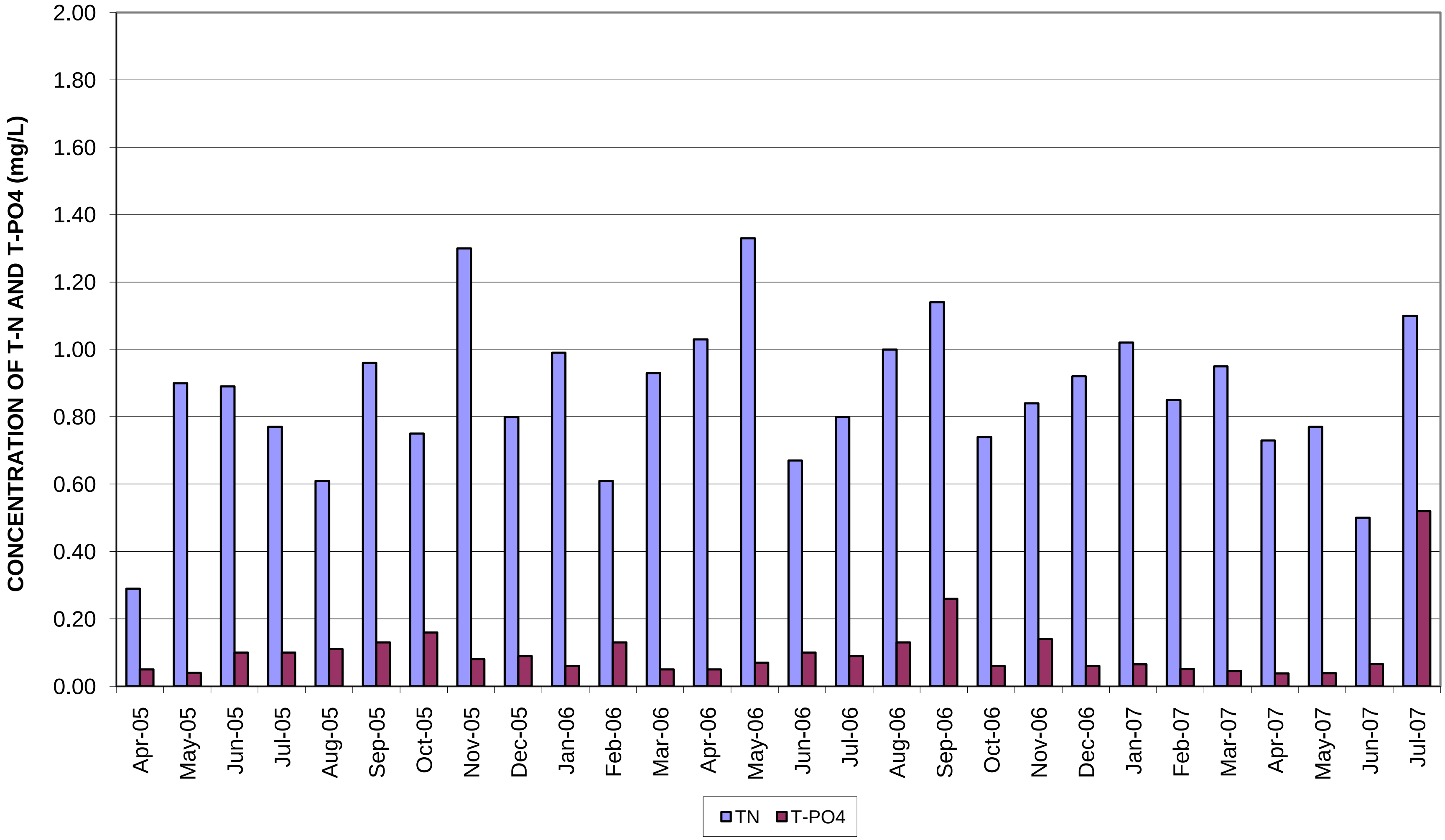


FIGURE 7-3

CONCENTRATION OF TOTAL NITROGEN (T-N) AND TOTAL PHOSPHOROUS (T-PO4) vs. TIME
FORD STREET CANAL AT FORT MYERS CEMETARY (CFMBILLY6)

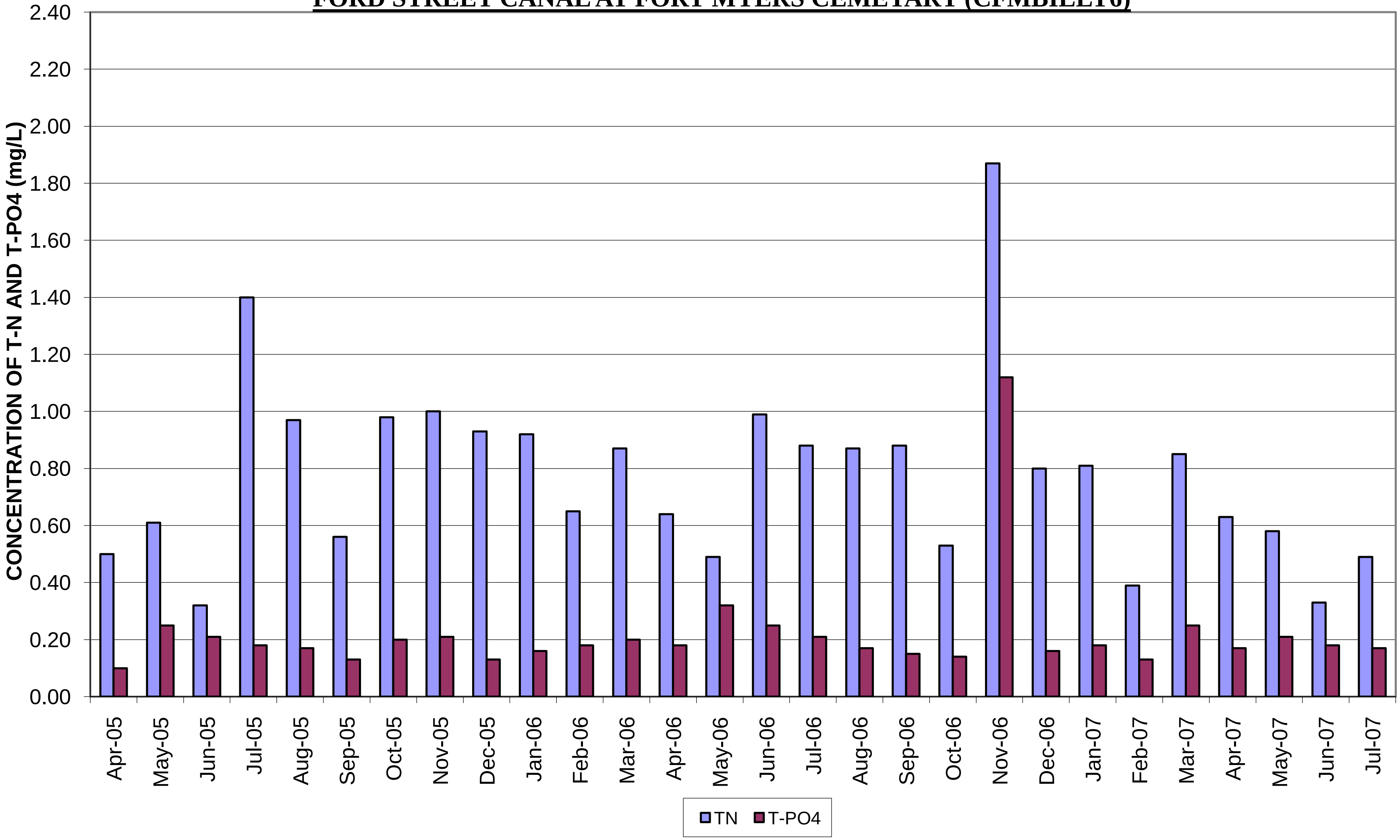


FIGURE 7-4

CONCENTRATION OF TOTAL NITROGEN (T-N) AND TOTAL PHOSPHOROUS (T-PO4) vs. TIME
L-3 CANAL AT BOY SCOUT ROAD (CFML-3)

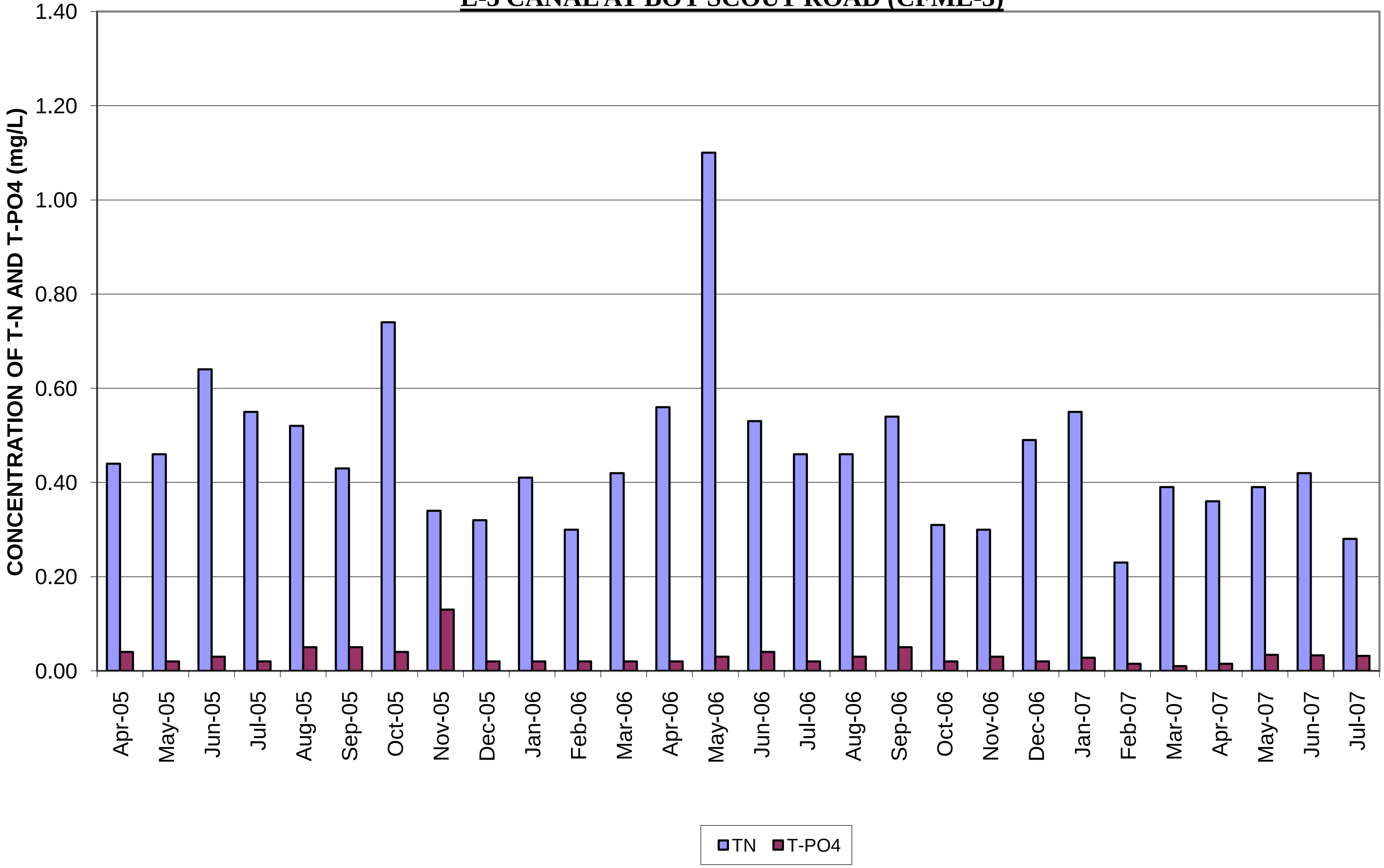


FIGURE 7-5

CONCENTRATION OF TOTAL NITROGEN (T-N) AND TOTAL PHOSPHOROUS (T-PO4) vs. TIME
MANUEL'S BRANCH CANAL, WILBUR MOORE BRIDGE AT FORT MYERS HIGH
(CFMMANUEL)

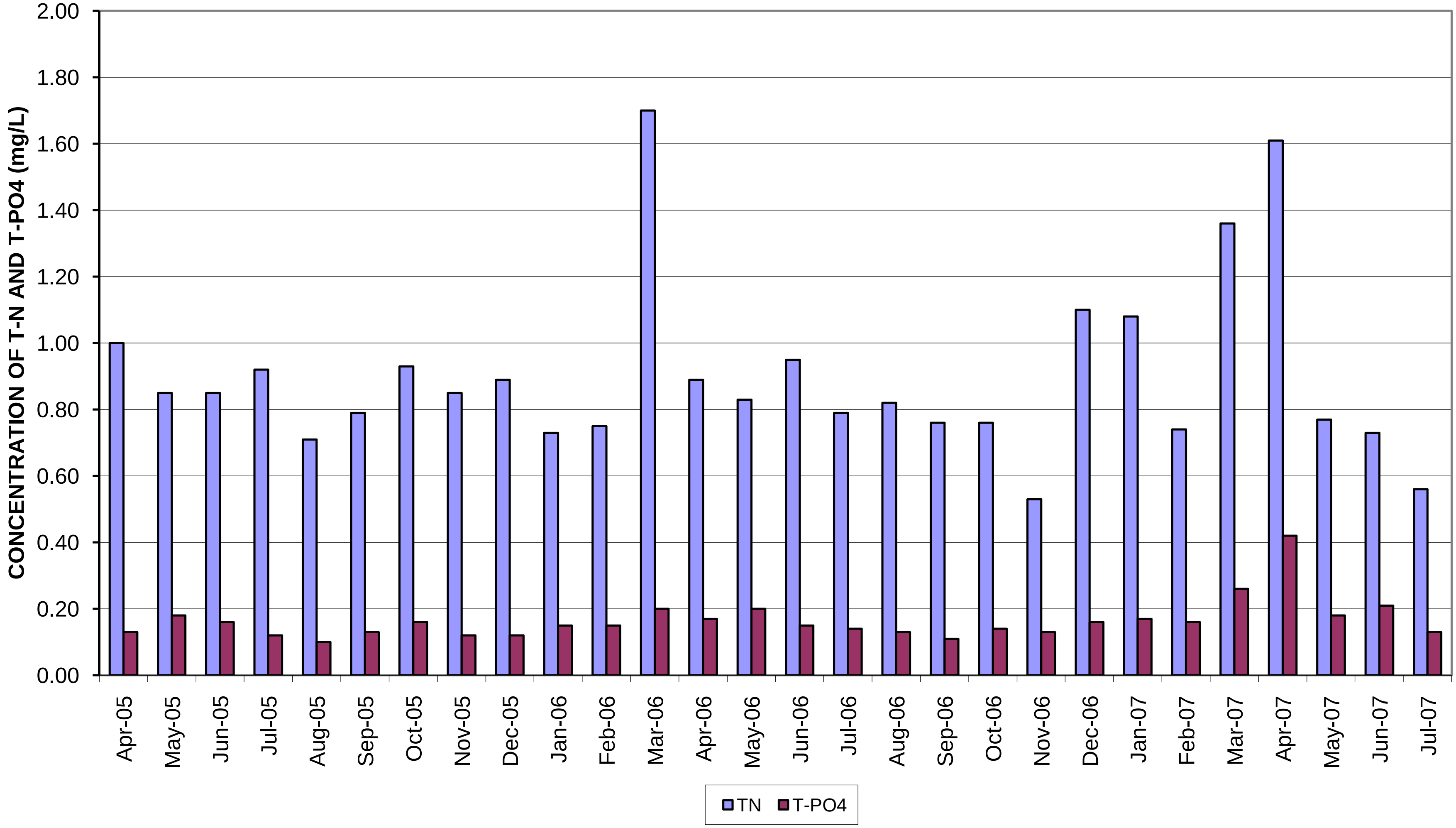


FIGURE 7-6

CONCENTRATION OF TOTAL NITROGEN (T-N) AND TOTAL PHOSPHOROUS (T-PO4) vs. TIME
NORTH COLONIAL WATERWAY AT METRO PARKWAY (CFMCOLONIAL)

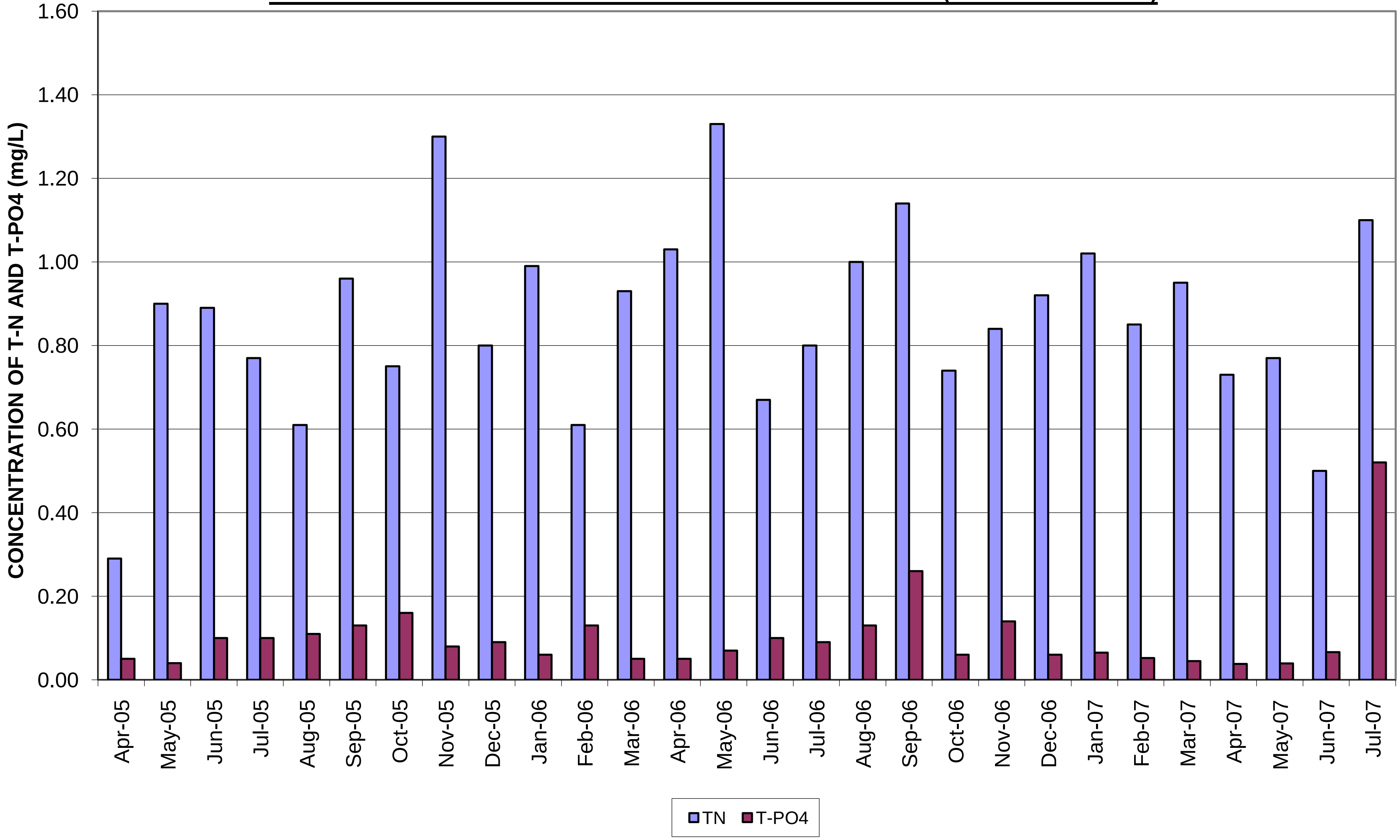


FIGURE 7-7

CONCENTRATION OF TOTAL NITROGEN (T-N) AND TOTAL PHOSPHOROUS (T-PO4) vs. TIME
SHOEMAKER CANAL AT MICHIGAN AVE. (BILLGR20)

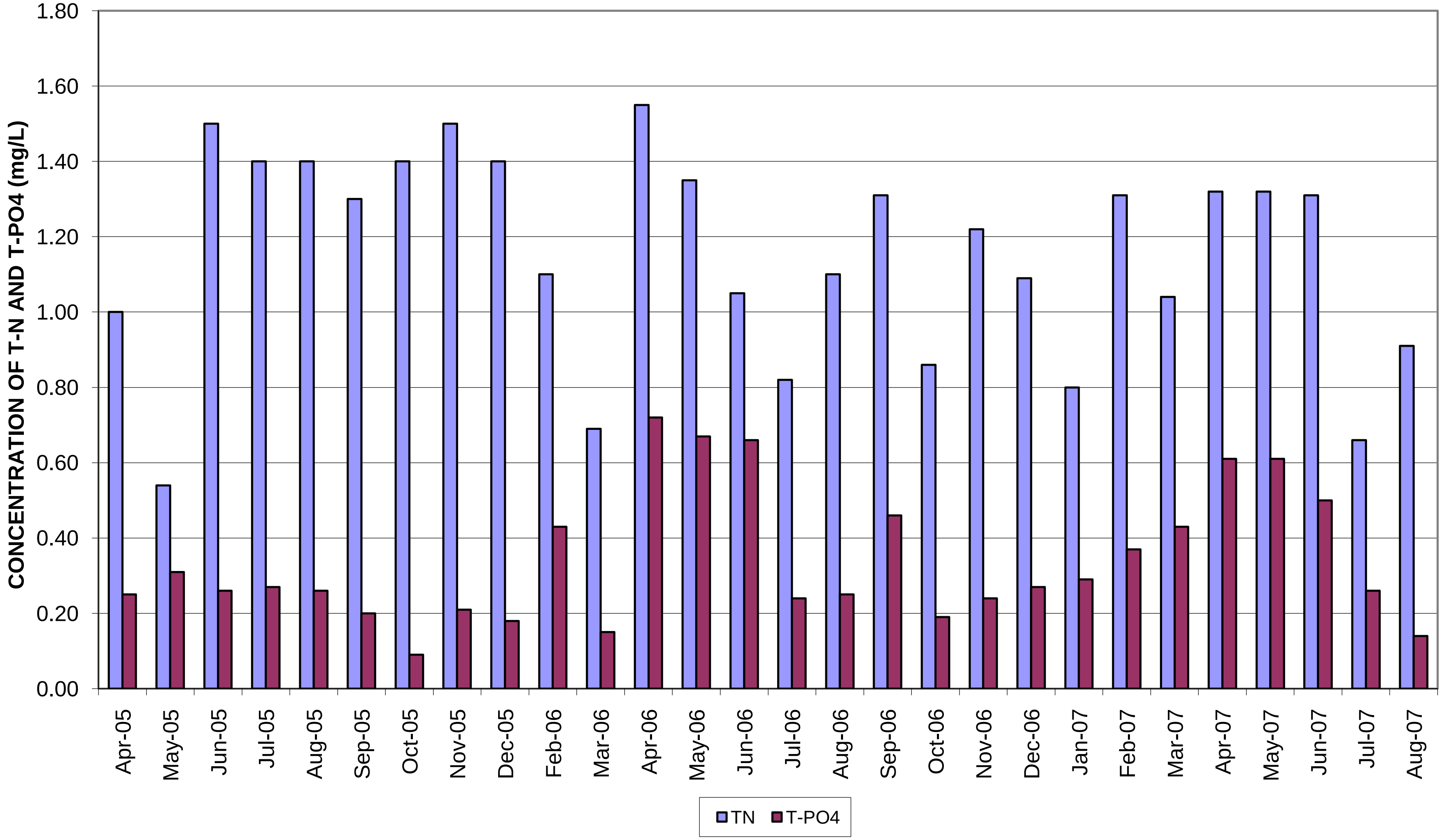


FIGURE 7-8

CONCENTRATION OF TOTAL NITROGEN (T-N) AND TOTAL PHOSPHOROUS (T-PO4) vs. TIME
WINKLER CANAL AT PRINCETON STREET (CFMWINKLER)

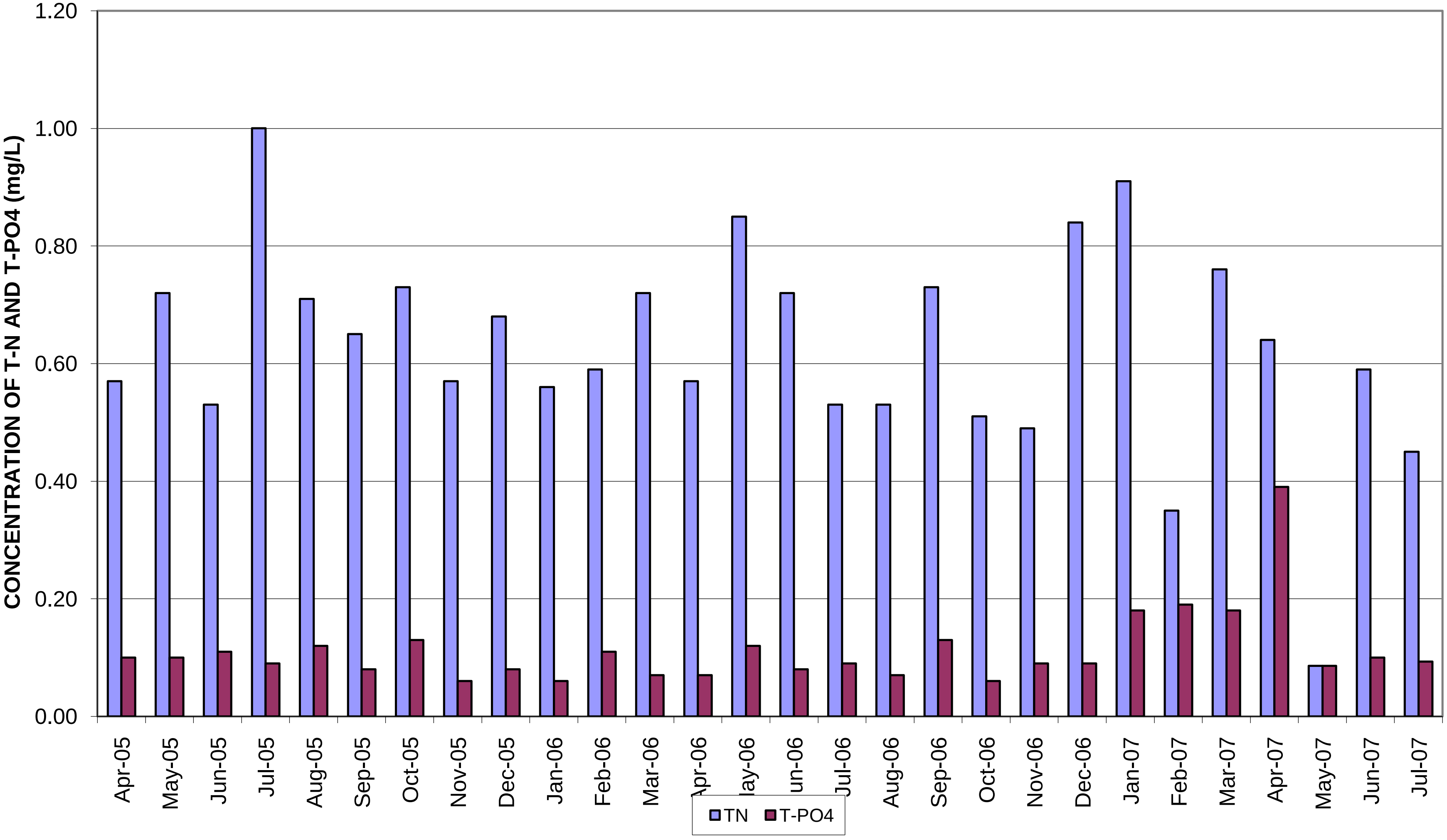


FIGURE 7-9

CONCENTRATION OF TOTAL NITROGEN (T-N) AND TOTAL PHOSPHOROUS (T-PO4) vs. TIME
ZAPATO CANAL AT MEADOWVIEW CIRCLE (CFMBILLY3)

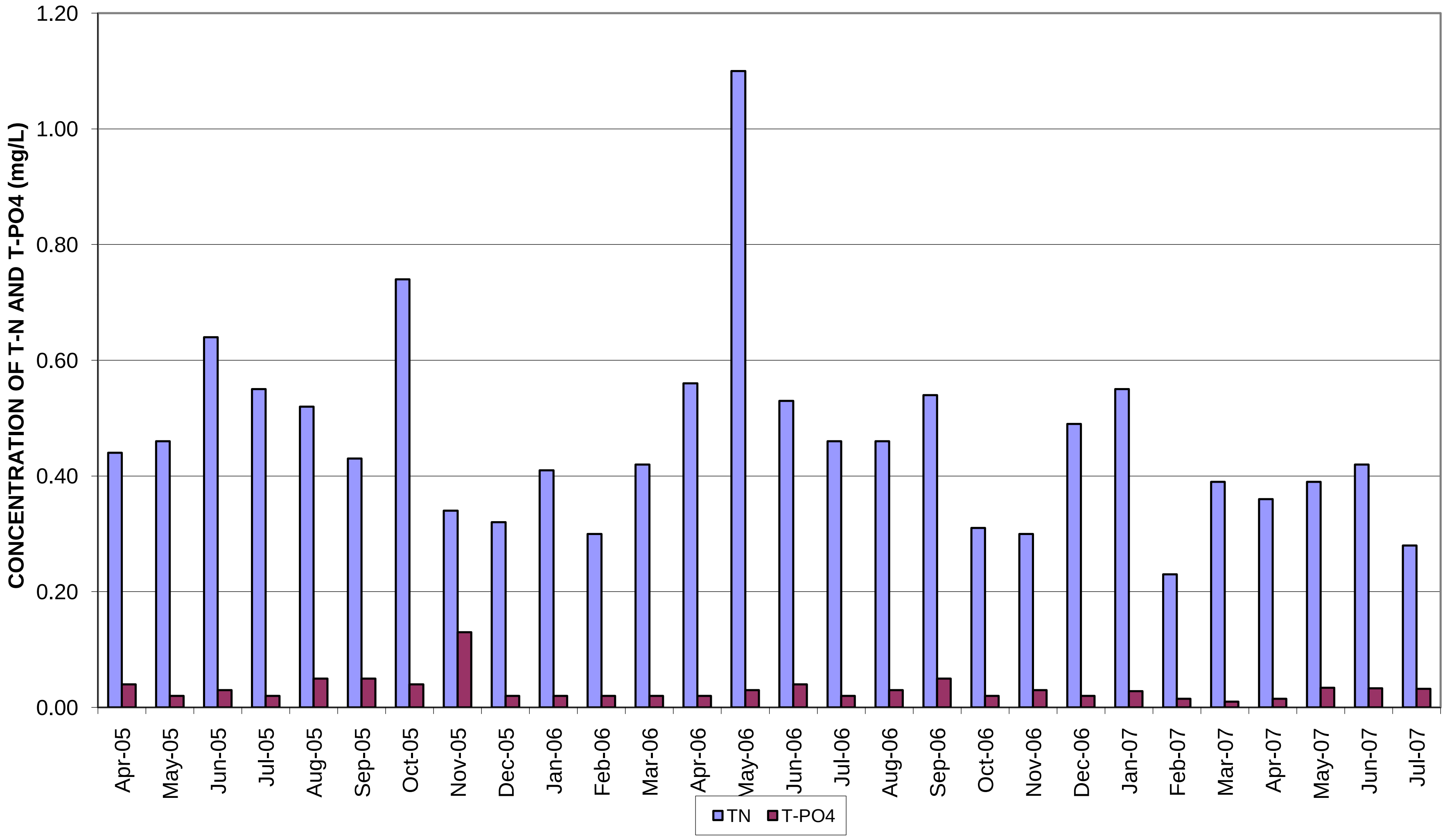


FIGURE 7-10

CONCENTRATION OF TOTAL NITROGEN (T-N) AND TOTAL PHOSPHOROUS (T-PO4) vs. TIME
BILLY CREEK AT SEABORD STREET (CFMBILLY1)

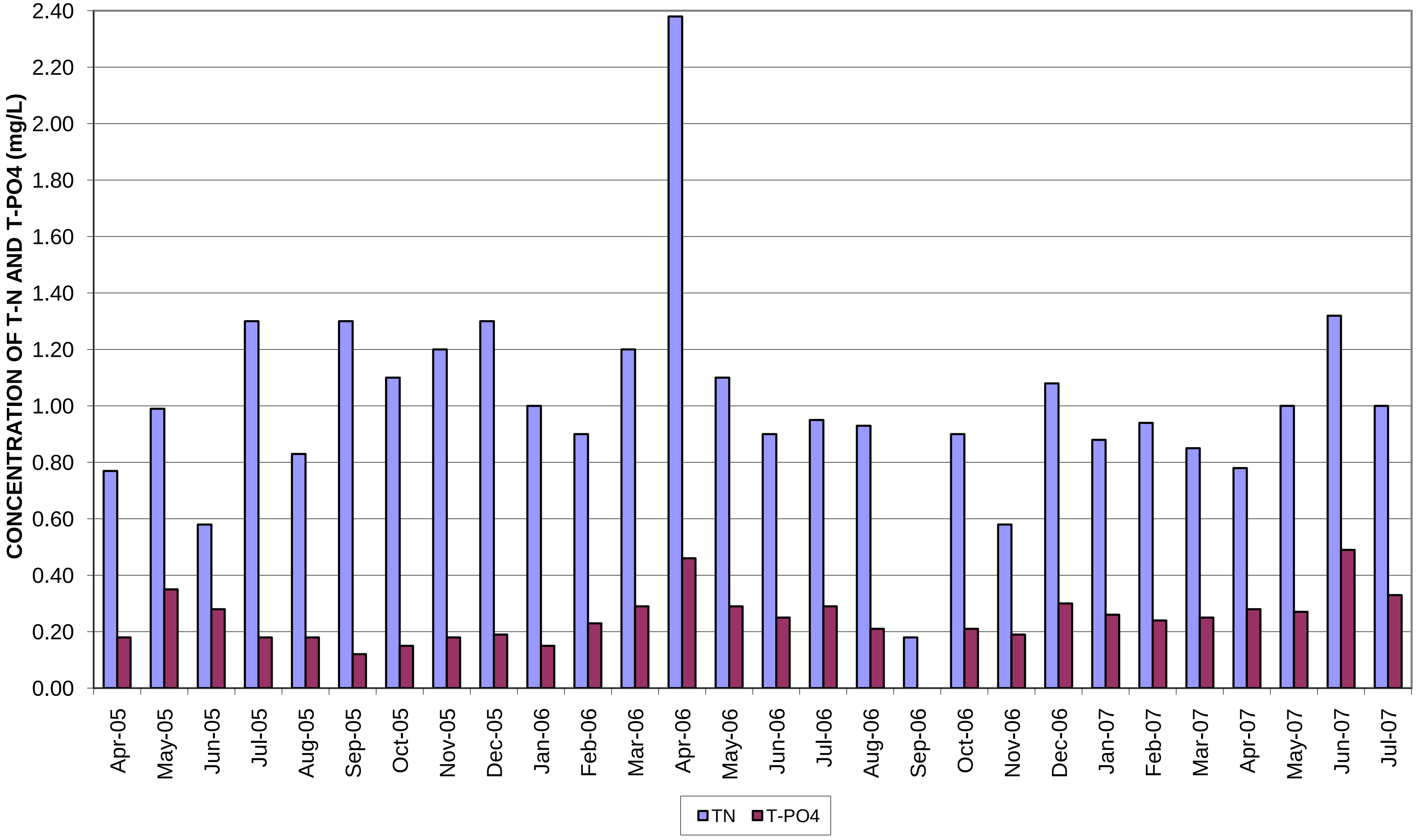


FIGURE 7-11

CONCENTRATION OF TOTAL NITROGEN (T-N) AND TOTAL PHOSPHOROUS (T-PO4) vs. TIME
BILLY CREEK AT ARNOLD DRIVE (CFMBILLY4)

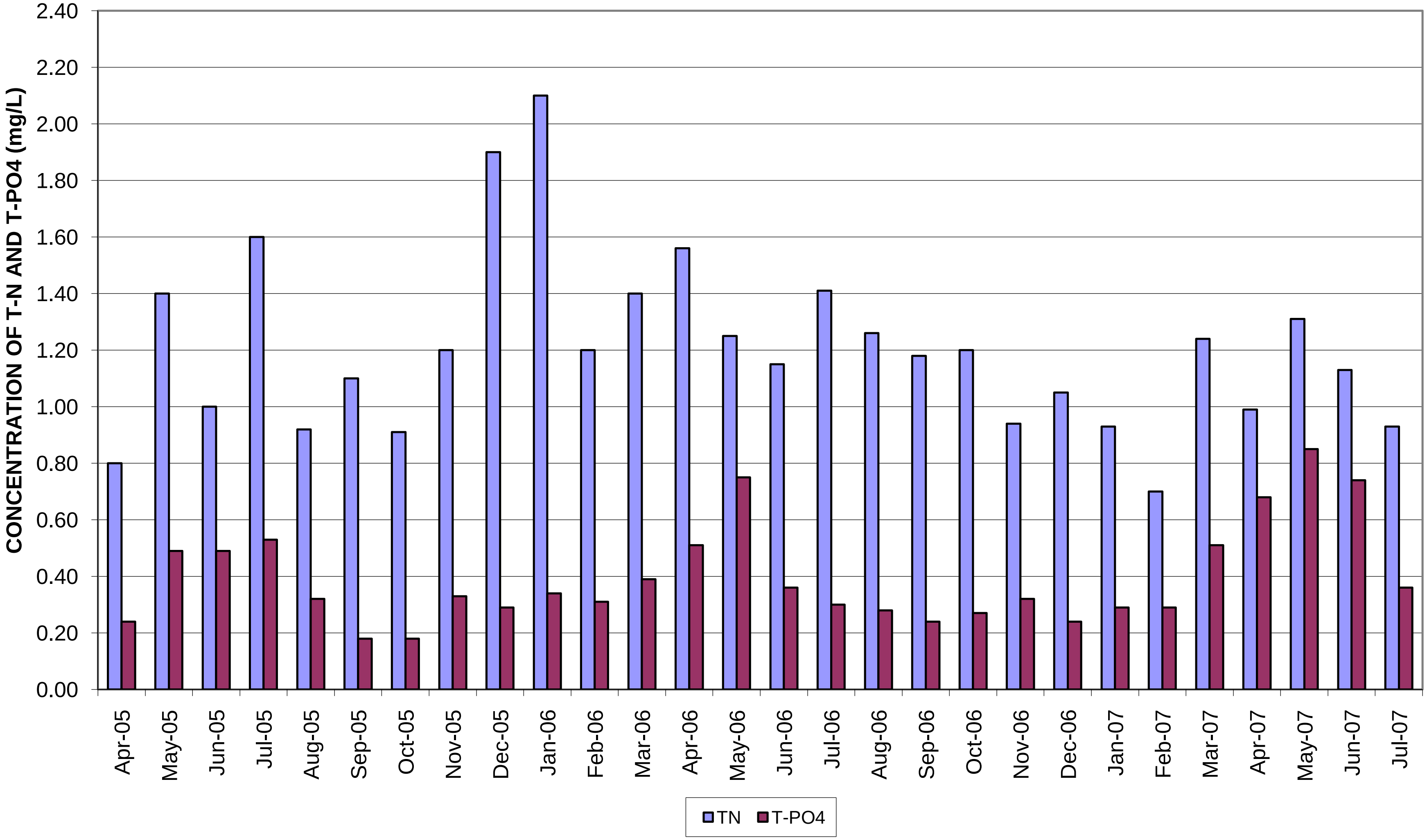


FIGURE 7-12

CONCENTRATION OF TOTAL NITROGEN (TN) AND TOTAL PHOSPHOROUS (T-PO4) vs. TIME
BROADWAY CANAL AT CENTENNIAL PARK BOAT RAMP (CFMBROADWAY)

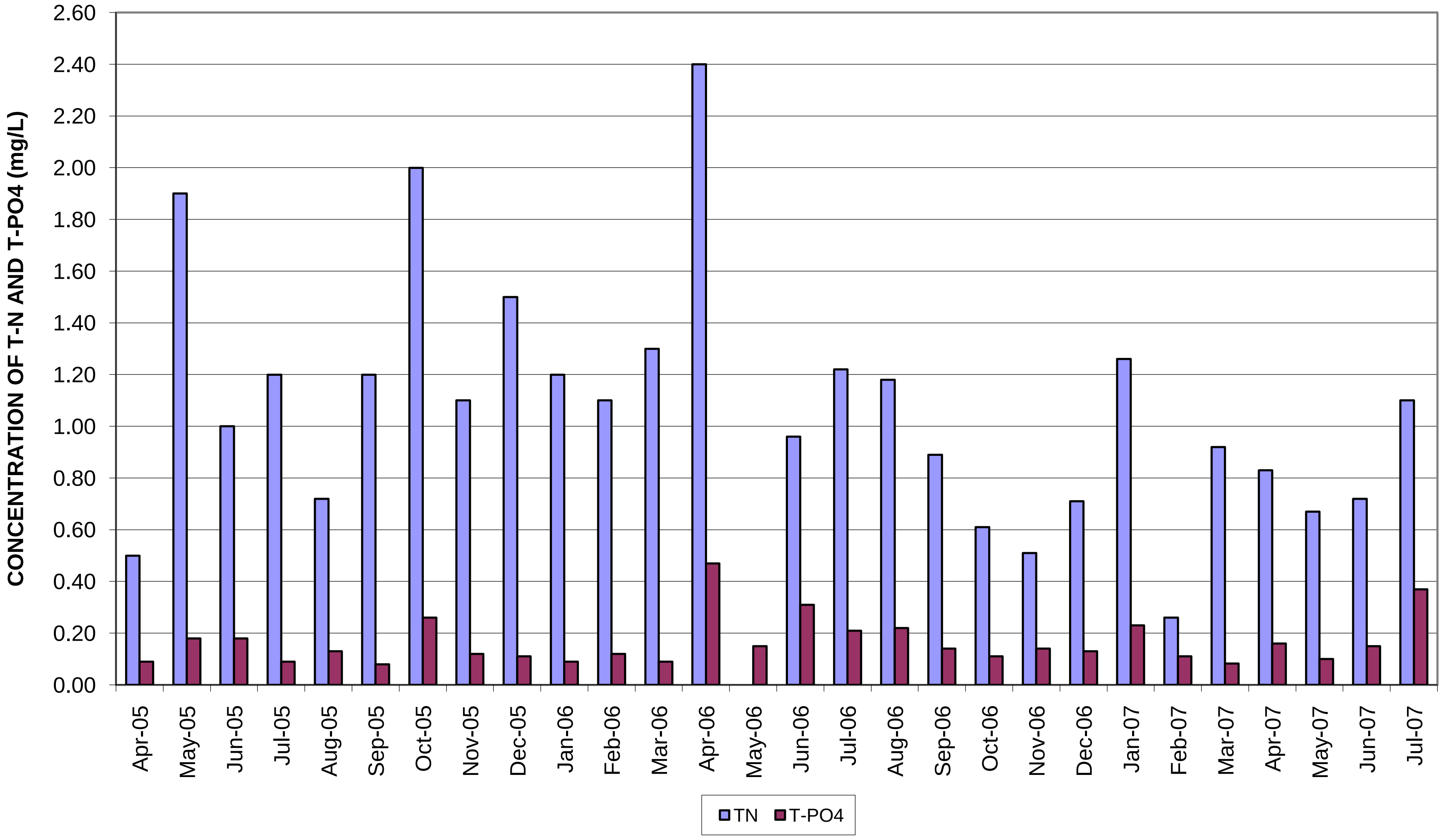


FIGURE 7-13

CONCENTRATION OF TOTAL IN-ORGANIC NITROGEN (In-Org N) AND ORGANIC NITROGEN (Org-N) vs. TIME
BILLY CREEK AT ORTIZ AVE. (BILLGR60)

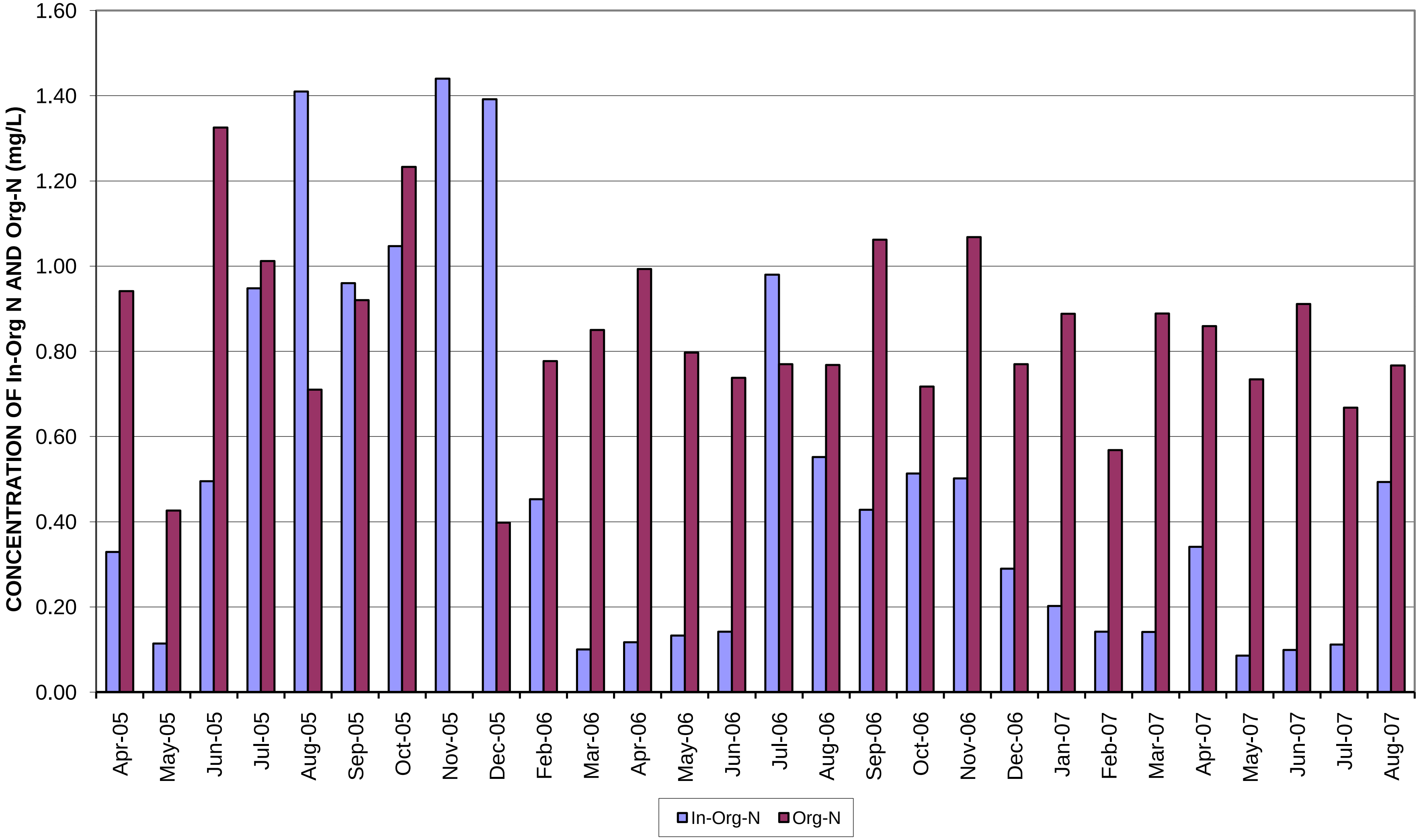


FIGURE 7-14

CONCENTRATION OF TOTAL IN-ORGANIC NITROGEN (In-Org N) AND ORGANIC NITROGEN (Org-N) vs. TIME
CARRELL CANAL AT FORT MYERS COUNTRY CLUB WEIR (CFMCARRELL)

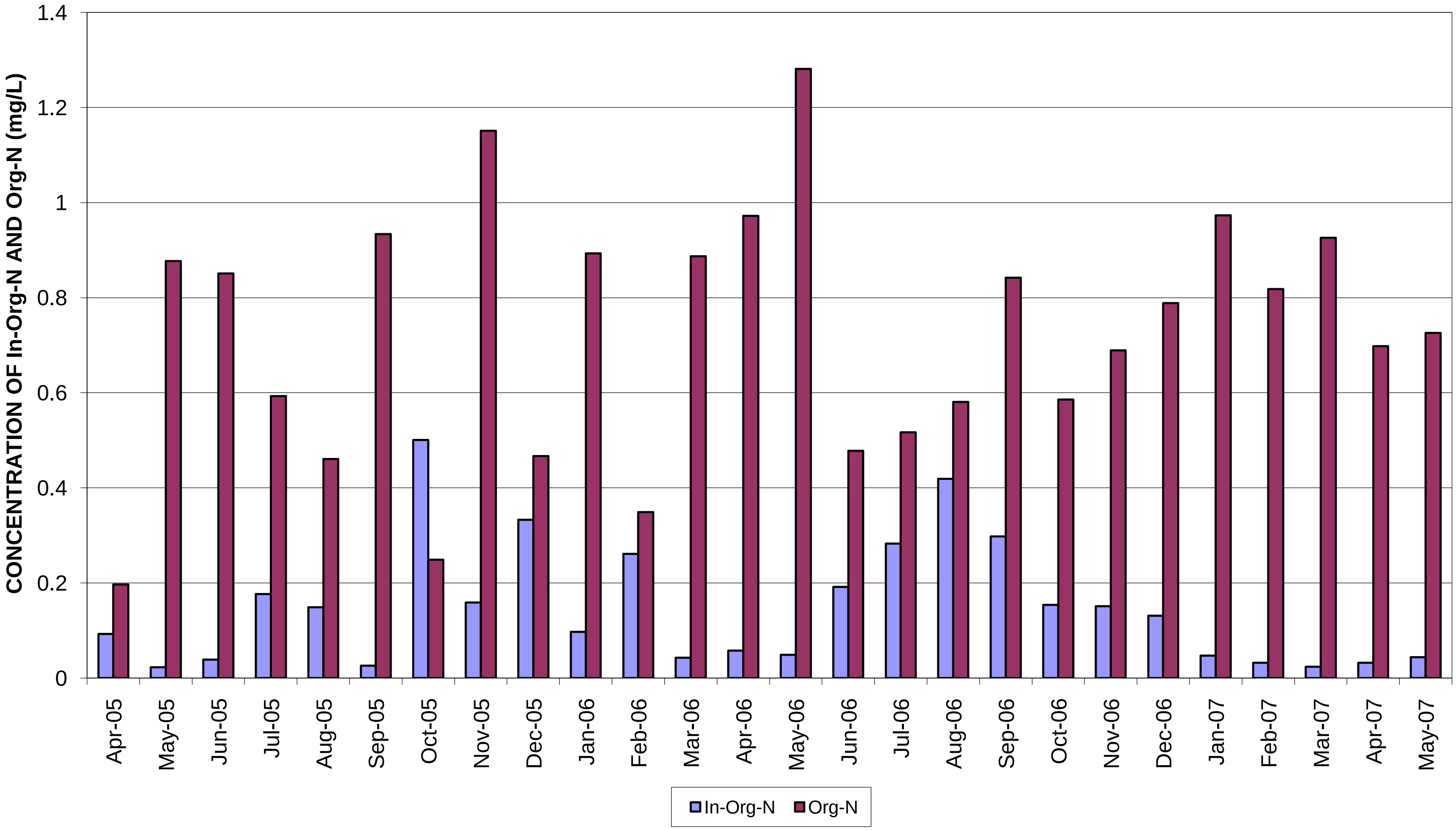


FIGURE 7-15

CONCENTRATION OF TOTAL IN-ORGANIC NITROGEN (In-Org N) AND ORGANIC NITROGEN (Org-N) vs. TIME
FORD STREET CANAL AT FORT MYERS CEMETERY (CFMBILLY6)

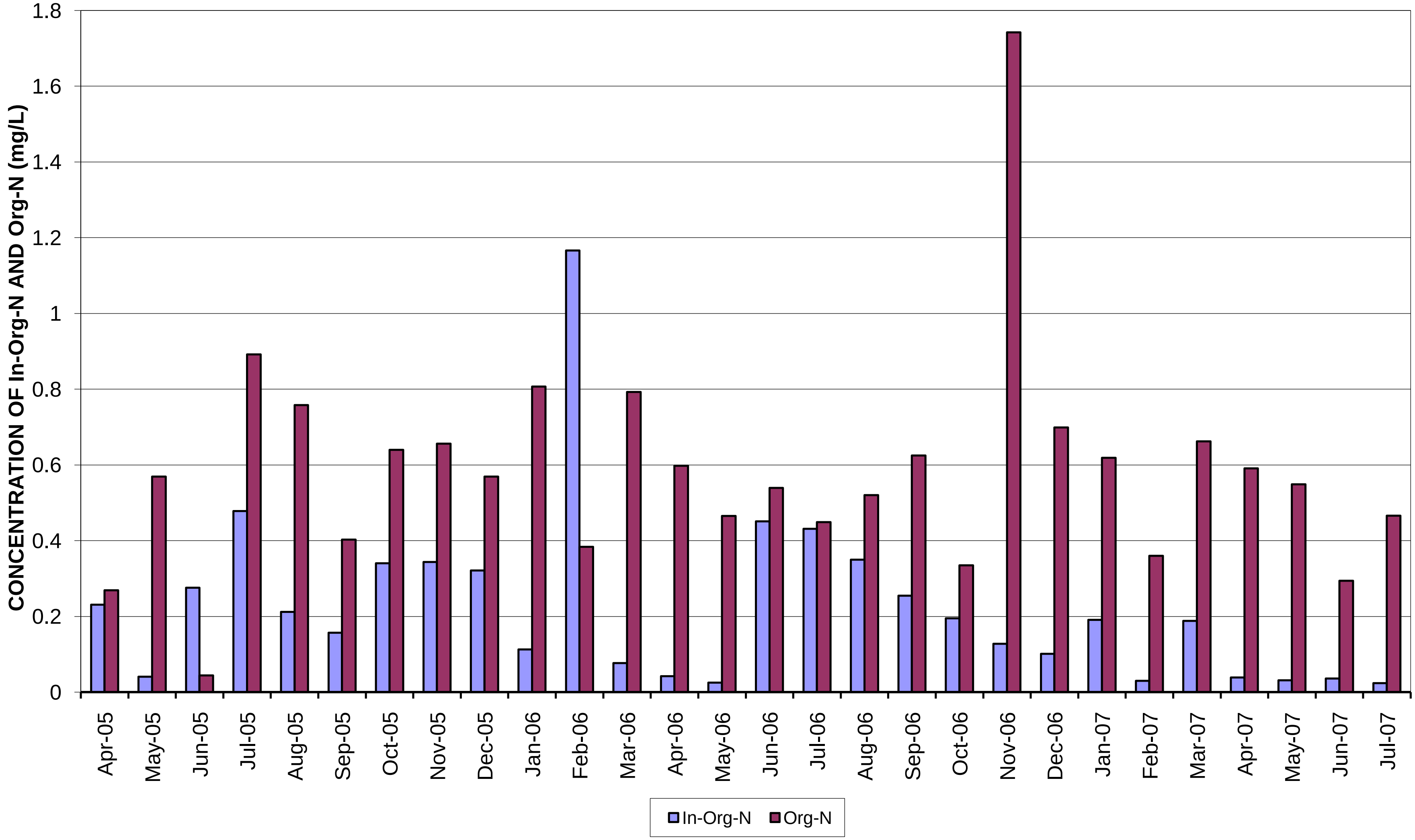


FIGURE 7-16

CONCENTRATION OF TOTAL IN-ORGANIC NITROGEN (In-Org N) AND ORGANIC NITROGEN (Org-N) vs. TIME
L-3 CANAL AT BOY SCOUT ROAD (CFML-3)

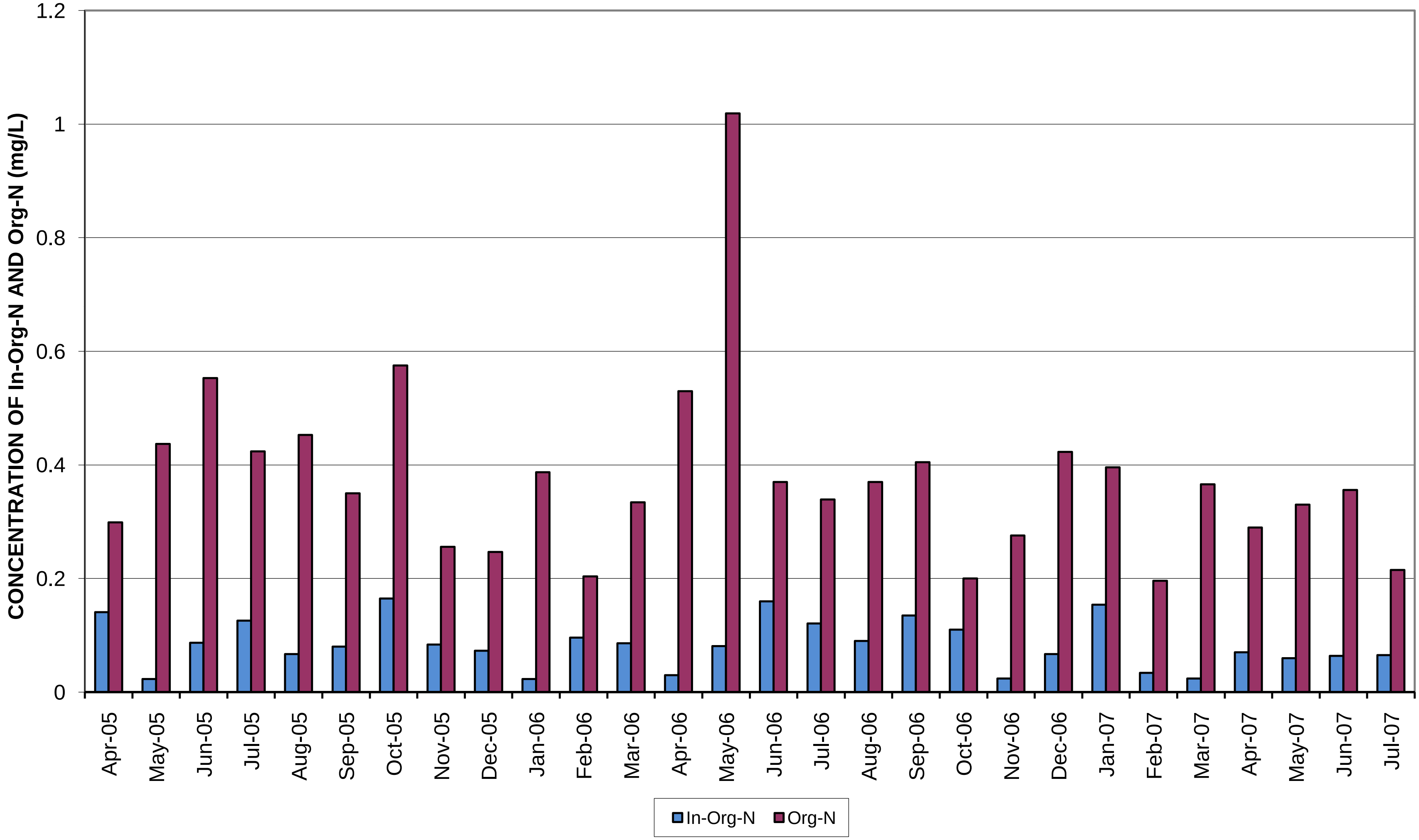


FIGURE 7-17

CONCENTRATION OF TOTAL IN-ORGANIC NITROGEN (In-Org N) AND ORGANIC NITROGEN (Org-N) vs. TIME
MANUEL'S BRANCH CANAL, WILBUR MOORE BRIDGE AT FORT MYERS HIGH (CFMMANUEL)

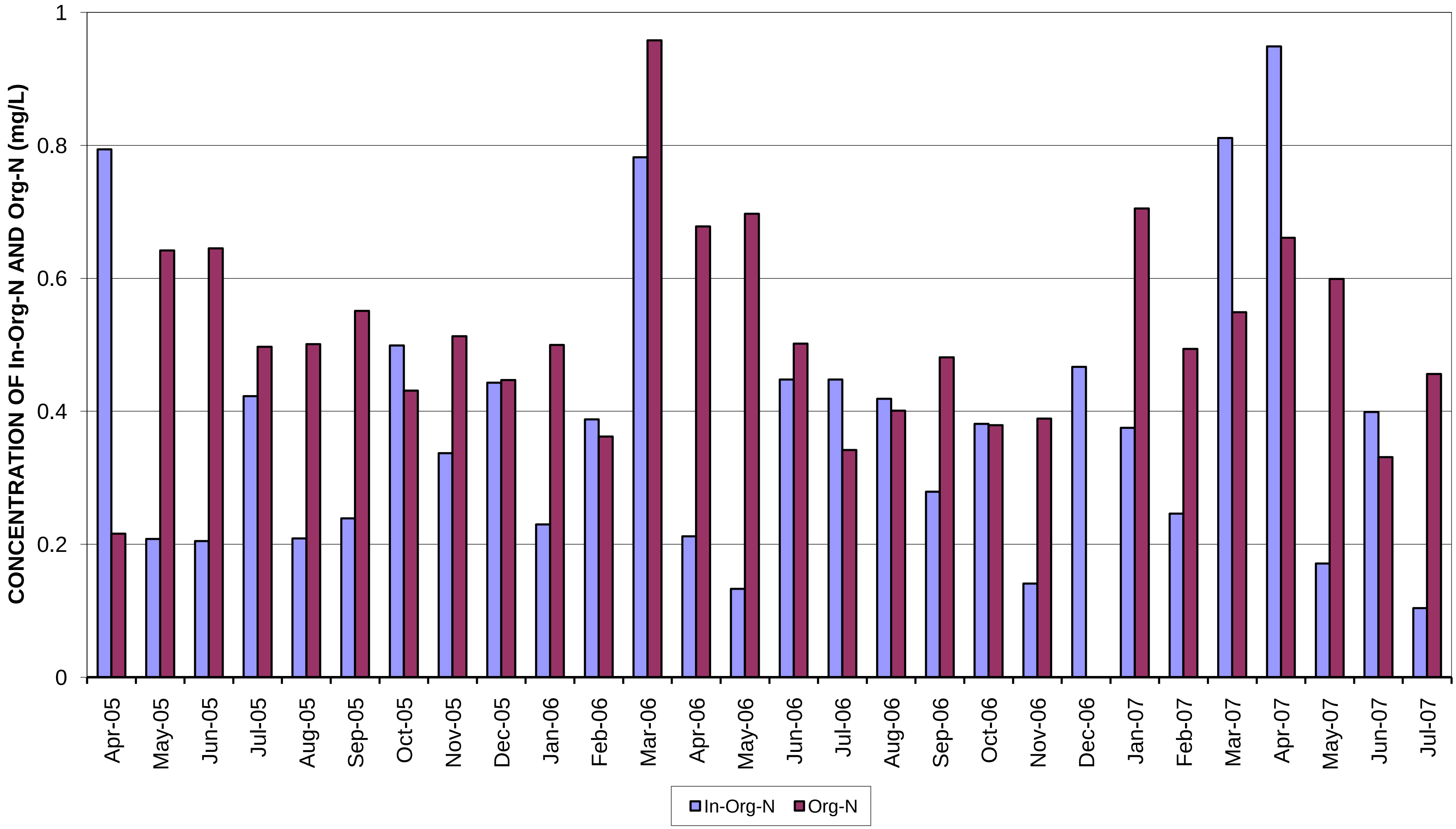


FIGURE 7-18

CONCENTRATION OF TOTAL IN-ORGANIC NITROGEN (In-Org N) AND ORGANIC NITROGEN (Org-N) vs. TIME
NORTH COLONIAL WATERWAY AT METRO PARKWAY (CFMCOLONIAL)

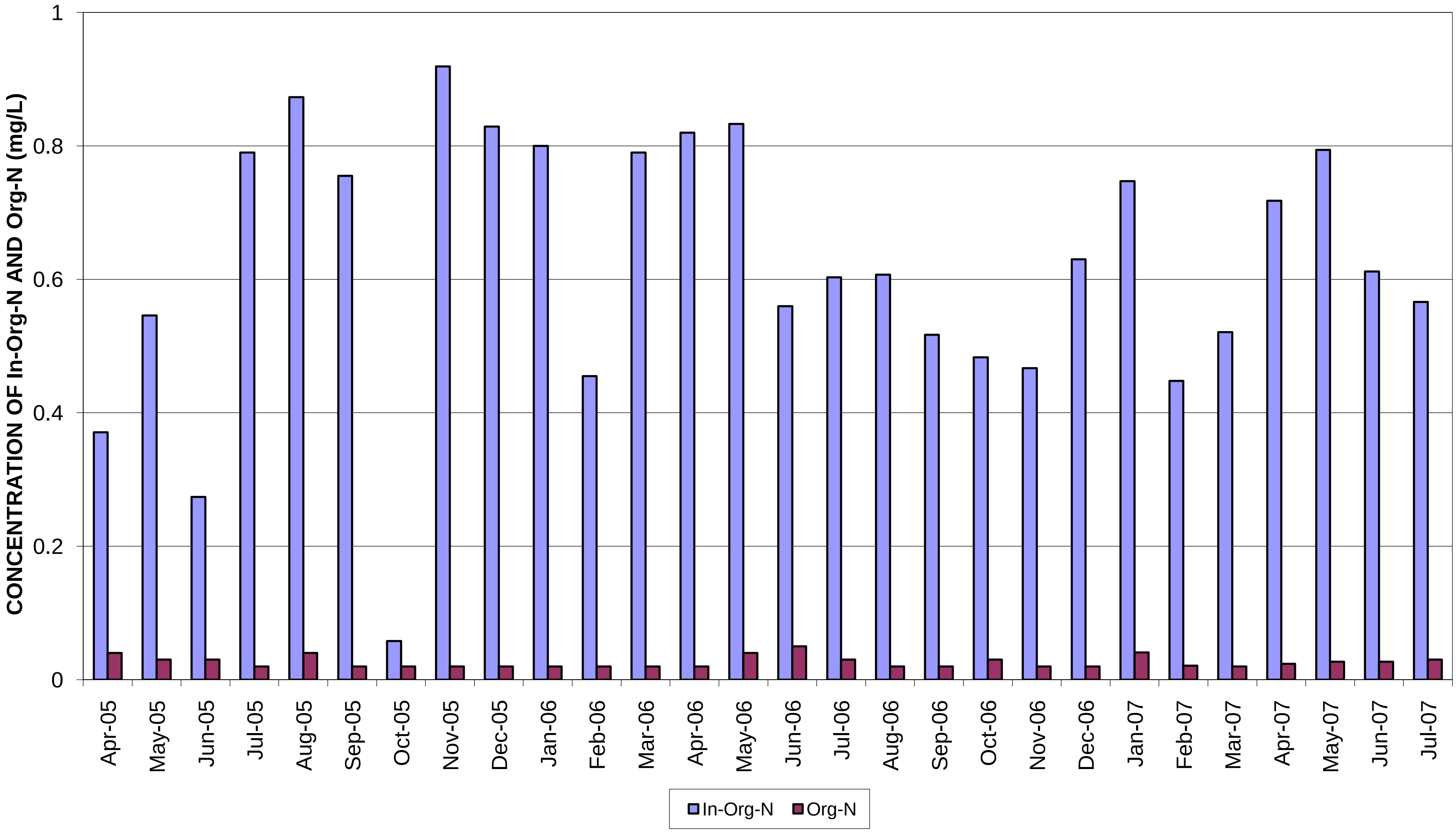


FIGURE 7-19

CONCENTRATION OF TOTAL IN-ORGANIC NITROGEN (In-Org N) AND ORGANIC NITROGEN (Org-N) vs. TIME
SHOEMAKER CANAL AT MICHIGAN AVE. (BILLGR20)

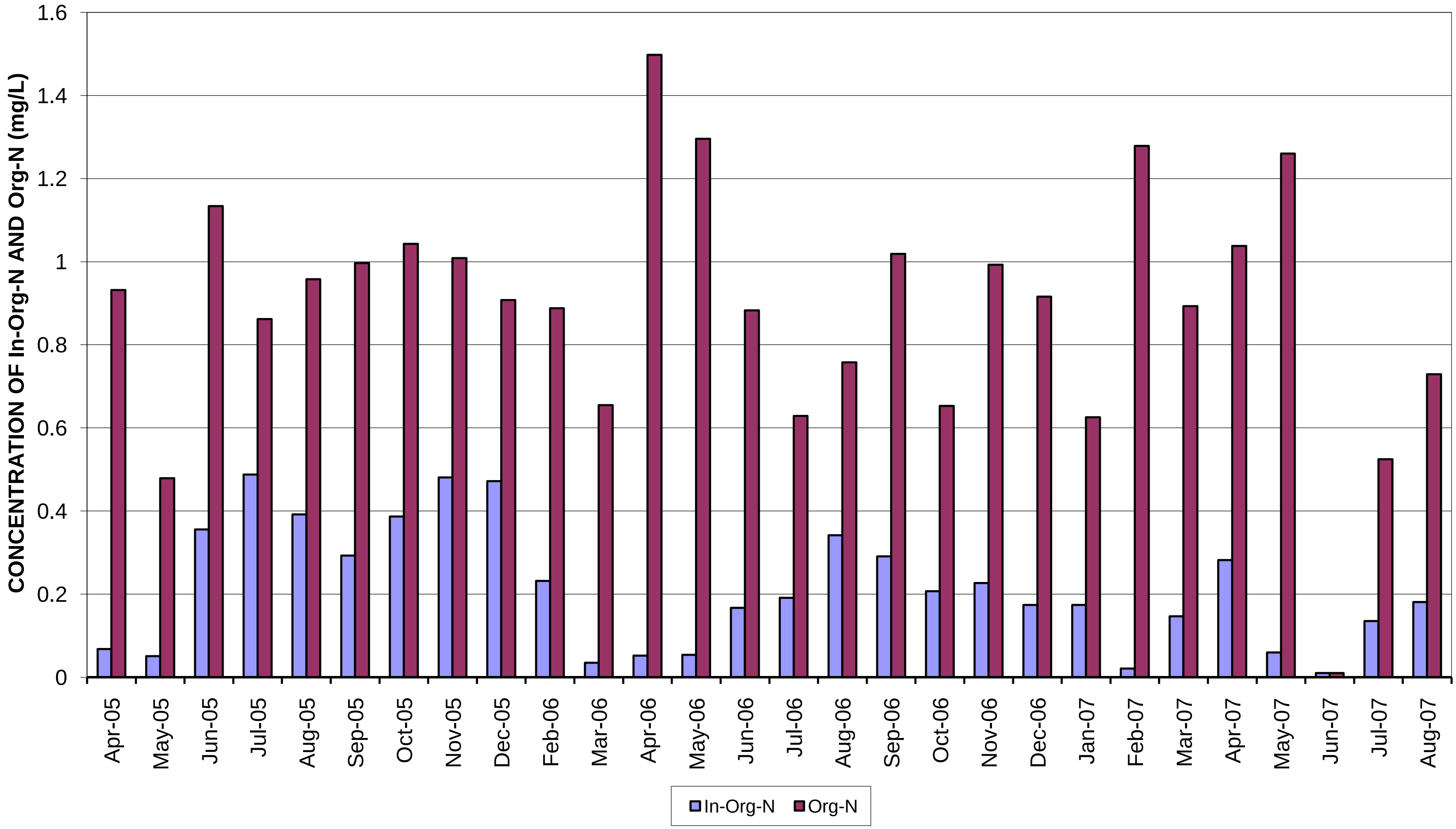


FIGURE 7-20

CONCENTRATION OF TOTAL IN-ORGANIC NITROGEN (In-Org N) AND ORGANIC NITROGEN (Org-N) vs. TIME
WINKLER CANAL AT PRINCETON STREET (CFMWINKLER)

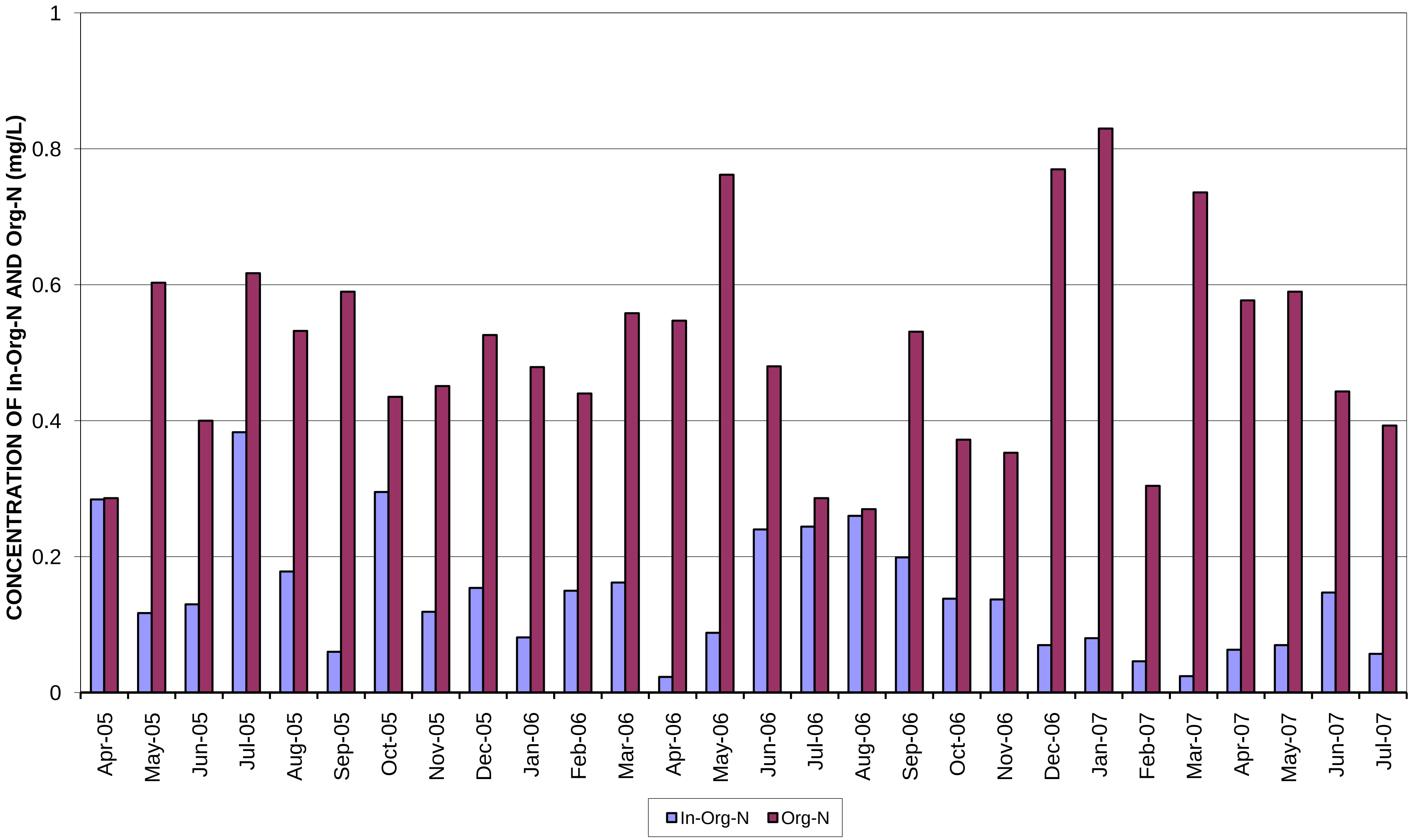


FIGURE 7-21

CONCENTRATION OF TOTAL IN-ORGANIC NITROGEN (In-Org N) AND ORGANIC NITROGEN (Org-N) vs. TIME
ZAPATO CANAL AT MEADOWVIEW CIRCLE (CFMBILLY3)

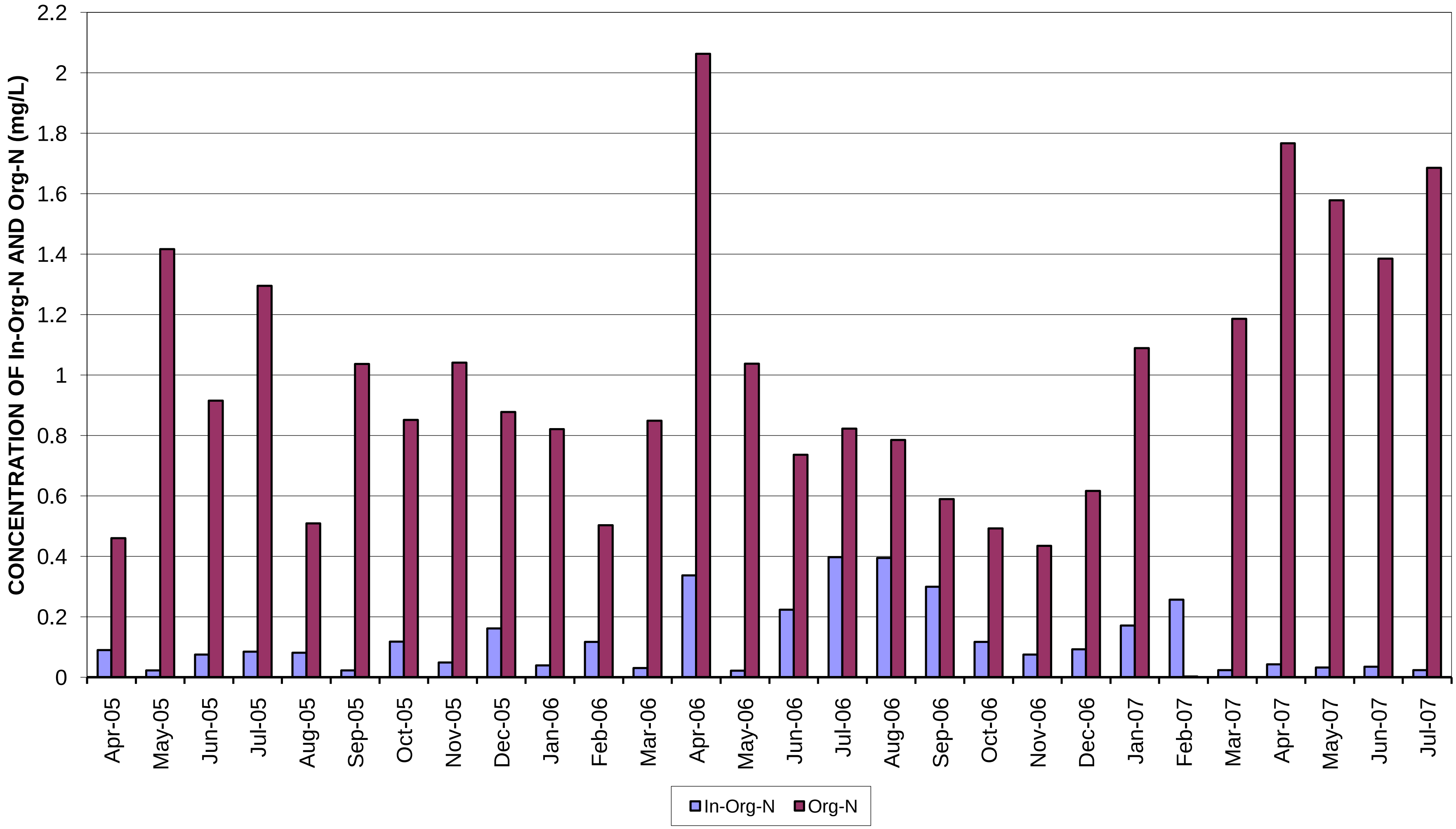


FIGURE 7-22

CONCENTRATION OF TOTAL IN-ORGANIC NITROGEN (In-Org N) AND ORGANIC NITROGEN (Org-N) vs. TIME
BILLY CREEK AT SEABORD STREET (CFMBILLY1)

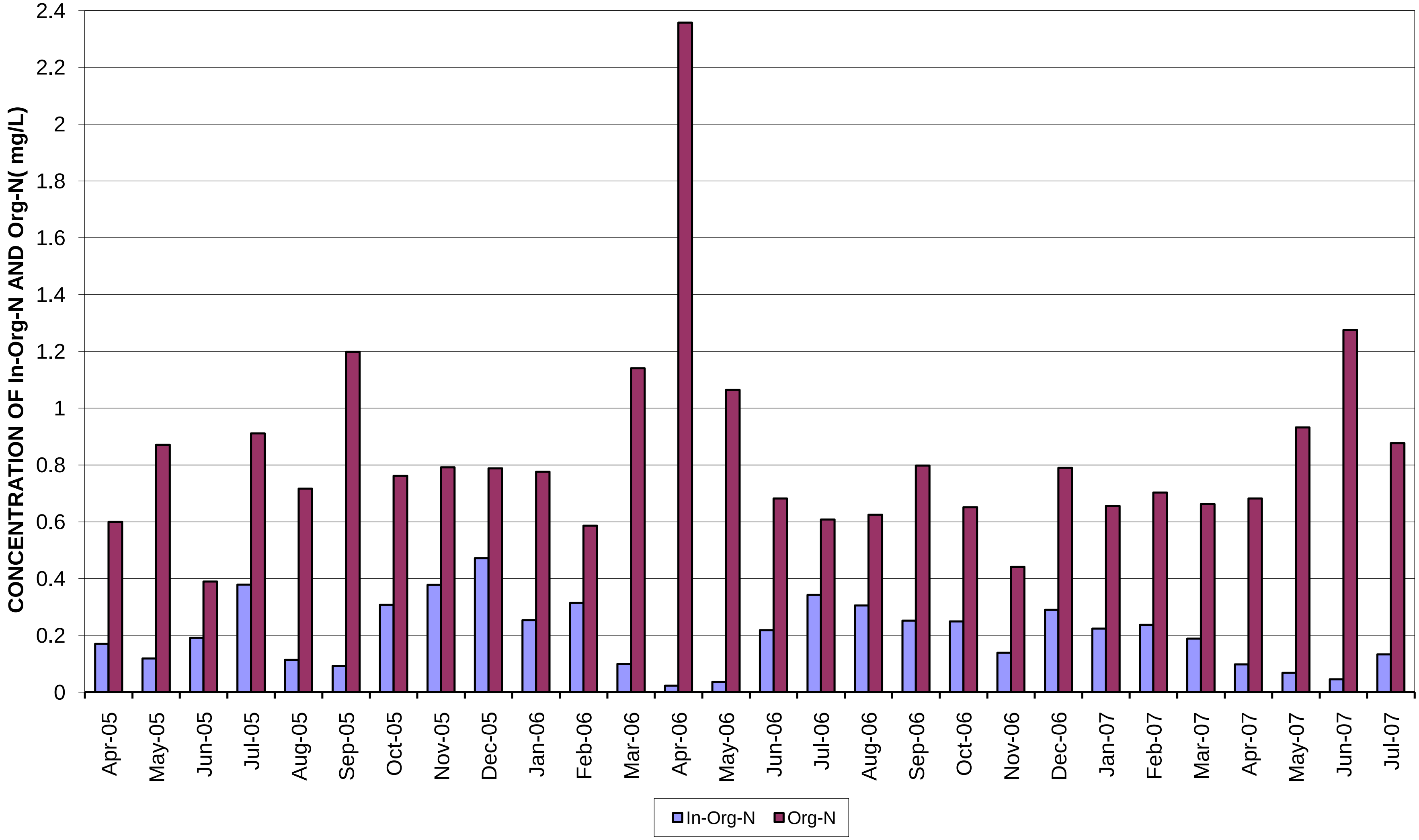


FIGURE 7-23

CONCENTRATION OF TOTAL IN-ORGANIC NITROGEN (In-Org N) AND ORGANIC NITROGEN (Org-N) vs. TIME
BILLY CREEK AT ARNOLD DRIVE (CFMBILLY4)

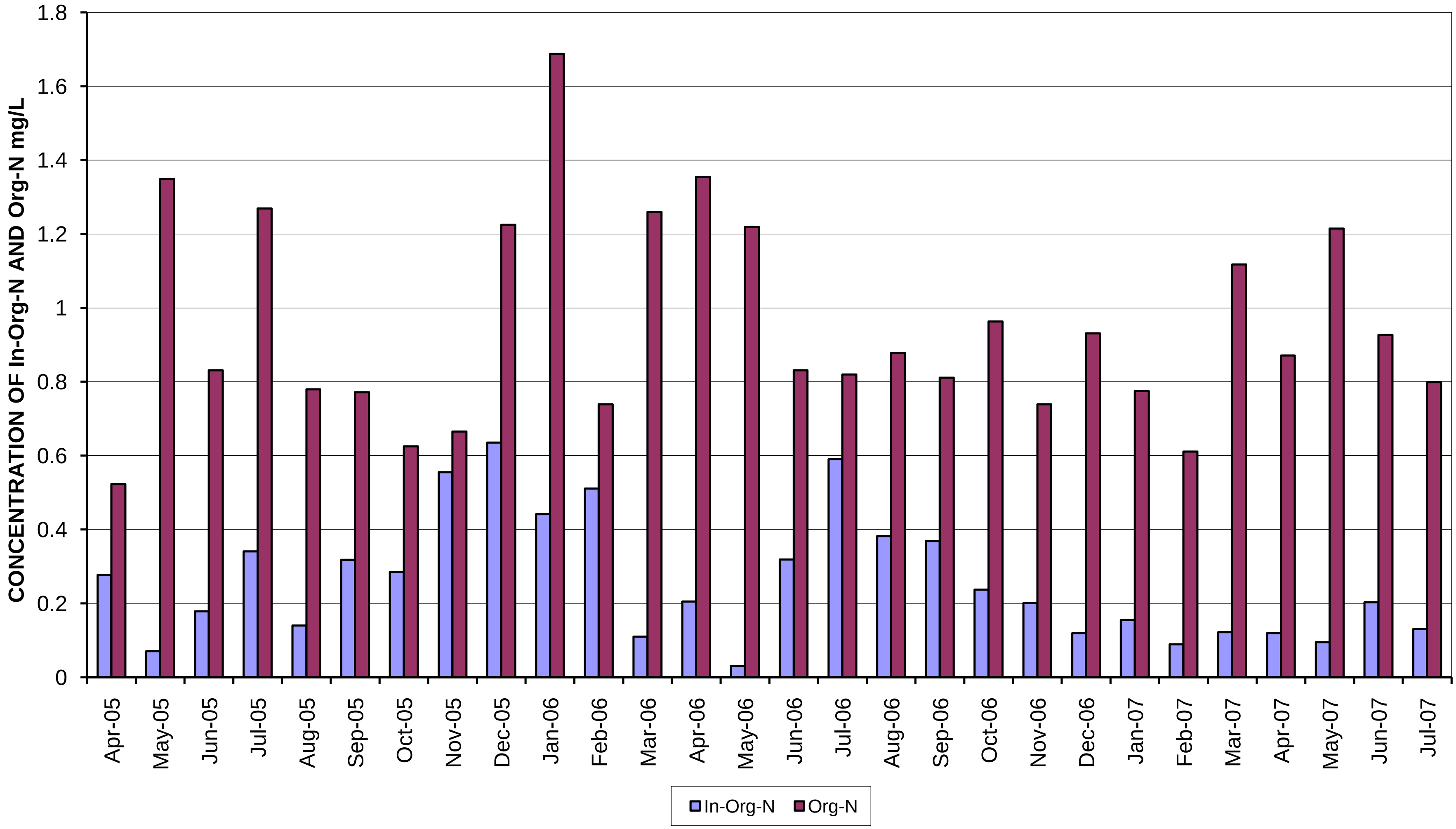
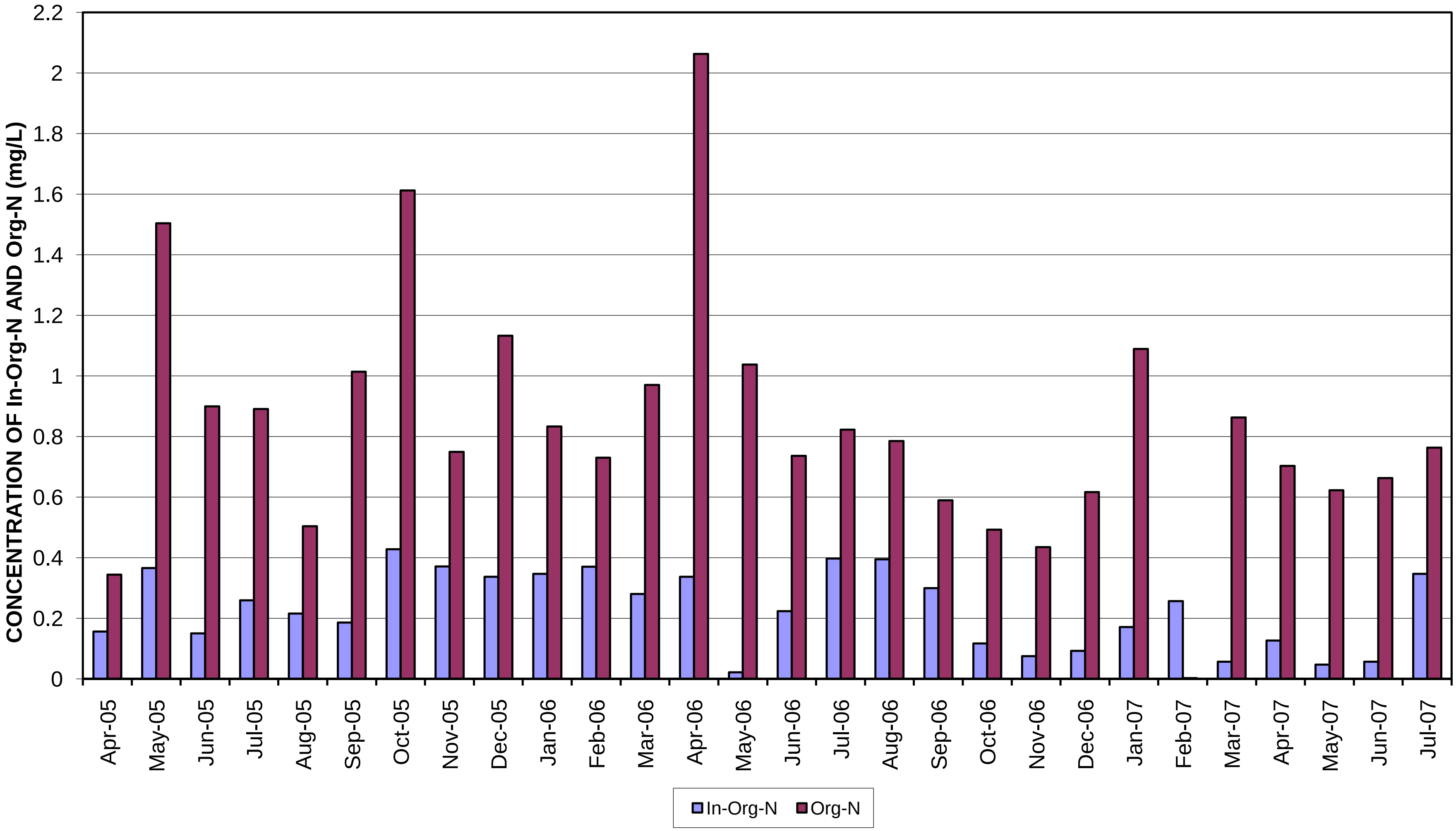
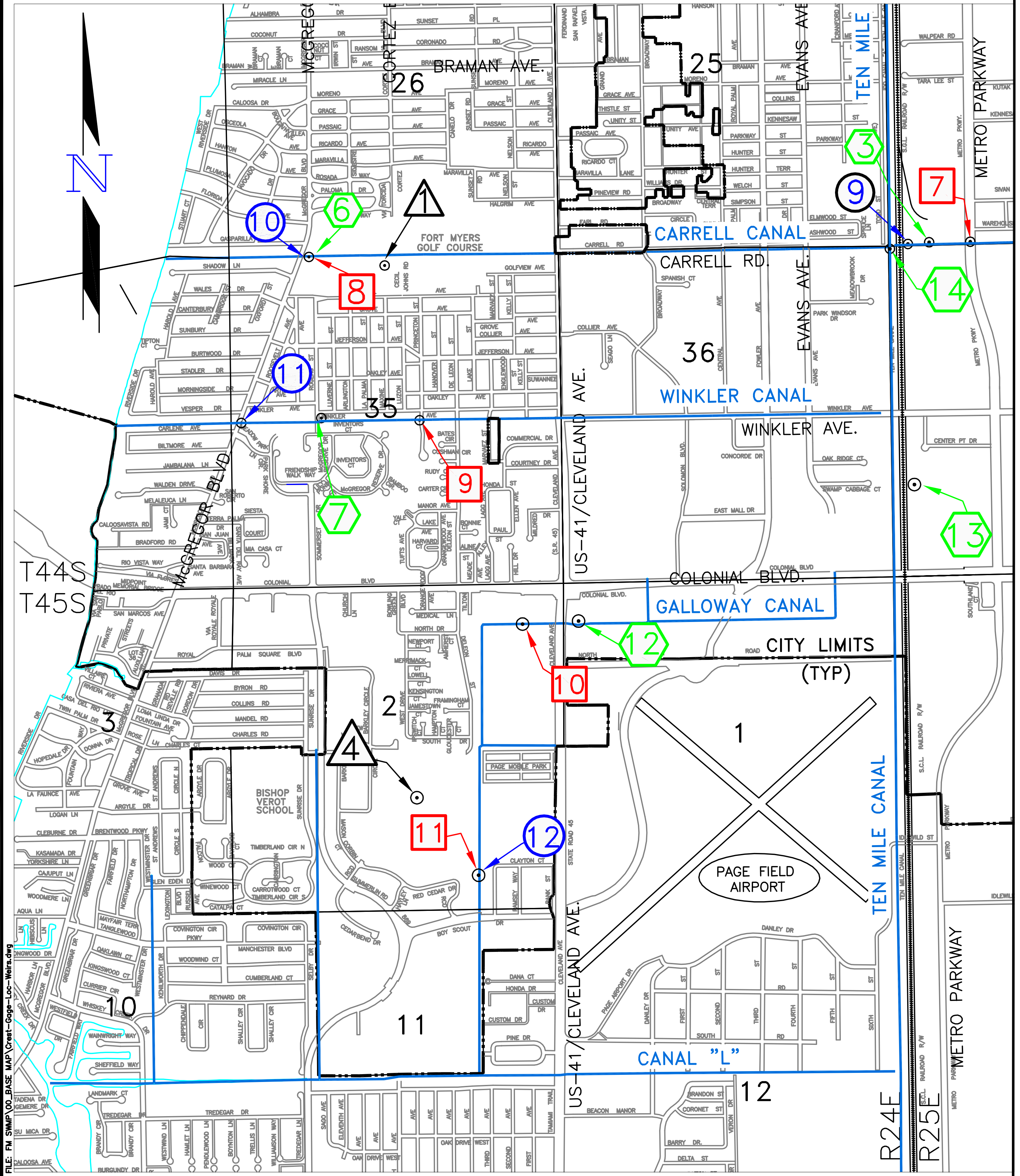


FIGURE 7-24

CONCENTRATION OF TOTAL IN-ORGANIC NITROGEN (In-Org N) AND ORGANIC NITROGEN (Org-N) vs. TIME
BROADWAY CANAL AT CENTENNIAL PARK BOAT RAMP (CFMBROADWAY)





REF# & STA. I.D. — LOCATION

LOCATION RELATIVE TO ASSIGNED NAD 83 STATE PLANE COORDINATES

WATER QUALITY MONITORING STATIONS

#	STATION I.D.	WATER QUALITY MONITORING STATIONS	LOCATION COODINATES
1)	CFMBILLY1	Billy Creek at Seabord Street	N842219, E704177 ±
2)	BILLGR20	Billy Creek at Veronica Shoemaker Blvd. (Lee Co)	N843500, E708285 ±
3)	CFMBILLY3	Zapato Canal weir at Markland Avenue	N843370, E710540 ±
4)	CFMBILLY4	Billy Creek at southern end of Arnold Street	N843841, E709943 ±
5)	BILLGR60	Billy Creek at Ortiz Ave. Bridge (Lee Co)	N847535, E717364 ±
6)	CFMBILLY6	Ford Street Canal in Fort Myers Cemetery	N841935, E705888 ±
7)	CFMBROADWAY	Centenial Park Boat Ramp	N840471, E698034 ±
8)	CFMMANUEL	Manuel's Branch – Upstream of Cortez Blvd.	N833696, E695357 ±
9)	CFMCOLONIAL	North Colonial Waterway at R.R. box culvert	N828138, E703590 ±
10)	CFMCARRELL	Upstream of weir at Fort Myers Country Club	N827931, E693996 ±
11)	CFMWINKLER	Winkler Canal box culvert at McGregor Blvd.	N825273, E692914 ±
12)	CFML-3	Upstream of bridge at Boy Scout Road	N818034, E696714 ±

CREST STAGE INDICATOR GAGES (CSIG)

#	STATION I.D.	CREST STAGE INDICATOR GAGES (CSIG)	LOCATION COODINATES
1)	CG_BIL01	50 feet downstream of Ortiz Avenue Bridge	N847535, E717364 ±
2)	CG_BIL02	50 feet upstream of Nuna Avenue Bridge	N846811, E715531 ±
3)	CG_ZAP01	Upstream of weir at Markland Avenue	N843565, E710391 ±
4)	CG_SHM01	Headwall at Michigan and Veronica Shoemaker	N841481, E708308 ±
5)	CG_FRD01	East end of Indian Street	N840080, E705673 ±
6)	CG_MAN01	Upstream of weir at Wilbur Moore Bridge	N833330, E696303 ±
7)	CG_NCL01	Headwall at Metro Parkway	N828175, E704588 ±
8)	CG_CAR01	10 feet upstream of weir at golf cart bridge	N827931, E693996 ±
9)	CG_WNK01	Headwall at Princeton Street	N825316, E695768 ±
10)	CG_GAL01	Upstream of bridge for South Plaza Shopping Center	N822054, E697418 ±
11)	CG_CNL01	600 feet upstream of Boy Scout Road	N818034, E696714 ±

RAIN GAGE STATIONS

#	STATION I.D.	RAIN GAGE STATIONS	LOCATION COODINATES
1)	FMCC	East of McGregor and North of Hill Avenue	N827794, E695209 ±
2)	CAWWT	East of the North end of Raleigh Street	N842729, E705453 ±
3)	WATER	NE of Canal Street and Rockfill Road	N834222, E712733 ±
4)	SAWWT	Easterly of Barkley Circle	N819275, E695727 ±

WATER CONTROL STRUCTURES

#	STRUCTURE I.D.	WATER CONTROL STRUCTURES	LOCATION COODINATES
1)	EASTWOOD WEIR	Southwest corner of Eastwood Golf Course	N828372, E713858 ±
2)	SOUTHSIDE WEIR	Approx. 150 feet east of Shoemaker Blvd	N828247, E708717 ±
3)	SEABOARD WEIR	Approx. 1250 feet west of Metro Parkway	N828166, E703929 ±
4)	CORTEZ WEIR	Upstream of Cortez Boulevard	N833696, E695357 ±
5)	WILBUR MOORE WEIR	Wilbur Moore Bridge at Fort Myers High School	N833360, E696041 ±
6)	FMCC WEIR	East of McGregor Blvd, near clubhouse	N827931, E693996 ±
7)	ROGERS WEIR	South of Winkler, approx. 1250 feet east of McGregor	N825353, E694194 ±
8)	FORD ST WEIR	Approx. 200 feet south of Thomas Ave, west of school	N837421, E706138 ±
9)	SHOEMAKER WEIR	Approx. 1250 feet south of Martin Luther King, Jr. Blvd.	N837490, E708362 ±
10)	ZAPATO WEIR	Upstream of Markland Avenue	N843370, E710540 ±
11)	GALLOWAY WEIR	South of Colonial Blvd, approx. 250 feet east of US 41	N822102, E698314 ±
12)	METRO MALL WEIR	Approx. 1,500 feet north of Colonial Blvd.	N824288, E703693 ±
13)	CARRELL GATE	Junction of Carrell Canal and Ten Mile Canal	N828061, E703300 ±

SCALE 1"=2,000'
0 2000ft 4000ft 6000ft 8000ft
SOURCE: ECT 11-2007, F.M.

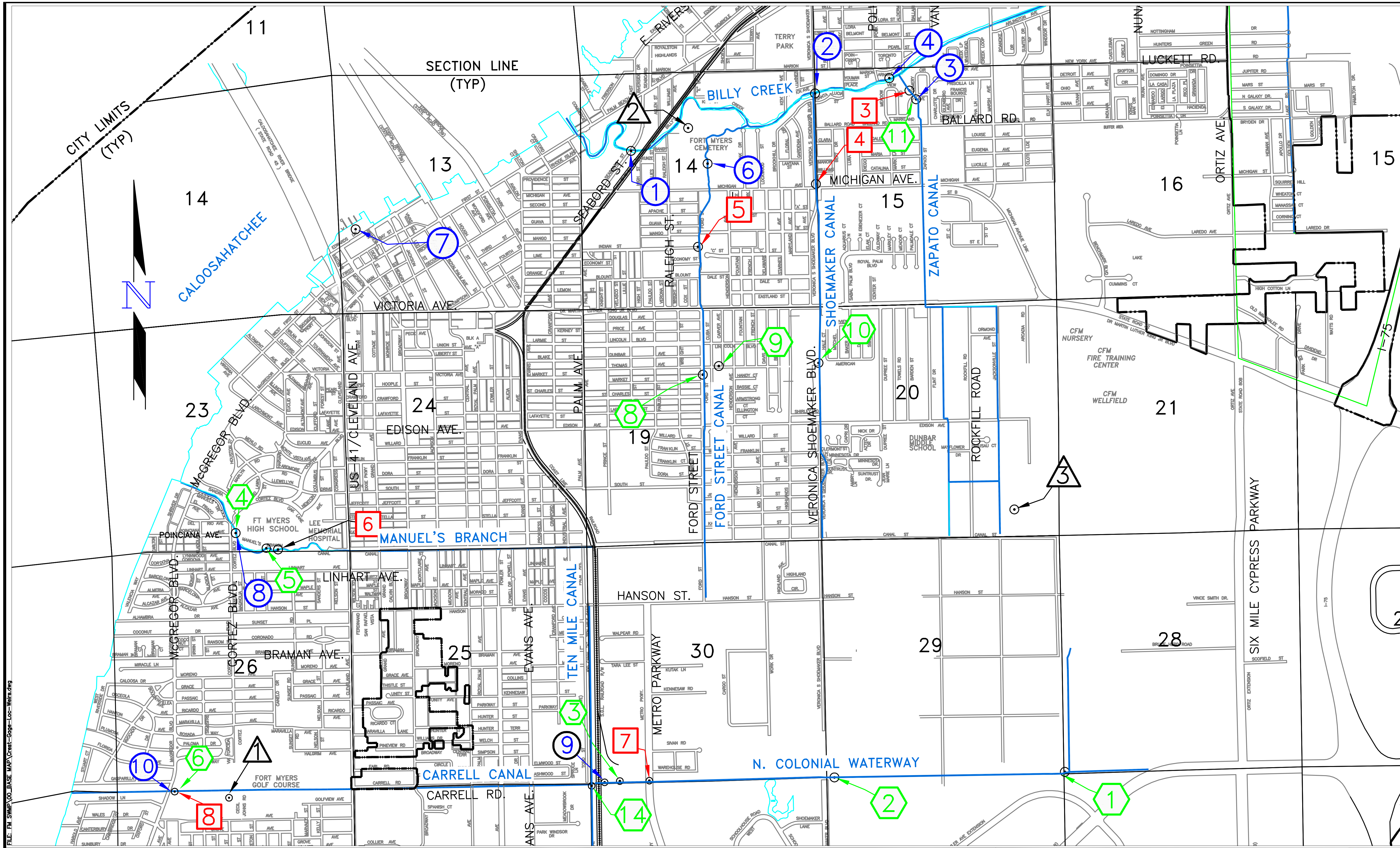
ECT
4100 Center Pointe Drive, Suite 112
Fort Myers, Florida 33916
Phone: (239) 277-0003 CA#5520

STORMWATER MASTER PLAN UPDATE
WATER QUALITY MONITORING STATIONS
RAIN & CREST STAGE GAGES
WATER CONTROL STRUCTURES

CITY OF FORT MYERS, FL
PUBLIC WORKS DEPT.
ENGINEERING DIVISION

City of Palms

FIGURE 7-25A
1 of 3



SCALE
1"=2,000'
0 2000ft 4000ft 6000ft 8000ft
SOURCE: ECT 11-2007, F.M.

ECT
4100 Center Pointe Drive, Suite 112
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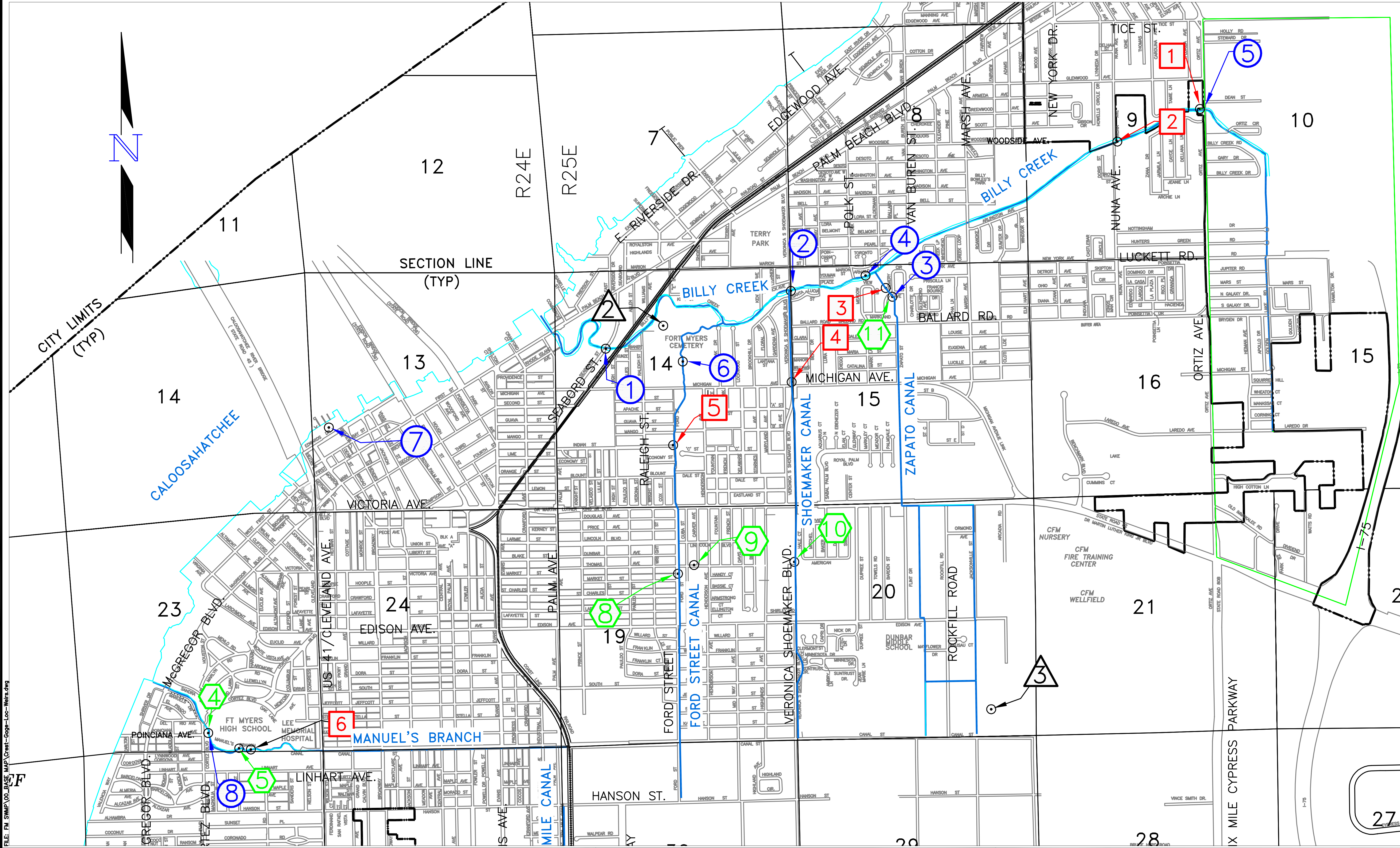
STORMWATER MASTER PLAN UPDATE
WATER QUALITY MONITORING STATIONS
RAIN & CREST STAGE GAGES
WATER CONTROL STRUCTURES

CITY OF FORT MYERS FLORIDA
City of Palms

CITY OF FORT MYERS, FL
PUBLIC WORKS DEPT.
ENGINEERING DIVISION

FIGURE
7-25B
2 of 3



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SOURCE: ECT 11-2007, F.M.

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STORMWATER MASTER PLAN UPDATE

WATER QUALITY MONITORING STATIONS
RAIN & CREST STAGE GAGES
WATER CONTROL STRUCTURES

CITY OF FORT MYERS FLORIDA
City of Palms

CITY OF FORT MYERS, FL
PUBLIC WORKS DEPT.
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FIGURE
7-25C
3 of 3

8.0 FLOODING and WATER QUALITY ISSUES

8.1 DESCRIPTION of FLOODING CONDITIONS

Urban flooding is generally the result of extreme rainfall events caused by high intensity, short duration rainfalls over small areas where drainage facilities cannot convey the excess stormwater runoff due to capacity limitations. This type of flooding usually is considered to be a nuisance, lasting less than twenty four (24) hours and frequently precludes design remedies due to fiscal limitations. This is most frequent type of flooding with the corporate limits of the City of Fort Myers, but is limited to only a few isolated areas.

System or watershed floods develop more slowly and may take a few days to show a noticeable impact, but have steadily rising water levels. Currents within a primary channel may be strong, but damages are mainly caused by the out of bank overflows (inundation) and have comparatively weaker current. System flooding can inundate an extensive area with floodwaters that may stand on the land for several days causing economic loss through property damage and degradation. This is the least frequent type of flooding in the City and is generally associated with the areas adjacent to the primary channels.

Seasonal hurricanes are also a potential cause of severe flooding. As shown on the current Flood Insurance Rate Map (FIRM), the indicated flood elevations are the result of a hurricane induced storm surge. In the City of Fort Myers, this type of flooding is generally considered to only affect areas with elevations of 8 feet (NGVD) or lower and can generally be associated with a Category 3 hurricane type storm surge. However, rainfall associated with hurricanes is generally very intense, thus resulting in widespread flooding. Flooding due to hurricanes is not a predictable occurrence due to the variant nature of hurricane frequency and as such is not considered to be a typical design event.

Economic losses from floods are of three types: direct damages, indirect damages, and other costs. Direct damages are those caused by the force of floodwaters, by inundation, or by the sediment and debris carried by floodwaters. They include such items as:

* Destruction of roads, bridges, utility systems, and infrastructure
* Collapse or flotation of structures
* Loss of legal, financial documents, and other records
* Damage to or destruction of building contents
* Siltation and erosion of property or facilities

Indirect damages are those that occur as a secondary effect of direct damages and are related to property damages. They include such items as:

* Loss or damage due to disruption of services (utilities, roads, and bridges)
* Fire and explosion due to inundation of electrical and gas systems
* Loss of local, state and federal tax revenue

Other costs include all of the identifiable expenses associated with flooding, other than damages to property. They include such items as:

* Evacuation and reoccupation
* Care of evacuees
* Debris removal and cleanup
* Business interruptions
* Rehabilitation loan interest and fees
* Traffic detours and delays

8.2 ALTERNATIVE SOLUTIONS (FLOODING)

The following alternatives were considered in the development of conceptual solutions: (1) channelization, (2) vegetative removal, (3) culvert modification, (4) buy out or relocation, and (5) diversion and detention. A general discussion of each of these various alternatives fo11ows:

Channelization

Channelization typically is the remnant turn of the century agriculture (drainage district) activity. As these areas urbanized, these formally natural channels were expanded into straight uniform section canals. This results in the previously discussed urban hydrograph with a short duration, high peak stag water levels. It is impractical to further deepen the existing waterways within the City or expand their widths due to the presence of other existing infrastructure. Environmental concerns with respect to mimicking natural functions prohibits this type alternative from being considered as a viable solution.

Current regulatory philosophy dictates the restoration of previously urbanized systems to a more natural flow regime with meandering channels and vegetated overbank flow zones or littoral shelves. This option is somewhat limited in its applicability to areas where real estate is available for such efforts.

Vegetative Removal

This alternative removes all exotic underbrush and small trees less than four (4) inches in diameter within the waterway and immediate floodplain area. The removal of this material provides for improved flow conditions by reducing drag (roughness coefficient) and thereby increases the efficiency of flow in the waterway.

Culvert Modifications

Examination of the field survey data along the various primary waterways illustrated locations where culverts appeared to be obstructions to peak flows. Generally culvert modifications would result in only minor localized improvements with respect to the waterway, thus this alternative provided little cost effective benefit.

Buy Out or Relocation

While not considered a modelable option and obviously having little to no impact on flood reduction, buy out was examined as a viable alternative for flood damage reduction. Often, when a limited number of structures are impacted by low-level flooding (i.e. 3 to 10-year frequency events), the most cost effective alternative is to buy the structures and possibly create recreational and/or park facilities designed for periodic inundation. However, this alternative is not considered to be a viable "community" wide solution.

Diversion and/or Detention

Stormwater diversion consists of the interception of excess floodwaters, those greater than the downstream capacity, and routing them to an offline storage location. The creation of a diversion or detention facility after is a matter of community concern. However, this alternative has been a proven method for flood damage reduction and also can serve a multipurpose (open space, water quality, recreation, etc.) function. Examples of these types of solutions include stormwater parks, filter marshes, retention ponds, and dry detention areas.

8.3 DESCRIPTION of WATER QUALITY CONDITIONS

The City of Fort Myers is not unique among Florida cities where much of the original drainage system was constructed during the early part of the century with little consideration to water quality impacts. In virtually all cases, construction design criteria used did not include any storm water quality treatment considerations. As such, the vast majority of the City's existing stormwater infrastructure is designed for flood protection. Similarly, as noted in previous sections of this report, most studies undertaken to date have been related to flood protection. A primary goal of this report was to modernize the City's existing situation to address the current regulatory focus on water quality and to address the few remaining flooding issues within the corporate limits.

8.4 ALTERNATIVE SOLUTIONS (WATER QUALITY)

A storm water best management practice (BMP) is a technique, measure, or structural control that is used for a given set of circumstances to manage the quantity and improve the quality of stormwater runoff in the most cost-effective manner. BMPs can be either engineered and constructed systems ("structural BMPs") to improve the quality and/or control the quantity of runoff. Examples of structural BMPs include detention ponds, constructed wetlands, or diversion structures or weirs, designed to limit the amount of stormwater runoff discharge and thus reduce the amounts of pollutants in the runoff. No single BMP will address all stormwater scenarios, each type has certain limitations based on drainage area served, available land space, cost, and pollutant removal efficiency, as well as a variety of site-specific factors such as soil types, slopes, depth to groundwater table, etc.

In existing urbanized areas, BMPs can be implemented to address a range of water quantity and water quality considerations. For new urban development, BMPs should be designed and implemented so that the post-development peak discharge rate, volume, and pollutant loadings to receiving waters are the same or less than pre-development values. To meet these goals, multiple BMPs can be implemented to address three main factors: flow control, pollutant removal, and pollutant source reductions.

Stormwater BMPs can be grouped into two broad categories: structural and non-structural. Structural BMPs are used to treat the stormwater at either the point of generation or the point of discharge to either the storm sewer system or to receiving waters.

Non-structural BMPs include product disposal, storm drain inlet stenciling, management of pesticide and herbicide use, waste disposal, etc. and include a range of pollution prevention, educational, institutional, management, and development practices designed to limit the conversion of rainfall to runoff and to prevent pollutants from entering runoff at the source of runoff generation. Only structural BMPs will be addressed herein.

Structural BMPs

Generally, application of a single BMP will be insufficient to adequately address all aspects of a particular set of stormwater circumstances. As such, the system designers must employ a series of BMPs commonly referred to as a “treatment train” to accomplish the design objective.

There are a wide variety of structural BMPs in use for stormwater management. Structural BMPs include engineered and constructed systems that are designed to provide for water quantity and/or water quality control of stormwater runoff. It is important to understand the distinction between BMP types, in particular, the terms “retention” and detention” are frequently used interchangeably, although they have distinct meanings. Detention is defined as providing temporary storage of a runoff volume prior to discharge. Retention on the other hand is defined as providing complete storage of runoff without discharge by means other than evaporation or infiltration. With the strict interpretation of this definition, retention practices would be limited to those practices that only infiltrate or evaporate runoff. However, retention is also commonly misused to describe a practice that primarily retains a runoff volume in a permanent pool until it is displaced in part or in total by the next storm event. Structural BMPs can been grouped and defined as follows:

- Infiltration systems which capture defined volumes of runoff and infiltrate into the ground.
- Detention systems which capture defined volumes of runoff and temporarily detain that volume for prior to release by surface discharge.
- Retention systems which capture a defined volume of runoff and retain that volume until it evaporates, infiltrates or is displaced in part or in total by the next runoff event.
- Constructed wetland systems incorporate elements of both retention and detention systems. Primarily, treatment in these systems is provided by aquatic vegetation that is incorporated in the design to treat runoff by bio-assimilation.
- Filtration systems which use a combination of filtration media such as sand, organic materials, carbon, or membrane technology to remove pollutants found in stormwater runoff.
- Vegetated systems (biofilters) such as grassed swales and vegetated filter strips designed to convey and treat runoff.
- Miscellaneous and vendor-supplied systems include a variety of proprietary mechanical systems that capture various solids in runoff. These systems include catch basin inserts, hydrodynamic devices and other filtration devices.

Infiltration Systems

Infiltration systems include infiltration basins, porous pavement systems, and infiltration trenches or wells. An infiltration BMP is designed to capture a specific volume of runoff, retain it and infiltrate that volume into the ground water regime. Infiltration of stormwater has a number of advantages and disadvantages. The primary advantage of infiltration is water quality treatment by reducing the volume of runoff contributing to discharge runoff. However, this however tends to be a limited fraction of the overall reducing runoff volume. Infiltration systems should be designed to capture a specific volume of stormwater runoff and infiltrate that volume into the ground over a period of time.

Infiltration provides secondary benefits by increasing recharge to the underlying surficial aquifer thus raising the ambient water table and providing increased base flow to nearby streams. Pollutant removal occurs as water percolates through the adjacent soil and filters pollutants. Microorganisms in the soil also provide degradations organic pollutants that are contained in the infiltrated stormwater. Also as noted herein, although the water quality aspect of infiltration systems is limited, infiltration of runoff mitigates and generally mimics the pre-urbanized characteristics of an area by eliminating discharge from numerous small events, and by returning that rainfall volume back into the groundwater column.

Although infiltration of stormwater has many benefits, there are limitations. First, infiltration may not be appropriate in the vicinity of areas where groundwater is a primary source of drinking water supply due to the potential for contaminant migration. This is especially true of runoff from commercial or industrial areas where the potential for contamination by organic compounds or heavy metals is present. The performance of infiltration BMPs is limited in areas with poorly permeable soils. Infiltration BMPs can experience reduced infiltrative capacity and even clogging due to excessive sediment accumulation. A dedicated maintenance program is required to maintain the infiltrative capacity of the system. Care must also be taken during construction to limit compaction of the soil layers underlying the BMP. Excessive compaction due to construction equipment will reduce infiltrative capacity of the system. Excessive sediment generation during construction and site grading/stabilization may cause premature clogging of the system if not addressed prior to operating the system. Infiltration systems should not be placed into service until disturbed areas have been stabilized by vegetation or grasses.

Infiltration Basins: Infiltration basins, such as dry detention areas, are designed to capture a specific stormwater runoff volume, hold this volume and infiltrate it into the ground over a period of time. Infiltration basins be placed off-line, and are designed to intercept a certain volume of runoff, with any excess volume bypassing the system. The basin should include the planting of aquatic vegetations, to assist in preventing the migration of pollutants. Also, the roots of the vegetation increase the permeability of the soils, thereby increasing the systems infiltration efficiency. Infiltration basins are typically not designed to retain a permanent pool volume, their primary treatment function is provided by converting surface water runoff to infiltrated groundwater. Pollutants are removed through mechanisms such as filtration, adsorption, and biological conversion as the water percolates through the underlying soil.

Infiltration basins should be designed to restore the treatment volume within 72 hours to prevent mosquito breeding and potential odor problems associated with standing water and to ensure that the basin is ready to receive runoff from the next storm. In addition to removing pollutants, infiltration basins are useful to help restore or maintain pre-development hydrology before increasing the ambient water table, and increasing stream base flow.

Porous Pavement Systems: Porous pavement is an infiltration system where stormwater runoff is infiltrated into the ground through a permeable layer of pavement or other stabilized permeable surface. These systems can include porous asphalt, porous concrete, modular perforated concrete block, cobble pavers with porous joints or gaps, or reinforced/stabilized turf.

Pervious pavement can be used in many applications where traditional paved surfaces are called for and can greatly reduce the amount of runoff and associated pollutants discharging from these areas. Pervious pavement systems are suitable for a limited number of applications and typically should only be used in areas that are not exposed to high volumes of traffic or heavy equipment. They are particularly useful for driveways, secondary streets, residential areas, and low turnover and overflow parking areas in commercial and industrial areas.

Pervious pavement is not effective in areas subject to high amounts of sediment due to the tendency of the pores to clog. To prevent clogging and subsequent loss of percolation porous pavements requires periodic maintenance by vacuuming or jet-washing to remove sediment from the pores. Paved areas should be clearly marked to indicate that a porous pavement system is in use and to limit use by heavy equipment, reduce traffic volume, and to prevent resurfacing with non-porous pavement.

Studies of properly maintained porous concrete systems used in Florida indicate the system has performed well. Many of the documented failures are attributed to lack of proper erosion and sediment controls during construction or lack of contractor experience with installation of porous pavement systems. When properly designed and maintained, porous pavement systems can be a very effective means of reducing urban stormwater runoff.

<u>Infiltration Trenches and Wells:</u> An infiltration trench or well is a gravel-filled trench or vertical well designed to infiltrate stormwater into the ground water column. A volume of stormwater runoff is diverted into a designed trench or well where it infiltrates into the surrounding soil. Typically infiltration trenches and wells can only capture a limited amount of runoff and therefore may be designed to capture the "first flush" of runoff from a relatively small area. For this reason, these systems are frequently used in combination with another BMP such as a detention basin to control peak stormwater flows. Infiltration trenches and wells can be used as initial treatment to remove suspended solids, particulates, bacteria, organics, and soluble metals and nutrients through the mechanisms of filtration, absorption, and microbial decomposition. They are also useful in providing groundwater recharge and to increase base flow levels in nearby streams. As

with any infiltration practice, the possibility for groundwater contamination due to buildup may exist.

Detention Systems

Detention systems are BMPs that are designed to intercept a volume of stormwater runoff and temporarily impound the water for gradual release to the receiving stream or storm sewer system. Detention systems are designed to completely discharge the treatment volume between storm events, and therefore provide primarily water quantity benefits as opposed to water quality treatment. However, detention basins do provide settling of particulate matter, and a limited amount of infiltration but a large portion of settled material can be re-suspended by subsequent runoff events and infiltration is limited by the reduced detention times. Detention facilities should be considered mainly as practices used to reduce the peak stages and discharge rates to receiving streams to reduce downstream flooding and to provide some degree of channel protection. There are several types of detention facilities used to manage stormwater runoff, including wet and dry detention basins, underground chambers.

<u>Dry/Wet Detention Systems</u>: Detention systems are of two types, wet or dry and are designed to intercept a volume of stormwater, temporarily impounding the water, and releasing it over time at a design rate after the storm event. The main purpose of a detention system is quantity control by reducing the peak flow rate of stormwater discharges. Wet systems are designed to retain permanent pool volumes below a design water level (control elevation) between runoff events. Dry detention system are not designed to retain a permanent pool below the control elevation and have a bottom elevation at least 1.0 foot above the wet season water table. Both systems are designed to empty in a time period of less than 72 hours. The treatment ability of detention system is usually limited to the removal of suspended solids and associated contaminants by gravity settling. The efficiency can be increased by incorporating various elements such as forebay or separate settling chambers for the accumulation of coarse sediment,

facilitating periodic cleaning to prevent re-suspension by subsequent storm events. Detention systems can assist in limiting downstream scour and subsequent loss of aquatic habitat by reducing the impact of peak flow rates and reducing the energy of stormwater discharges to the receiving stream. Treatment efficiency can be further enhanced by including the plantings of various hydrophyotic plants to increase pollutant assimilation.

Underground Chambers: Underground detention chambers such as vaults, pipes and tanks are designed to provide temporary storage of stormwater runoff. Significant water quality improvements should not be expected with this BMP without a significant infiltration component. They should mainly be used for providing storage to limit downstream impacts due to high peak flow rates. Like detention basins, underground detention systems are designed to empty out between runoff events so that storage capacity is available for subsequent runoff events.

Retention Systems: Retention systems are designed to capture a defined volume of runoff and retain that volume until it is displaced in part or in total by the next runoff event. Retention ponds, when properly designed and maintained, can be extremely effective BMPs, providing both water quality improvements and quantity control, as well as providing aesthetic value and aquatic and terrestrial habitat for a variety of plants and animals. The volume available for storage, termed the water quality volume, is provided above the permanent pool level of the system. Discharge from these systems is limited to evaporation, infiltration, or displacement. The main pollutant removal mechanisms in retention systems are sedimentation and bio assimilation. By retaining a permanent pool of water, retention systems can benefit from the added biological and biochemical pollutant removal mechanisms provided by aquatic plants and microorganisms, mimicking a natural pond or lake ecosystem. Also, sediments that accumulate in the pond are less likely to be re-suspended and washed out due to the presence of a permanent pool of water and then relative depth of the system. In addition to sedimentation, other pollutant removal mechanisms in retention systems include filtration of suspended solids by vegetation, infiltration, biological uptake of nutrients by aquatic plants and algae, volatilization of organic compounds, uptake of metals by plant tissue, and biological conversion of organic compounds. Retention basins that incorporate an aquatic bench around the perimeter of the pond that is planted with aquatic vegetation can have an additive pollutant removal efficiency. This littoral zone can aid in pollutant removal efficiency by incorporating mechanisms found in wetland systems.

Constructed Wetland Systems

Constructed wetland systems also referred to as filter marshes or Stormwater Treatment Areas (STA), incorporate the natural functions of native wetlands to aid in pollutant removal from stormwater. Constructed wetlands provide for quantity control of stormwater by providing storage volume of ponded water above the permanent pool elevation. As a living system, constructed wetland systems have limits to their applicability in that a water balance must be performed to assess the limits of the systems' hydroperiod to sustain the aquatic vegetation between runoff events and during the dry season. Additionally, a sediment forebay or some other pretreatment provision should be incorporated into the wetland system design to allow for the removal of coarse sediments and floating debris that can degrade the performance of the system. Constructed wetlands are particularly appropriate where groundwater levels are historically close to the land surface.

Depending upon regulatory considerations, stormwater runoff maybe routed to natural wetlands after pretreatment in a constructed wetland system. Natural wetlands that receive treated stormwater runoff should be evaluated to determine if the runoff will cause degradation of the wetland, and if so, additional measures should be taken to protect the wetland from further degradation. As noted, regulatory authorities should be consulted early in the design process of the constructed wetland systems to avoid undue complications.

Wetland Treatment Areas and Wetland Channels: Wetland treatment areas and channels are any of a number of designed systems that incorporate mechanisms of natural wetland systems to improve water quality and provide quantity control. A wetland channel is designed to develop dense wetland vegetation to slowly convey storm flows to a rate of less than two (2) feet per second. Wetland treatment areas may be designed with or without an open water (permanent pool) component. Wetland treatment areas with open water are similar to retention ponds, except that a significant portion, usually 50 percent or more, of the permanent pool volume is covered by emergent wetland vegetation. Wetland treatment areas without open water are typically inundated during peak runoff events, but maintain a shallow pool. Wetland treatment areas of this type, also known as filter marshes, support a variety of hydrophilic vegetation adapted to saturated soil conditions and tolerant of periodic inundation by runoff. Pollutant removal in wetlands can occur through a number of mechanisms including sedimentation, filtration, volatilization, adsorption, absorption, microbial decomposition, and plant uptake. In addition, wetlands can provide for significant amount of water storage during runoff events, thus supplying water quantity control as well.

Filtration Systems

A filtration system is a device that uses a media such as sand, gravel, peat, or compost to remove a fraction of the pollutant constituents found in stormwater runoff by filtration through the media. Filters are primarily a water quality control device designed to remove particulate pollutants. Limited quantity control can be included by providing additional storage volume in a pond or basin, by providing vertical storage volume above the filter bed, or for example by allowing water to temporarily pond in parking lots or other areas before being discharged through the filter. Media filters are commonly used to treat runoff from small sites such as parking lots and small developments, in areas with high pollution potential such as industrial areas, or in highly urbanized areas where land availability or costs preclude the use of other BMP types. Filters should be placed off-line i.e., a portion of the runoff volume, called the water quality volume or first flush, is diverted to the BMP, while any flows in excess of this volume are bypassed.

Media filters should incorporate the use of a forebay or pre-treatment chamber to remove a portion of the particulates solids before filtration. This helps to extend the life of the filter and prevent clogging of the filter media by removing a portion of the coarse sediment. Also, care must be taken to prevent construction site sediments and debris such as fines washed off of newly paved areas from entering the filter, as these can cause premature clogging of the filter.

Surface Sand Filter: The surface sand filter was developed in Florida in 1981 for sites that could not infiltrate runoff or were too small for effective use of detention systems. The surface sand filter system usually incorporates two basins. Runoff first enters a sedimentation basin where coarse particles are removed by gravity settling. This sedimentation basin can be either wet or dry. Water then flows through a control device such as a weir or inlet into the filter basin. The filter bed consists of sand with a gravel bed and a perforated pipe under-drain system to capture the treated water. The surface of the filter bed should be planted with grass or other appropriate vegetation. Additional storage volume can be provided above the filter bed to increase the volume of water that can be temporarily ponded in the system before filtration. This two-basin configuration can help to limit premature clogging of the filter bed by first removing excess sediment loading.

Biofiltration/Bioretention Systems: Bioretention systems are designed to mimic the functions of a natural forested ecosystem for treating stormwater runoff. Bioretention systems are a variation of a surface sand filter, where the sand filtration media is replaced with a planted soil bed. Stormwater flows into a bioretention area, first ponds on the surface and infiltrates into the soil bed. Pollutants are removed by a number of processes including adsorption, filtration, volatilization, ion exchange, and decomposition. Treated water is allowed to infiltrate into the surrounding soil, or is collected by an under-drain system and discharged to a second treatment element or directly to the receiving waters. When water is allowed to infiltrate into the surrounding soil, bioretention systems can be an excellent source of groundwater recharge. Several components of a bioretention system include:

Grass Buffer Strips. Runoff enters the bioretention area as sheet flow through a grass buffer strips. These buffers reduce the velocity of the runoff, filters particulates, and promotes assimilation and uptake of pollutants. Grass strips are typically directly connected to impervious areas.

Ponding Area. The ponding area provides for surface storage of stormwater runoff before it filters through a soil bed. The ponding area allows for discharges by evaporation and uptake by the system vegetation as well as promoting settling of sediment from the runoff.

Organic Mulch Layer. The organic mulch layer has several functions, which include protecting the soil bed from erosion, retaining moisture in the plant root zone, providing a medium for biological growth and decomposition of organic matter, and providing some filtration of pollutants.

Planting Soil Bed. The planting soil bed provides water and nutrients to support plant life in the bioretention system. Stormwater filters through the planting soil bed where pollutants are removed by the mechanisms of filtration, plant uptake, adsorption, and biological degradation.

Sand Bed. The sand bed underlies the planting soil bed and allows water to freely drain from the planting soil bed through the sand bed and into the surrounding soil. The sand bed also provides additional filtration and allows for aeration of the planting soil bed.

Plantings. Plantings are an important component of a bioretention system. Plants remove water though evapotranspiration and remove pollutants and nutrient through uptake. The plant species selected are designed to replicate a forested ecosystem and to survive stresses such as frequent periods of inundation during runoff events and drying during inter-event periods.

In addition to providing for treatment of stormwater, bioretention facilities, when properly maintained, can be aesthetically pleasing. Bioretention facilities can be placed in areas such as parking lot islands, in landscaped areas around buildings, the perimeter of parking lots, and in other open spaces. Since local regulations frequently require site plans to incorporate a certain percentage of open landscaped area, additional land requirements for bioretention facilities are often not required. The layout of bioretention facilities can be flexible, and the selection of plant species can provide for a wide variety of landscape designs. However, it is important that these systems be designed by registered individuals with experience in designing bioretention systems. Bioretention facilities can be adapted easily for use on individual residential lots. Prince George's County, MD has developed the concept of "rain gardens" which are small bioretention systems for use in single or multi-lot residential areas. They provide an easily maintainable, aesthetically pleasing, and effective means of controlling runoff from residential areas. By placing a series of bioretention areas throughout a residential area, the volume of stormwater runoff produced and requiring subsequent management can be significantly reduced.

Vegetated Systems (Biofilters)

Vegetated systems such as grass filter strips and vegetated swales are used to convey and provide initial stormwater treatment. These BMPs are commonly referred to as biofilters, since the grasses and vegetation "filter" the stormwater as it flows. Open channel vegetated systems are alternatives to traditional curb-and-gutter and storm sewer conveyance systems. By conveying stormwater runoff in vegetated systems, some degree of treatment, storage, and infiltration can be provided before discharge to subsequent treatment BMP's. This can help to reduce the overall volume of stormwater runoff that is generated from a particular drainage area.

Grass Filter Strips: Grass filter strips are densely vegetated and uniformly graded areas that intercept sheet runoff from impervious surfaces such as parking lots, highways, and rooftops. Grass filter strips are frequently planted with turf grasses, however alternatives that adopt any natural vegetated form such as meadows or small forest may be used. Grass filter strips can either accept sheet flow directly from impervious surfaces, or concentrated flow can be distributed along the width of the strip using a gravel trench or other level spreader. Grass filter strips primarily intended to trap sediments, to partially infiltrate this runoff and to reduce the velocity of the runoff. Grass filter strips are frequently used as a "pretreatment" system before stormwater being treated by other BMPs such as filters or bioretention systems. Grass filter strips can also be used in combination with riparian buffers in treating sheet flows and in stabilizing drainage channel banks and stream banks. Grass filter strips should be irrigated to maintain a dense stand of vegetation and to prevent export of unconfined soil during the dry season.

Vegetated Swales: Vegetated swales are broad, shallow channels with a dense stand of vegetation covering the side slopes and channel bottom. Vegetated swales are designed to slowly convey stormwater runoff trapping pollutants, promoting infiltration and reducing flow velocities. Vegetated swales can be either wet or dry. Dry swales are used in areas where standing water is not desired, such as in residential areas. Wet swales can be used where standing water does not create a nuisance problem and where the groundwater level is close enough to the surface to maintain the permanent pool in inter-event periods. Wet swales provide the added benefit of being able to include a range of wetland vegetation to aid in pollutant removal.

Miscellaneous and Vendor-Supplied Systems: There is a wide variety of proprietary mechanical devices that are available for urban stormwater management. Many of these systems are fabricated systems and incorporate some combination of filtration media, hydrodynamic sediment removal, oil and grease removal, or screening to remove pollutants from stormwater. Their use has varied applicability and is circumstance dependant. Most have design limitations but can be effective in the appropriate situation.

8.5 OPERATIONS & MAINTENANCE CONSIDERATIONS

All of the systems discussed herein require a dedicated long term commitment to the operation and maintenance of these systems. Most municipal operation and maintenance programs for stormwater facilities are frequently in response to citizen complaints concerning flooding. Replacements or upgrades to the existing system capacity is normally dependent upon the degree, severity, and/or frequency of the occurrence(s). Existing system improvements can only be addressed through the capital improvement programming process. That said, a comprehensive maintenance program including street sweeping, culvert and inlet maintenance, channel mowing and cleaning, will constitute a reduction in citizen complaints.

8.6 URBANIZED vs. DEVELOPING AREAS

Core Urban Area

Given the previously noted State and Federal mandates related to water quality improvements such as the TMDL program, this study has focused primarily on water quality issues in the core urban area of the City. The watersheds within the City limits that are generally west of Interstate 75 and north of Colonial Boulevard, these areas were predominately developed in the pre-regulatory years prior to 1980. As such, the land use development pattern did not incorporate the storm water management practices that are currently required by the state Environmental Resource Permitting process and regulations of the SFWMD. As such, much of the runoff from this area is described as uncontrolled and untreated with direct discharge to the primary conveyance channels directly discharging to the Caloosahatchee River.

Given the intensity of the development within this area, many of the traditional structural and non-structural treatment alternatives are not economically available. Therefore, special effort to incorporate appropriate BMP's into the existing infrastructure using available lands will be required to achieve any improvements to the existing water quality and water quality situation.

To mitigate for the adverse affect of past storm water practices in this area with limited treatment opportunities, the following recommended projects propose to re-introduce detention storage within the existing canals by constructing water control structures and detention and treatment facilities within areas adjacent to existing systems, such as the Ten Mile Canal. Additionally, strategic placement of structures will have the effects of creating interconnectivity within the city's watersheds.

By constructing water control structures and storage areas, storm water runoff will better mimic a pre-developed hydrologic response condition(s) by delaying discharge, thereby decreasing the degree of flooding in downstream areas and decreasing the pollutant loading. The cumulative impact being enhanced water quality outfalling to the Caloosahatchee River.

Developing and Annexation Areas

For the watershed areas within the City limits that are generally east of Interstate 75 and south of Colonial Boulevard, these areas have mostly been or will be developed under the current Environmental Resource Permitting (ERP) provisions of the SFWMD or the FDEP. As such these areas should provide for adequate flood protection and water quality treatment for those lands within these areas. However, as noted herein, the greater emphasis on water quality improvement and mitigation by state and federal agencies and the ultimate responsibility on local government for the quantity and quality of stormwater discharging from its corporate limits, will require the City to be proactively involved in the planning, design, permitting, and operation of systems within its corporate limits.

9.0 LEVEL OF SEVICE STANDARDS

9.1 GENERAL CONSIDERATIONS

The City of Fort Myers is not unique among Florida cities where many of the original drainage systems were either constructed during "boom times" to create new land suitable for development, by railroads extending track beds, or by State or Federal governments for construction of major roads. In virtually all cases, construction design criteria used often did not include any stormwater treatment considerations.

The establishment of Levels of Service (LOS) is one of the most important aspects of stormwater management planning. LOS is the criteria used to measure and evaluate the adequacy of infrastructure serving existing or proposed development. Typically, LOS criteria for stormwater management is primarily concerned with the public health and safety, as reflected on the level of protection provided from flooding and the degree of water quality degradation potential of a nonpoint source discharge. Poor development practices or overuse of physical capacities usually are associated with a lower LOS than is desired or acceptable.

9.2 LEVEL OF SERVICE - GENERAL

In its simplest form, a Level of Service (LOS) criteria is the anticipated functionality that would be considered acceptable in either a residential or businesses environment during a specified rainfall event. For example, an LOS criteria for flooding in a defined geographic area can be established by the functional and operational requirements of its depths and/or duration of the flood waters for a given event.

One goal in setting LOS criteria is for the LOS to be flexible enough to address known problem areas and yet not require unnecessary and costly modification to the existing system. In other words, they need to be practical. When developing LOS criteria, both the condition and function of the existing stormwater drainage system(s) must be considered. It should be noted that the LOS guidelines provided in this report in this are proposed for consideration purposes and would not necessarily apply to areas within newer developments, based on the premise that newer development(s) meet current City and SFWMD regulations that address such issues.

9.3 LEVEL OF SERVICE – SYSTEMWIDE

In the past 30 years much attention has been directed toward improving the management of urban storm water. Urbanization has resulted in increased volumes and velocities of storm runoff largely due to the increase of impervious areas such as streets, parking lots, and rooftops. Management tools have included ordinances requiring developers to size pipes to accommodate a designed return period of flood, to build above a certain minimum elevation (usually the 100-year flood elevation), and, in some cases, to control the post development peak discharge in such a manner that it does not exceed the predevelopment peak discharge. In spite of these tools, there are still problems associated with urban streams in urban which in most cases have not been enlarged or improved to accommodate the increased urbanized flows.

Five levels of service are defined qualitatively as follows with examples of flooding or erosion conditions that are associated with the particular level of service.

• **Level of Service A** - represents a waterway in its “natural” condition, the floodplain is undeveloped, no structures or yards are affected by the 100-year flood, no accelerated erosion is occurring, the primary waterway section has not been affected by development in anyway, and the water quality meets or exceeds the criteria set forth for each parameter pursuant to Chapter 62 of the Florida Administrative Code (FAC).

• **Level of Service B** - represents a waterway in a desirable condition, no property damage to permanent structures is experienced in the 100-year flood, yard flooding may be experienced, erosion is slight or waterway banks are armored against erosion, riparian property owner rarely experiences any inconvenience caused by the waterway, and the water quality meets or exceeds the 85th percentile of the criteria set forth for each parameter pursuant to Chapter 62, FAC.

• **Level of Service C** - represents a waterway in a tolerable condition, some inconvenience due to yard flooding may be experienced by riparian property owners, but not enough that the waterway would detract from property values, erosion may be occurring, but the waterway cross section has altered only slightly, and the water quality meets or exceeds the 70th percentile of the criteria set forth for each parameter pursuant to Chapter 62, FAC.

• **Level of Service D** - represents a waterway in an unacceptable condition, the value of surrounding property is slightly affected due to erosion or flooding, the riparian property owner is frequently inconvenienced by problems with the waterway, and the water quality meets or exceeds the 50th percentile of the criteria set forth for each parameter pursuant to Chapter 62, FAC.

• **Level of Service F -** represents a waterway in a damaged condition, causes a significant reduction in the value of surrounding property, flood damage to buildings and structures occurs, large amounts of sediment may be moving from the bed or banks, health and safety issues exist along some segments, and the water quality meets less than the 50th percentile of the criteria set forth for each parameter pursuant to Chapter 62, FAC.

9.4 LEVEL OF SERVICE - NEIGHBORHOOD

Before a level of service scheme can be developed, it is necessary to determine the qualities of service expected of the facilities involved. The proposed use of the level of service concept for streams is intended to be applicable for analysis of existing conditions and design of any improvements. The goal of the level-of-service scheme is to maximize the quality of service as perceived by the user of the facility.

In many cases, property owner's concerns are of only frequent and/or extensive yard flooding. It is obvious from inspecting of a number of these cases, that a considerable portion of these yards (up to 70%) would be flooded in a heavy rain. This is in most cases not acceptable to the property owner, thus it becomes perceived that short term nuisance flooding is a major problem. In general, it can be cost prohibitive to solve a nuisance flooding problem.

The Neighborhood Level of Service (Duration Basis) can be defined by the duration time(s) of standing water in consideration of available infiltration rates and conveyance capacities subsequent to the ending of a single rainfall storm event and the presence of the following conditions: (1) the receiving water course, body, or facility does not create a backwatering condition to the system and/or recovers to the listed conditions within 24 hours of ending rainfall event above; (2) the lowest finished floor elevation (LFFE) of the building structure must be one foot (1.0') above the top of grate elevation (minimum); (3) the minimum slope from the building structure (LFFE) to the top of grate (or outfall invert) elevation must be 0.01 feet/foot (1.0%); (4) the top of grate/invert elevation must be five tenths (0.5) feet below the edge of pavement (minimum); (5) the swale(s) must be on a continuous mono-sloped grade and be of well maintained short grasses; (6) the minimum longitudinal slope of the conveyance swale is 0.005 feet/foot (0.5%); (7) the drainage area to each stormwater inlet must be evenly distributed and be no greater than one-sixth (0.6) acres; (8) for each additional 500 feet of subsurface piping, the pipe will increase to the next higher diameter size with the minimum pipe size being 15 inches; and (9) the computed water quality measures and/or best management practices must be accordance with the SFMWD criteria.

Subject to the above conditions and criteria outlined above, the Level of Service (LOS) for an existing neighborhood stormwater system can be classified based on the difference in depth from top of grate or invert elevation to receiving water or ground water table elevation, as follows:

Neighborhood Level of Service	Depth to Water Elevation	Standing Water Duration
A	2.0 feet	24 hrs.
B	1.5 feet	36 hrs.
C	1.0 feet	48 hrs.
D	0.5 feet	72 hrs.
F	0.0 feet	96 hrs.

10.0 REGULATORY STANDARDS OVERVIEW

10.1 CODE OF ORDINANCES (City of Fort Myers)

The City of Fort Myers has a stormwater management ordinance that regulates the practices of development within the City corporate limits. This ordinance is found under Chapter 122, Article IV, entitled "Drainage Facilities". For the most part, this criteria reflects the same considerations provided for within the South Florida Water Management (SFWMD) basis of review for surface water management criteria. In the interests of uniformity and consistency, it is recommended that the current procedure regarding the permitting process be continued with the City reserving its individual right of review and approval.

10.2 COMPREHENSIVE PLAN (City of Fort Myers)

The State of Florida Local Government Comprehensive Planning and Land Development Regulation Act (Sections 163.3161-163.3215 of the Florida Statutes) requires local governments to prepare comprehensive plans to guide and control future development, which must be submitted to the State for approval. By statute, these comprehensive plans are required to specify minimum Levels of Service (LOS) for certain public facilities and services, which include drainage and stormwater management.

The City of Fort Myers Comprehensive Plan has been revised since the original plan was completed in the late 1980's, with each of these various revisions approved by the State of Florida - Department of Community Affairs. The Municipal Services/Surface Water Management Element (Section 4) of this Plan contains goals, objectives, and policies which specifically address the management and protection of natural surface water functions to minimize the adverse impacts of development.

10.3 SOUTH FLORIDA WATER MANAGEMENT DISTRICT (SFWMD)

The South Florida Water Management District (SFWMD) has criteria for determining flood protection levels of service for roadways and structures as provided for under Chapter 373 of the Florida Statutes. The SFWMD requires development to secure Environmental Resources Permits (ERP) that address stormwater quantity and quality issues in chapter 5 of Volume IV of the Basis of Review and addresses new facility construction and the maintenance of existing facilities. Subsequent linking of the Environmental Resources Permit process to the designation of impaired waters appears eminent. Currently the issuance of an ERP provides the permittee with a state water quality certification. Conventional wisdom indicates that an application for an Environmental Resources Permit for a stormwater management system discharging to a designated impaired water (identified on the 303(d) Impaired Waters List under FDEP's -TMDL Program) may either be (1) denied, or (2) issued with additional permit conditions focused on controlling annual pollutant loads discharged from the system into water of the state.

FDEP's Total Maximum Daily Load (TMDL) program is intended to remove water quality impairments in state waters caused by excessive pollutant discharges and will likely become Florida's most far-reaching stormwater regulatory program. The core of this program is developing water quality simulation models for impaired waters to assess pollutant discharges, identify necessary reductions in pollutant loads, and incorporating these reductions into permits authorizing stormwater discharge. This program will impact all of Florida's existing stormwater systems and is likely to serve as the basis for more communities to develop and implement stormwater utilities in order to meet the fiscal challenges of correcting decades of water quality degradation.

10.4 NPDES PERMITTING PROGRAM

The role of the Federal government has become more pronounced in Florida since the emergence of the Environmental Protection Agency's (EPA) NPDES Permitting Program pursuant to the Clean Water Act (CWA). Starting in 1990, EPA required Florida counties and cities to secure Municipal Separate Storm Sewer System (MS4) Permits for their storm water discharges to waters of the United States. The MS4 Permit focuses on the reduction of pollutant loads discharged from stormwater outfalls and overall improvement of ambient water quality through the development of an integrated process for prevention, reduction and mitigation of pollutant discharges by citizens and governmental functions, and the education of citizens and governmental employees in the areas of stormwater management and pollution abatement.

EPA's Stormwater NPDES Permitting Program is not a voluntary process as it is mandated for all communities. The CWA provides the EPA with administrative, civil and criminal penalties for failure to apply for required permits and failure to properly implement issued permits. EPA's program directly impacts a community through the incremental costs associated with the implementation of stormwater management programs and additional capital investments required for the modification and retrofitting of existing stormwater facilities.

11.0 RUNOFF ANALYSIS and IMPACTS

11.1 FLOODING PROBLEMS in URBAN WATERWAYS

It has been well documented in the literature that the urbanization of a watershed tends to increase the magnitude of flooding. In a synthesis of studies on urban flooding effects, it has been concluded that: (1) small floods may be increased by a factor of 10 or more depending upon the degree of urbanization, (2) floods with a return period of 100 years may be doubled in size by the complete urbanization of a watershed, if that urbanization results in at least a 30% paving of the basin, and (3) the effect of urbanization declines in relative terms as flood recurrence intervals increase (Hollis 1975). Study of urban flooding effects note that the basin lag time for a fully developed basin is about one-fourth the predevelopment lag time. The increase in impervious area from urbanization combined with the decrease in lag time roughly doubled the discharge from the 20-year flood in the basins studied. The increased discharge resulted in increased peak flood stages. Higher peak stages in urbanized areas are problematic primarily due to the flooding of low lying areas, which prior to urbanization constricted the flood plain of natural drainage ways. Encroachment of urbanization into these floodplains results in a reduction of natural storage with the watershed and frequently places commercial and residential structures in jeopardy. To remedy these conflicts, municipalities construct efficient conveyance systems in which to convey the stormwater to the receiving body, thus decreasing the available treatment times and resulting in degraded water quality conditions.

11.2 LOCALIZED FLOODING CONCERNS

During the investigative portion of this study, several generalized areas within the City limits were identified as areas of flooding concern based on the number and frequency of work orders issued by the Public Works Department. The scope of this report did not provide for development of specific solution(s) to these flooding problems. It is recommended that separate efforts be instituted by the City to determine the appropriate action in these areas. Appended to this section as Figure 11-1 is a map depicting the location of each flooding areas listed below. Due to the nature and indeterminate cost of such projects, they were not included in the proposed capital improvement implementation schedule provide in section 13.

* Fowler (Edison to Hanson)
* Marsh Avenue at Arlington Avenue
* Edison Avenue at Cranford Avenue
* Palm Avenue (MLK to 2nd Street)
* McGregor Boulevard/Colonial Boulevard (Northeast Quadrant)
* McGregor Boulevard/Caloosahatchee (Vesper Drive to Shadow Lane)
* Dean Park

11.3 HYDROLOGICAL CONSIDERATIONS

Climatic Factors

The temporal and spatial relationship for the climate of Southwest Florida is classified as subtropical with no radical seasonal temperature changes. Average monthly temperatures range from 64.3 degrees Fahrenheit in January to 82.6 degrees Fahrenheit in August. Freezes are not common in the region.

Patterns of precipitation in Southwest Florida exhibit strong seasonal variations. Average annual precipitation from 1951 through 1980 was approximately 52.7 inches, of which approximately 59.3 percent fell during the wet season, June through September. The normal mean July rainfall from 1951 through 1980 was fairly consistent throughout the area at 8+ inches.

Typical storm (rainfall) events are generally associated with convective thunderstorms, resulted by heated air rising from the earth's surface and are the typical weather phenomenon during afternoon hours in the rainy season. The lack of upper level air currents cause these thunderstorms to develop in isolated areas, as opposed to storms associated with frontal system which are more common during the dry season. Furthermore, the low topographical relief of the area causes additional problems when heavy rainfall does occur. Major flooding problems can occur when such rains precede the onset of tropical storms and hurricanes.

Southwest Florida has been identified by the National Weather Service (NWS) as one of the most hurricane vulnerable areas of the United States. Tropical storms of hurricane caliber (sustained winds greater than or equal to seventy four miles per hour) have historically passed within 100 miles of the southwest Florida Region about once every 2.5 years. The official Atlantic hurricane season is defined as occurring from June 1 through November 30, with the period of greatest frequency from August through October. Coastal flooding from tropical storms and hurricanes is a common occurrence, with flooding experienced in low lying areas, and around river and bay systems.

Dry season storm events are generally associated with the movement of frontal systems. With the coming of spring, cold fronts usually stall to the north of Southwest Florida. Thus, in the absence of significant rainfall water tables will decline to their lowest levels of the year.

Design Storm Events

Drainage improvements are typically designed for a maximum flow that results from a selected design storm. The significant factors involved in selecting the design storm are the amount of rainfall, the intensity of the rainfall and the duration of the storm. Storm patterns are represented by a hyetograph which is a plot of rainfall intensity versus time with the area under the hyetograph representing the total volume of rainfall. As such, the total amount of rainfall over the duration of the storm may not be as significant as the intensity of rainfall in affecting the design of drainage improvements.

The severity of storms is usually expressed in terms of the statistical frequency of occurrence or recurrence interval. The recurrence interval of a storm is generally the average length of time between two equal occurrences. For example, a 10-year storm is one that can be expected to occur at least once every 10 years. Recurrence intervals are not necessarily based on past records and although there are discernible patterns of weather occurrences, an actual storm event is unpredictable. Thus, a 100-year storm does not refer to a storm that occurs once every 100 years, but rather refers to a storm with a one percent (1%) or greater chance of being equaled or exceeded in any given year. In most cases design events are prescribed by various agencies with purview over the facility being designed.

Frequency Considerations

Drainage improvements in the Southwest Florida area are commonly designed for storms of 2- to 10-year recurrence intervals depending on the size of and the amount of development within the watershed. More severe occurrences, such as the 25- and 100-year storms are considered a flood control problem, and design improvements to convey runoff from these storms are limited to the primary channels. These primary channels form the basic drainage network or “backbone” for the watersheds under consideration.

Watershed Boundary Determination

A thorough examination of GIS aerial and contour mapping, USGS quadrangle maps, roadway, and development plans, etc., is required to obtain a minimum comprehensive overview of the watershed and must be supplemented by a field reconnaissance to further familiarize one’s self with the terrain and topography.

Due to the extremely flat terrain in the study area, there are many uncertainties which affect the drainage design. In these flat areas, there are usually no ridge lines or line which may accurately define a drainage area due to varying topographic, vegetative, and/or rainfall patterns. ECT undertook a review of most watersheds within the City to confirm the limits thereof. This information is provided in Section 4 of this report.

Drainage System Functions

A drainage system consists of three basic elements: (1) the primary channels, including major natural creeks and waterways; (2) the secondary lateral channels, which are tributaries to the primary channels and serve smaller areas; and (3) the tertiary system of storm sewers, small ditches, roadside ditches, etc. The primary channels are the subject of this study and the detailed evaluation of the secondary lateral and tertiary systems improvements are not. However, the evaluation for the secondary tertiary systems requirements for existing urban areas and for future conditions is often an essential requirement for the design at an adequate system for primary channels.

Ground Water Table

The amount of groundwater contributing to stream flow varies along the channel and according to the hydraulic gradient in the contributing aquifer. When the stream level is below the bordering groundwater table, a positive gradient exists and groundwater flows into the stream. If the bordering water table declines below stream level, seepage may flow from the stream into the aquifer. Water that seeps into stream banks during passage of floods is referred to as bank storage and returns relatively quickly to the stream after high flows recede. Throughout most of the City, the existing primary and secondary drainage systems have contributed to the over drainage of the ambient groundwater tables. Weir structures were constructed in the Manuel’s Branch, Carrell Canal, Winkler Canal, and Ten Mile Canal to provide some protection to the groundwater table, but were generally constructed as saltwater intrusion barriers. This report will recommend the construction of several improvement projects to provide groundwater and surface water diversions.

11.4 WATER QUALITY CONSIDERATIONS

General

The watersheds within most portions of the City of Fort Myers' corporate limits are characterized by the typical 1950 – 1960 style of land development with the primary drainage system consisting of deep narrow earthen channels and subsurface drainage piping systems installed to remove stormwater as quickly and efficiently as possible. Pollutants that are inherent with these land use and this type of Drainage System are also transported within these flows and are discharged without any attenuation, absorption or assimilation into the receiving body including the Caloosahatchee River and Estero Bay.

The water quality enhancement projects proposed herein should reduce the concentration of pollutants such as nutrients, suspended solids and sediments generally associated with the contributory land uses. It is anticipated that a pollutant load reduction on the order of 10 - 25% can be expected from these projects however, an ongoing monitoring program will be required to document. These projects are also consistent with goals and objectives of that identified by the South Florida Water Management District (SFWMD) as "Priority Waterbodies" for the Lower Charlotte Harbor Area. A prescribed ongoing maintenance program will also be required to sustain removal effectiveness and to periodically remove accumulated pollutants from the system. Other benefits may also accrue thru open space environmental educational enhancements and enhanced groundwater recharge.

Factors Affecting Water Quality and Waterway Processes

There are many factors that can and do adversely affect the quality of water in waterways draining from highly urbanized watersheds. Urbanization itself, the replacement of open or vegetated green areas with impervious surfaces oils, hydrocarbons and heavy metals from roadways and parking areas, the application of chemicals such as pesticides, herbicides, and fertilizers, all contribute to the degradation of the stormwater quality reaching the receiving water bodies of the Caloosahatchee River and Estero Bay.

Waterways are dynamic systems that convey, store and transform water, sediment, and organic matter. These transformations involve physical processes (aeration, dispersion currents, sedimentation), chemical processes (photosynthesis, metabolism) and biological processes (biological flocculation and precipitation) that act in concert to naturally transform rain water into storm water. These natural processes can have both positive and negative results relative to water quality.

Organic matter and nutrients in stormwater are decomposed and re-synthesized through chemical reactions in association with aquatic organisms. The material is transformed by the cycles of nitrogen, phosphorus, carbon and sulfur in aerobic decomposition. These processes create biochemical oxygen demand (BOD) that depletes dissolved oxygen in the water. Re-oxygenation is effected through aeration, absorption and photosynthesis. Riffles and other turbulences in waterways enhance aeration and oxygen absorption. Aquatic plants add oxygen to the water through transpiration. Oxygen production from photosynthesis of aquatic plants slows down or ceases at night creating a diurnal or daily fluctuation in dissolved oxygen levels in waterways.

The quality of water in a waterway is defined by its physical and chemical properties and by the composition and health of the aquatic organisms that live in the waterway. The presence of various larvae of for example, generally indicates good quality water; whereas, large populations of rat tail maggot, blood worm and sewage fungus indicate polluted water. Ecological interpretations can be made based on what associations of organisms should be in the waterway and recognition of abnormal numbers, associations, and conditions of living things. The condition or health of a waterways' ecosystem is reflected by its biological integrity. Biological integrity has been defined as "the ability of an aquatic ecosystem to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of the natural habitats of the region." (Karr and Dudley, 1981).

Waterway systems are impacted by human activities that make use of these systems and by human occupancy of flood plains and adjacent uplands. Impacts can result from direct disturbance of natural waterways through such things as channelization and point discharge of pollutants to receiving waters or may be more indirect through damaging land management practices and nonpoint source pollution in the watersheds. In many situations, waterways are responding to complex multiple disturbances and pollutant sources that occur over an extended period of time.

The most damaging impacts result from changes in the basic structure and function of the waterways' ecosystem. (Doppelt, et al., 1993) These impacts may include the following:

- changes in water quantity and/or flow regime by diversions, drainage conveyance projects, and land use changes;

- modification of channel and riparian ecosystem morphology by channelization and/or the removal of vegetation;

- degradation of chemical water quality by addition of contaminants;

- excessive nonpoint source pollution including siltation and nutrient enrichment;

- deterioration of waterway substrate quality and stability;

- separation of waterways from their normal ground water table and elimination of riparian wetlands by dredging and induced down cutting of the waterways;

- modification of normal water temperature regime by removal of tree canopy or alteration of base flow regime;

- introduction of exotic species that disrupt the dynamic balance of the ecosystem;

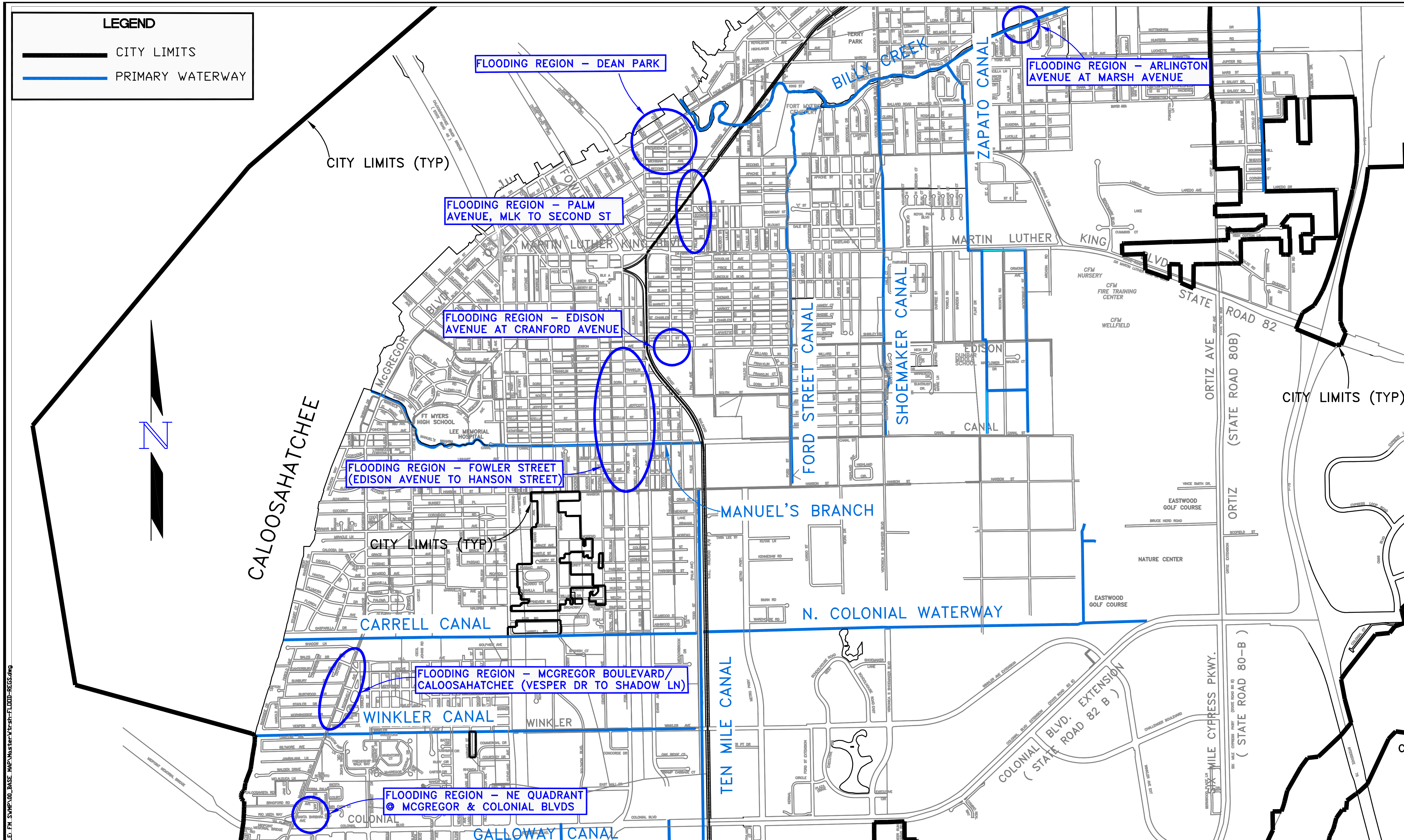
Management of these resources requires multi-disciplinary knowledge of: (1) the climatic environment; (2) geologic factors, including soil conditions; (3) surface water and ground water hydrology; (4) waterway channel hydraulics; (5) sedimentation; (6) fluvial geomorphology; (7) aquatic ecology; (8) watershed management; and (9) social, cultural, economic and political constraints. A team of knowledgeable individuals is generally needed to accurately assess the factors contributing to waterway problems and to find suitable solutions.

Recommended Best Management Practices

As noted previously, best management practices (BMPs) can be broken into two categories, structural and non-structural. Considering that the waterways germane to this study are currently in the advanced stages of degradation and are in several cases listed by the state as impaired. This study focuses on structural BMPs which should provide the quickest most efficient response to this situation and provide an effective level of pollutant removal. BMPs intended to limit nutrients and suspended solids are being primarily considered including conventional peak attenuation (volumetric detention storage) facilities and created wetland treatment systems such as flow through filter marshes.

11.5 FIGURES

Figure 11-1: "Localized Flooding Concerns"



SCALE
1"=2,500'

0 2500ft 5000ft 7500ft 10000ft

SOURCE: ECT 11-2007, F.M.

ECT
4100 Center Pointe Drive, Suite 112
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STORMWATER MASTER PLAN UPDATE

LOCALIZED FLOODING CONCERNS

City of Palms

CITY OF FORT MYERS, FL
PUBLIC WORKS DEPT.
ENGINEERING DIVISION

FIGURE 11-1

FILE: FM SWMP\00_BASE MAP\MasterWtrsh-FLOOD-REGS.dwg

12.0 WATER QUALITY ANALYSIS

12.1 OVERVIEW

Stormwater management for water quality control is a relatively recent concept. Historically urban stormwater was considered a water quantity issue best solved by rapidly draining runoff into sewers, ditches or directly into lakes and rivers. By the mid 1970s studies showed over half the pollutant loads entering Florida waters came from non-point sources (stormwater) caused in part by paving, ditching and draining techniques that increased storm runoff volumes and subsequently pollutant loadings. Regulations were implemented and by 1984 all new developments in Florida were required to include systems for the management and storage of surface waters. In recent years many local governments have initiated efforts to retrofit older mostly pre-regulatory urban areas. In response to these challenges, engineers have developed a wide variety of methods and devices for treating stormwater. These methods have demonstrated various levels of success and further data is needed to quantify the pollution removal capabilities of these systems. Accurate data is also needed to improve the accuracy of watershed models, to obtain permits through the National Pollutant Discharge Elimination System (NPDES) program, and to help establish Total Maximum Daily Loads (TMDLs). Increasingly, uniform and reliable measurements are needed to quantify the efforts being made to protect our water resources.

12.2 WATER QUALITY MODELING

As previously discussed herein, ECT utilized EPA's Stormwater Management Model (SWMM) to model each of the City's major watersheds for the purpose of modeling system flow routings during multiple rain events. For the purpose of maintaining consistency amongst models, SWMM has also been utilized to model the existing and proposed water quality characteristics of each simulated watershed.

Modeling Methodology

It is generally understood that given the typical water quality characteristics of watersheds in Southwest Florida total concentrations of Nitrogen (Total-N), Phosphorous (Total-P), and Total Suspended Solids (TSS) are key indicators of the general water quality within a watershed. Consequently, these parameters were chosen for analysis herein based on their historical use in published surface water quality literature specific to South Florida. These parameters were studied in a report entitled “Evaluation of Alternative Stormwater Regulations for Southwest Florida,” which was prepared by Harvey H. Harper, Ph.D., P.E. and David M. Baker, P.E. of Environmental Research & Design, Inc. in March 2003. For the purposes of discussion within this document this report will be referred to as the Harper-Baker Study. In the Harper- Baker Study, land use is the predominate variable used in assessing the quality of stormwater runoff from a particular basin.

Using the guideline of the Harper-Baker Study, existing land use was qualified at the sub-catchment level within each watershed that was evaluated using a combination of data acquired by field inspection and evaluation of aerial photographs of lands within the City’s corporate boundaries. Table 12-1, included at the end of this Section, identifies the land-use categories, pollutant event mean concentrations (EMC) and the estimated best management practice (BMP) removal efficiencies that were utilized in the water quality models.

The water quality model was created within the framework of the previously developed SWMM model used for water quantity evaluation by this study, such that any future changes to either model would be reflected in the flood routings as well as in the water quality analysis. SWMM allows users to define any number of analytes for inclusion in water quality modeling. Additionally, the user generally has three options for defining pollutant loadings in each watershed. They include evaluating pollutants as a function of their typical buildup over each land use, evaluating pollutants as a function of their Event

Mean Concentration (EMC) during wash-off, or lastly by combining the pollutant build-up and wash-off scenarios.

The models included in this report utilized EMCs and the wash-off function within SWMM to simulate water quality characteristics during the chosen rain event. Based on the availability of industry-recognized and published reports on the creation of estimated values for EMCs, it was determined that utilizing EMCs with the wash-off function would produce results that are more comparable to other similar water quality models in this region of Florida. As such, the models do not utilize the option to estimate pollutant build-up over a land-mass as a unit of time.

A brief discussion of the specific methodology utilized for selecting land use categories, EMCs and BMP efficiencies for inclusion in the models is outlined below:

Land Use Categories

Similar to the methodology used within the Harper-Baker Study, land uses are generally subdivided by residential (single and multi-family), commercial, industrial, undeveloped and park categories. Within each category these uses are further broken down by the predominant stormwater BMP utilized within each. The following is a brief discussion of the land use types created for water quality modeling purposes:

Residential: For the purpose of this Report this designation includes both single-family (SF) and multi-family (MF) residential land uses. Similar reports and studies may separate the SF and MF residential land use categories, however, for the purposes of clarity and based on the multitude of neighborhoods within the corporate limits in which SF and MF are intermixed, the Residential category is inclusive of both.

Commercial: The Commercial designation includes both low-intensity and high-intensity commercial land uses. Review of aerial photography as well as general knowledge of the

City's existing land uses indicate that the majority of the commercial land use could be considered to be high-intensity rather than low-intensity. Many of the City's commercial centers were constructed prior to the initiation of many of the current South Florida Water Management District (SFWMD) criteria for water quality management systems, resulting in many commercial areas with very little water quality treatment and high impervious/pervious ratios.

Industrial: The City's Industrial land uses generally consist of concrete/aggregate mixing plants, concrete pre-fabrication facilities, metal manufacturing/recycling, forestry operations, and many smaller manufacturing operations. As is the case with the much of the City's commercial development, many of the City's industrial developments were constructed prior to the initiation of the current SFWMD criteria for water quality management systems, resulting in industrial areas with very little water quality treatment and high impervious/pervious ratios.

Undeveloped: Undeveloped land uses include land that has never been developed, or land that was once developed but has since returned to, or near to its pre-development state, both in respect to vegetative cover as well as the natural topography of the site in relation to the adjacent land.

Park: The Park land use category includes all municipally maintained parks, golf courses, and cemeteries within the corporate limits. It should be noted that while the Harper-Baker Study includes parks under a category entitled "Low-Density Residential," which includes an average of single-family, recreational, and open space loading rates, "parks" have been identified in this report as a separate, individual land use category.

Pond/Lake: The Pond/Lake land use category was reserved for any water body that is approximately 1-acre in size or greater. Smaller water bodies, such as detention ponds are not included in the Pond/Lake land use category of this report.

As previously stated, ECT prepared water quality models for the Billy Creek, Manuel's Branch, Carrell Canal and Winkler Canal watersheds. Characterization at the sub-catchment level is provided at the end of this section in Tables 12-2 though 12-8. Each table includes the subcatchment land use breakdown, total areas, BMP utilized and the estimated BMP efficiency. It should be noted that although the Shoemaker Canal, Ford Street Canal, Zapato Canal and the Billy Creek watershed tables have been provided individually, the provided water quality model includes all four (4) as sub-watersheds of the Billy Creek watershed system. The Manuel's Branch, Winkler Canal, and Carrell Canal watersheds are evaluated as separate and individual watersheds.

Event Mean Concentrations

Event mean concentration (EMC) is a value given to a particular pollutant for the purpose of representing the concentration of that pollutant contained in stormwater running off of a particular land use type within a watershed. EMC values are historically generated via actual field measurements collected over extended durations and over broad urban and non-urban settings. The EMC values listed in Table 12-1 identify values that were derived by the Harper-Baker Study.

As part of the City's NPDES permit, the annual report for "Year 3" (Period Covering: 3/11/05 to 3/10/06) included an analysis to estimate the pollutant loadings for a number of parameters in watersheds throughout the City. This report was prepared by Johnson Engineering, Inc. (Johnson). It should be noted that the Johnson report is similar in nature to the analysis performed in this report in that published values for EMCs are utilized to ultimately estimate annual pollutant loadings. However, the methodology utilized in each report varies, as do the results that are produced by each.

The following is a brief discussion of the EMCs assigned to each land use category within the water quality models developed by ECT for this study:

Residential **(*EMCs: Total-N =2.40 mg/L, Total-P =0.50 mg/L, TSS =50.0 mg/L)***

Historically derived data indicates that EMCs in multi-family residential land uses tend to be greater than those typically found in single family residential areas. However, given the nature of the general density of areas studied and for conservatism and clarity, the City's residential land uses are assigned EMCs typical of those utilized for strictly MF Residential areas as identified by the Harper-Baker Study.

Commercial (***EMCs: Total-N =2.50 mg/L, Total-P =0.40 mg/L, TSS =80.0 mg/L)***

As previously noted, the majority of commercial development within the City's corporate limits is considered to be "high-intensity" commercial and therefore, EMC values typical of high-intensity commercial development were assigned to all commercial land uses within the water quality model.

Industrial (***EMCs: Total-N =1.80 mg/L, Total-P =0.30 mg/L, TSS =95.0 mg/L)***

EMC values for Industrial land uses have been taken directly from the Harper-Baker Study.

Park **(*EMCs: Total-N =1.70 mg/L, Total-P =0.20 mg/L, TSS =17.0 mg/L)***

EMC values in the Park land use category match those identified as "Low-Density Residential" in the Harper-Baker Study.

Undeveloped **(*EMCs: Total-N =1.10 mg/L, Total-P =0.05 mg/L, TSS =8.0 mg/L)***

EMC values in the Undeveloped land use category match those identified as "Undeveloped Rangeland/Forest" in the Harper-Baker Study.

Pond/Lake ***(EMCs: Total-N =1.60 mg/L, Total-P =0.10 mg/L, TSS =3.10 mg/L)***

EMC values in the Pond/Lake land use category have been directly from the Harper-Baker Study.

BMPs and Estimated Efficiencies

Within the SWMM model, ECT identifies three (3) BMP methods utilized as large-scale methods for improving water quality. These methods are identified as one of the following: street sweeping, grassed swales, detention ponds. In cases where BMPs are not employed, the land use is listed alone without a corresponding BMP. Table 12-1 lists each BMP with an estimated removal efficiency as a percentage of total pollutant removal within each subcatchment area. The following is a brief discussion of the BMPs and corresponding efficiencies assigned to each within the models:

Street Sweeping: Street sweeping is a commonly used maintenance practice for the removal of solid particulates in urban settings when the road cross-section includes curb and gutter. Historically utilized as a maintenance practice for aesthetic purposes, street sweeping is now recognized for its ability to remove harmful pollutants from deposition into the watershed's receiving water body.

Several studies in various regions and over various land uses have been performed by others in an attempt to define expected removal efficiency to the practice of street sweeping. However, the variables are substantial and include such aspects as initial pollutant loading, pollutant type, rainfall, sweeper type, etc. Most published reports on the effectiveness of street sweeping were based on studies of controlled environments.

A generally accepted range for estimated pollutant reductions provided by street sweeping is 20-70% depending on the pollutant and the particular study. These values represent removal rates when street sweeping is performed on a weekly basis. With the exception of the City's Downtown and River Districts, which are swept on a weekly basis, street sweeping in the City's designated areas is performed on a 4 to 6 week rotation. Therefore, a value of 20% has been assigned as the removal efficiency of street sweeping for modeling purposes in this study.

Street sweeping maps provided by the City's Public works Department were referenced when determining areas that are street swept. Electronic copies of these maps have been attached in Appendix G of this report as backup data.

Grassed Swales: The use of grassed swales is considered to be one of the most cost effective methods for storing, transporting and removing pollutants from stormwater runoff. The City has several acres of development that includes paved roadways and grassed swales. Grassed swales have proven to be effective in pollutant removal when properly maintained.

Several published reports have studied the effectiveness of grassed swales as a tool in reducing pollutant loadings from a watershed. Typical values estimate removal efficiency for Total-N and Total-P to be between 15 and 45%, and for TSS to be between 30-65%, and in some cases as high as 90%. As previously discussed, the variables for obtaining a true estimate for the effectiveness of a particular BMP within a particular watershed are virtually limitless. For the purpose of the models contained within this report, a conservative value of 35% has been assigned as the BMP efficiency of grassed swales within the City's watershed areas for Total-N, Total-P and TSS.

Detention Ponds: The majority of recent (post 1980's) developments within Southwest Florida were developed pursuant to the rules of South Florida Water Management District and include stormwater management systems to provide on-site storage and pre-treatment prior to off-site discharge. This requirement very often results in the construction of a wet or dry detention or retention facilities.

The City of Fort Myers has many pre-regulatory residential and commercial developments constructed prior to the enactment of state and federal rules governing the way stormwater runoff was to be stored and treated within developments. Therefore, the use of detention/retention ponds within the City is relatively limited and generally exists only on newer developments. Larger planned communities, which primarily exist within the more recently annexed areas in the south and southeast portion of the City, were constructed with the prescribed detention/retention facilities. A review of the City's aerial photography makes evident the limited use of detention/retention basins within the northern and central portion of the City.

Studies that explore the effectiveness of retention and detention basins are numerous and the variables therein are many. Wet detention facilities are generally expected to provide greater removal efficiencies than dry detention facilities due to the longer residence time that they are designed to provide. However, many treatment facilities in Southwest Florida are typically of the dry detention type due to the proximity of the water table to natural grade. Published values for pollutant removal efficiency of dry detention facilities are generally in the range of 15 to 45% for Total-N and Total-P, and in the range of 30% to as high as 90% for TSS. For conservatism, a value of 30% has been assigned to the efficiency of detention facilities as a BMP for removal of Total-N, Total-P and TSS.

Simulation Results

Existing Conditions

As previously discussed, the SWMM software allows the user to run these models using various rainfall events, whether user-defined or pre-defined rainfall events commonly recognized by regulatory agencies. For the purpose of demonstrating the water quality modeling results for a commonly simulated rainfall event, the pollutant concentrations for Total-N, Total-P and TSS have been provided for the approximate mean annual rain event as recognized by the SFWMD and FDEP, which is the 3-year/24-hour rain event (3/1 Event).

The SWMM output generates a graph of any single pollutant concentration at any selected location within the model stream. For the purpose of examining the model's calculated pollutant concentration at each watershed's outfall point during the 3/1 Event, the concentration of Total-N, Total-P and TSS has been graphed against time for each of the watershed's outfall points. These graphs are included at the end of this section of the report as Figures 12-1 through 12-15.

As indicated by the graphs, the SWMM model produces estimated pollutant concentrations for Total-N, Total-P and TSS that are reasonably comparable to the or field data produced by the monthly NPDES sampling program as previously described herein section 7. In many cases, and as expected due to the conservatism applied to the model inputs, the SWMM model generally produces estimated concentrations for a 3/1 Event that are higher than the actual values determined by the monthly NPDES laboratory analysis. However, as shown in the attached Table 12-9, the pollutant concentrations generated by SWMM for the 3/1 Event are near or within the range of the values typically generated by the monthly NPDES sampling program. The results indicate that the SWMM water quality model, while generally conservative, produces credible values for the purpose of estimating pollutant loadings.

<u>Pollutant Loadings</u>

The SWMM report provides a tabular listing of the watershed's calculated pollutant loading in pounds (lbs) at the outfall point. The data includes the calculated pollutant loading for each pollutant at the outfall for the 3/1 Event. Tables 12-10, 12-11 and 12-12, attached, provide the event-specific, the loading per inch of rainfall and the projected annual pollutant loading for Total-N, Total-P and TSS in each of the modeled watersheds. A discussion of the data and the methodology for determining the projected pollutant loading values provided in the tables follows.

As previously discussed the simulated rainfall is the 3/1 Event, which is an event that totals 4.5 inches of rainfall for this area. The values in the "Event Specific Pollutant Loading" column of Tables 12-10 through 12-12 represent the estimated loadings generated by the 4.5 inches of rainfall during the 3/1 Event. This value is then converted to a value equivalent to the pollutant loading per inch of rainfall. Lastly, the projected annual loading is determined by multiplying the average total annual rainfall for the

Greater Fort Myers Area, by the loading per inch of rainfall to obtain the projected annual loading values. According to the Harper-Baker Study, the average annual rainfall total for the Greater Fort Myers area is approximately 53.13 inches. A reduction factor to convert rainfall to actual runoff is not necessary as the SWMM model transforms the actual rainfall to a runoff value based on the land use descriptions provided for each watershed. The actual runoff/rainfall ratio for the 3/1 Event for each watershed is as follows: Winkler Canal: 66% (2.96-inches of runoff), Carrell Canal: 47% (2.14-inches of runoff), Manuel's Branch: 52% (2.35-inches of runoff) and Billy Creek: 56% (2.54-inches of runoff).

Proposed Water Quality Improvement Projects

For the purpose of demonstrating the estimated benefits from the various water quality improvement projects proposed in Section 13 of this report, the following is a brief discussion of each project and includes a discussion of the reasoning used in the determination of the anticipated impact on the water quality of their corresponding watershed. The projects are discussed within the watershed in which each is proposed. Please note that these projects are discussed in further detail in Section 13 of this report and are at this point only proposed. Authorization by the city council will be required prior to the implementation of these projects. Each water quality improvement method discussed in this section of the report is a method that has historically been utilized in Southwest Florida, has demonstrated some degree of success in pollutant removal, and has been widely documented in reports by both academia and private industry. For the purpose of simplicity in referencing a single, published document when discussing the proposed effectiveness of these water quality improvements as they relate to typical mass removal efficiencies, the FDEP's "TMDL Protocol" dated June 2006 will be cited when discussing each project.

WINKLER CANAL WATERSHED

Winkler Canal Filter Marsh

The Winkler Canal Filter Marsh project is a proposed planted, aquatic filter marsh, also known as a Stormwater Treatment Area (STA) located approximately at the mid-way point of the Winkler Canal system between US 41 and McGregor Boulevard. The filter marsh is a proposed off-line system, including approximately 2.5 acres of planted aquatics on a site that is approximately 4.5 acres in size. The filter marsh is designed to divert and treat low-flows from small rain events using a diversion weir. High flows are designed to bypass the system by topping over the proposed diversion weir.

An estimate of the project's anticipated effectiveness takes the following into consideration:

(1) The TMDL Protocol identifies the typical mass removal efficiencies of an STA for Total-N, Total-P and TSS to be in the range of 20-40%, 20-60%, and 60-80%, respectively.

(2) The STA will treat approximately 500-acres of the watershed's total area of 820-acres, or approximately 60%.

(3) Due to the small size of the STA in relation to total up-stream area of the watershed, it can be assumed that the system will only effectively treat rain events between 0 and 0.5-inches. According the Harper-Baker Study, this data range equates to approximately 84 rain events per year, or a total of approximately 12.5 inches per year, or approximately 24% of the yearly rainfall.

Given the above reduction factors and using the conservative efficiency values provided in the TMDL Protocol, the estimated annual removal efficiency of the STA for each pollutant would be as follows:

T-N = (0.2*0.6*0.24) = 3% (min)

T-N = (0.4*0.6*0.24) = 6% (max)

T-P = (0.2*0.6*0.24) = 3% (min)

T-P = (0.6*0.6*0.24) = 9% (max)

TSS = (0.6*0.6*0.24) = 9% (min)

TSS = (0.8*0.6*0.24) = 12% (max)

Table 12-13, attached, summarizes the Winkler Canal watershed's pollutant loadings based on the projected impact of the filter marsh system.

CARRELL CANAL WATERSHED

Carrell Canal (FMCC) Water Quality Improvement Project

The Carrell Canal Water Quality Improvement Project is proposed to be located at the Fort Myers Country Club between US-41 and McGregor Blvd. The project involves the addition of one (1) in-line settling pond/planted marsh approximately 2.2 acres in size and a series of three (3) off-line, interconnected settling ponds/planted marsh areas totaling approximately 3 acres in size. Each settling pond will provide a total of approximately 2 feet of storage, providing approximately 10 acre-feet of additional storage to the Carrell Canal watershed area. The settling ponds will act as wet detention ponds with outfall control structures and bottom elevations approximately equal to the existing water table.

The following reduction factors are considered to determine the pollutant removal efficiency of the project:

(1) The TMDL Protocol identifies the typical mass removal efficiencies of a wet detention facility for Total-N, Total-P and TSS to be in the range of 20-40%, 40-60%, and 80-90%, respectively.

(2) The watershed area up-stream of the proposed project totals approximately 650-acres of the watershed's total area of 980-acres, or 65%.

(3) As with the other proposed water quality improvement projects, the settling ponds/marsh areas are designed to treat low flows generated by small to average rain-fall

events. Based on the size of the contributing watershed area and the proposed capacity of the settling ponds/marsh areas, the project is expected to effectively treat rain events between 0.2 and 1.0 inch. The Harper-Baker Study indicates that approximately 39 events fall in the range of 0.2 to 1.0 inch, which equates to approximately 20 inches per year, or approximately 38% of the yearly rainfall. Given these reduction factors, the conservative estimate of annual pollutant removal efficiency of the Carrell Canal (FMCC) Water Quality Improvement Project is as follows:

T-N = (0.2*0.65*0.38) = 5% (min)
T-N = (0.4*0.65*0.38) = 10% (max)
T-P = (0.4*0.65*0.38) = 10% (min)
T-P = (0.6*0.65*0.38) = 15% (max)
TSS = (0.8*0.65*0.38) = 20% (min)
TSS = (0.9*0.65*0.38) = 22% (max)

North Ten Mile Canal Stormwater Treatment System

The proposed North Ten Mile Canal Stormwater Treatment System project involves the extension, widening and improvement of the existing Ten Mile Canal between Carrell Canal north to Manuel's Branch. The proposed project will provide up-stream connectivity between the Carrell and Manuel's Branch Canal systems and provide additional storage and attenuation that will provide water quality benefits to both the Carrell Canal and Manuel's Branch watershed systems.

The proposed project will involve the improvement of approximately 5,000 feet of the Ten Mile Canal and will provide approximately 3 feet of additional storage, or 40 acre-feet of additional storage to the Carrell Canal and Manuel's Branch watershed systems. Since the project will equally benefit the Carrell Canal and Manuel's Branch systems, it is estimated that the project will provide approximately 20 acre-feet of additional storage and attenuation to the Carrell Canal watershed system.

The following reduction factors are considered to determine the pollutant removal efficiency of the project:

(1) The TMDL Protocol identifies the typical mass removal efficiencies of a wet detention facility for Total-N, Total-P and TSS to be in the range of 20-40%, 40-60%, and 80-90%, respectively.

(2) Based on the extreme up-stream location of the project within the Carrell Canal watershed, the proposed improvements will treat approximately 100 acres of the watershed's total area of 980 acres, or 10%. It is noted that subsequent proposal projects, Manuel's and Carrell weirs will facilitate the treatment of this project. However, that relation has not been included in this discussion.

(3) The proposed project will provide an additional 20 acre-feet of additional storage to the industrialized, up-stream portion of the Carrell Canal system. Due to the up-stream industrial development (less initial abstraction assumed) and the volume of additional storage proposed, it can be assumed that the project will receive and treat small rain events up-to 1.5 inches. According to the Harper-Baker Study, this would account for approximately 108 events per year, equaling approximately 34 inches, or approximately 64% of the yearly total.

Below are the estimated annual pollutant removal efficiencies of the proposed North Ten Mile Canal Stormwater Treatment System, followed by the total estimated removal efficiencies of both the Carrell Canal (FMCC) Water Quality Improvement and the North Ten Mile Canal Stormwater Treatment System projects within the Carrell Canal Watershed:

"<u>North Ten Mile Canal Stormwater Treatment System</u>"

T-N = (0.2*0.10*0.64) = 1% (min)

T-N = (0.4*0.10*0.64) = 3% (max)

T-P = (0.4*0.10*0.64) = 3% (min)

T-P = (0.6*0.10*0.64) = 4% (max)

TSS = (0.8*0.10*0.64) = 5% (min)

TSS = (0.9*0.10*0.64) =6% (max)

"Carrell Canal (FMCC) Water Quality Improvement Project + North Ten Mile Canal Stormwater Treatment System"

T-N = 5 + 1 = 6% (min)

T-N = 10 + 3 = 13% (max)

T-P = 10 + 3 = 13% (min)

T-P = 15 + 4 = 19% (max)

TSS = 20 + 5 = 25% (min)

TSS = 22 + 6 = 28% (max)

Table 12-14, attached, summarizes the Carrell Canal watershed's pollutant loadings based on the projected impact of the water quality improvements.

MANUEL'S BRANCH WATERSHED

Manuel's Branch East and West Weir Structures

A series of two (2) weirs is proposed along the Manuel's Branch between Royal Palm Avenue and Grand Avenue. The weirs are to be constructed such that they act as detention structures for the purpose of increasing storage and attenuation within the canal between Grand Avenue and Royal Palm Avenue as well as between Royal Palm Avenue and the eastern end of Manuel's Branch Canal to Palm Avenue. The structure at Grand Avenue will create 2 feet of additional storage between Grand Avenue and Palm Avenue, while the structure at Royal Palm Avenue will create an additional 3 feet of storage between Royal Palm Avenue and the eastern limits of the canal. All together, the structures will provide an additional 5.2 acre-feet of effective wet detention to treat and store runoff from the heavily industrialized eastern half of the Manuel's Branch watershed.

The following reduction factors were considered to determine the pollutant removal efficiency of the project:

(1) The TMDL Protocol identifies the typical mass removal efficiencies of a wet detention facility for Total-N, Total-P and TSS to be in the range of 20-40%, 40-60%, and 80-90%, respectively.

(2) The project's location will allow potential treatment of approximately 400 acres of the watershed's total area of 980 acres, or 41%.

(3) The wet detention areas are designed to treat small rain events such as those between 0.2 and 1.0 inch. As discussed in the "Carrell Canal (FMCC) Water Quality Improvement Project" section above, these rain events would account for approximately 20 inches of rain per year, or approximately 38% of the yearly total. Therefore, the estimated annual pollutant removal efficiency of the "Manuel's Branch Weir Structures" project is as follows:

T-N = (0.2*0.41*0.38) = 3% (min)
T-N = (0.4*0.41*0.38) = 6% (max)
T-P = (0.4*0.41*0.38) = 6% (min)
T-P = (0.6*0.41*0.38) = 9% (max)
TSS = (0.8*0.41*0.38) = 12% (min)
TSS = (0.9*0.41*0.38) =14% (max)

Manuel's Branch Siltation Structure

For the purpose of further reducing the quantity of sedimentation to the Caloosahatchee River from the Manuel's Branch, a siltation facility is proposed along the canal at or near Cortez Boulevard. The structure will be designed to receive the incoming flow, reduce its velocity and allow for the settling of suspended particulates.

The following reduction factors are considered to determine the pollutant removal efficiency of the project:

(1) The TMDL Protocol identifies the typical mass removal efficiencies of a siltation

facility for Total-N, Total-P and TSS to be in the range of 0-20%, 20-40%, and 70-90%, respectively.

(2) The downstream location of the proposed siltation box allows the siltation box to treat all but 200 acres of the 980 acre watershed, or approximately 80% of the watershed.

(3) The structure will be designed to effectively treat low flows resulting from rain events in the range of 0.2 to 1.0 inch, or approximately 38% of the yearly total rainfall as previously discussed. Therefore, the estimated annual pollutant removal efficiency of the "Manuel's Branch Siltation Structure" project is as follows:

T-N = (0*0.80*0.38) = 0% (min)
T-N = (0.2*0.80*0.38) = 6% (max)
T-P = (0.2*0.80*0.38) = 6% (min)
T-P = (0.4*0.80*0.38) = 12% (max)
TSS = (0.7*0.80*0.38) = 21% (min)
TSS = (0.9*0.80*0.38) =27% (max)

North Ten Mile Canal Stormwater Treatment System

As discussed above in the "Carrell Canal Watershed" section, the Ten Mile Canal Water Quality Improvement Project will provide approximately 20 acre-feet of additional wet-detention storage to the Manuel's Branch watershed system. Because the projected is anticipated to treat approximately 10% of the Manuel's Branch watershed, the same reduction factors are applied when determining the pollutant removal efficiency of the project. Below are the estimated annual pollutant removal efficiencies of the proposed North Ten Mile Canal Stormwater Treatment System, followed by the total estimated removal efficiencies of the proposed weir, siltation structure, and North Ten Mile Canal Stormwater Treatment System projects within the Manuel's Branch watershed:

"North Ten Mile Canal Stormwater Treatment System"
T-N = (0.2*0.10*0.64) = 1% (min)
T-N = (0.4*0.10*0.64) = 3% (max)

T-P = (0.4*0.10*0.64) = 3% (min)

T-P = (0.6*0.10*0.64) = 4% (max)

TSS = (0.8*0.10*0.64) = 5% (min)

TSS = (0.9*0.10*0.64) =6% (max)

"Weir Structures + Siltation Structure + North Ten Mile Canal Stormwater Treatment System"

T-N = 3 + 0 + 1 = 4% (min)

T-N = 6 + 6 + 3 = 15% (max)

T-P = 6 + 6 + 3 = 15% (min)

T-P = 9 + 12 + 4 = 25% (max)

TSS = 12 + 21 + 5 = 38% (min)

TSS = 14 + 27 + 6 = 47% (max)

Table 12-15, attached, summarizes the Manuel's Branch watershed's pollutant loadings based on the projected impact of the water quality improvements.

BILLY CREEK WATERSHED

Billy Creek Filter Marsh Park

The proposed Billy Creek Filter Marsh Park (BCFMP) is proposed to include an 8 acre settling pond plus approximately 13 acres of planted aquatic filter marsh area (STA) for the purpose of providing enhanced residence time and nutrient up-take within the Billy Creek watershed area. The filter marsh is to be located on the north side of the Billy Creek, just east of Marsh Avenue. The BCFMP will be an off-line system that will receive and treat low flows diverted by a proposed diversion weir. Flows will first enter the settling pond, flow through the filter marsh as water levels rise and then outfall back to the Billy Creek via outfall control structures. High flows from large rain events will over top the proposed diversion weir and bypass the filter marsh system.

The following reduction factors are considered to determine the pollutant removal efficiency of the project:

(1) As stated above the BCFMP will consist of a settling pond as well as a planted aquatic filter marsh (STA). For the purpose of conservatism, the TMDL Protocol's mass removal efficiencies for a planted aquatic marsh will be utilized over the entire treatment area that includes 21 acres (8 acres of settling pond plus 13 acres of filter marsh). The TMDL Protocol's mass removal efficiencies for Total-N, Total-P and TSS are in the range of 20-40%, 20-60%, and 60-80%, respectively.

(2) The proposed location of the BCFMP indicates that it will be downstream of approximately 2,400-acres of the Billy Creek watershed area, or approximately 45%, of the watershed's total area of 5,300-acres.

(3) As the filter marsh is designed to treat small to medium-sized rainfall events (0.2 to 1.0 inch), it too is assumed to effectively treat 38% of the yearly rainfall. The estimated annual pollutant removal efficiency of the BCFMP project is as follows:

T-N = (0.2*0.45*0.38) = 3% (min)
T-N = (0.4*0.45*0.38) = 7% (max)
T-P = (0.2*0.45*0.38) = 3% (min)
T-P = (0.6*0.45*0.38) = 10% (max)
TSS = (0.6*0.45*0.38) = 10% (min)
TSS = (0.8*0.45*0.38) =14% (max)

Ford Street Canal Filter Marsh Park

The proposed Ford Street Canal Filter Marsh Park (FSCFMP) is proposed to include approximately 7-acres of planted aquatic filter marsh area (STA) for the purpose of providing enhanced residence time and nutrient up-take within the Billy Creek watershed area.

The following reduction factors were considered to determine the pollutant removal efficiency of the project:

(1) The TMDL Protocol's mass removal efficiencies for Total-N, Total-P and TSS are in the range of 20-40%, 20-60%, and 60-80%, respectively.

(2) The FSCFM is proposed to be located at the northern limits of the Ford Street Canal sub-watershed, which will allow it the opportunity to treat the sub-watershed's entire area of 830 acres, or approximately 16% of the total area within the Billy Creek Watershed.

(3) Similar to the BCFMP, the FSCFMP is designed to treat small to medium rainfall events, or approximately 38% of the annual rainfall. The estimated annual pollutant removal efficiency of the FCSFM project is as follows:

T-N = (0.2*0.16*0.38) = 1% (min)
T-N = (0.4*0.16*0.38) = 2% (max)
T-P = (0.2*0.16*0.38) = 1% (min)
T-P = (0.6*0.16*0.38) = 4% (max)
TSS = (0.6*0.16*0.38) = 4% (min)
TSS = (0.8*0.16*0.38) = 5% (max)

Shoemaker-Zapato Canal Stormwater Treatment

The project proposes the installation of a weir/water control structures upstream of Michigan Avenue within both the Zapato Canal and the Shoemaker Canal. The canals are hydraulically connected by a canal (Vo-Tech) that runs in the east/west direction, approximately 1,000 feet south of Michigan Avenue. These weirs will raise the water level approximately 1.5 feet between each weir, thereby increasing storage and attenuation between the two systems for a total of 6,000 feet, or a total of approximately 6.2 acre-feet of additional storage.

The following reduction factors were considered to determine the pollutant removal efficiency of the project:

(1) The TMDL Protocol identifies the typical mass removal efficiencies of a wet

detention pond for Total-N, Total-P and TSS to be in the range of 20-40%, 40-60%, and 80-90%, respectively.

(2) The project's location will allow potential treatment of approximately 900 acres of the watershed's total area of 5,300-acres, or 17%.

The storage and attenuation area is designed to treat small rain events such as those between 0.2 and 1 inch. As previously discussed these rain events would account for approximately 20 inches of rain per year, or approximately 38% of the yearly total. Below are the estimated annual pollutant removal efficiencies of the proposed Shoemaker-Zapato Canal Stormwater Treatment project, followed by the total estimated removal efficiencies of the proposed BCFMP, FSCFMP, and the Shoemaker-Zapato Canal Stormwater Treatment projects within the Billy Creek Watershed:

"Shoemaker-Zapato Canal Stormwater Treatment Project"

T-N = (0.2*0.17*0.38) = 1% (min)

T-N = (0.4*0.17*0.38) = 3% (max)

T-P = (0.4*0.17*0.38) = 3% (min)

T-P = (0.6*0.17*0.38) = 4% (max)

TSS = (0.8*0.17*0.38) = 5% (min)

TSS = (0.9*0.17*0.38) =6% (max)

"BCFM + FSCFM + Shoemaker-Zapato Canal Stormwater Treatment Project"

T-N = 3 + 1 + 1 = 5% (min)

T-N = 7 + 2 + 3 = 12% (max)

T-P = 3 + 1 + 3 = 7% (min)

T-P = 10 + 4 + 4 = 18% (max)

TSS = 10 + 4 + 5 = 19% (min)

TSS = 14 + 5 + 6 = 25% (max)

Table 12-16, attached, summarizes the Billy Creek watershed's pollutant loadings based on the projected impact of the water quality improvements.

12.3 TABLES and FIGURES

Tables

Figures

TABLE 12-1

LAND USE CATEGORIES, POLLUTANT EVENT MEAN CONCENTRATIONS AND ESTIMATED BMP EFFICIENCIES

LAND USE CATEGORY	EVENT MEAN CONCENTRATION (mg/L)			BEST MANAGEMENT PRACTICE (BMP)	
	Total-N	Total-P	TSS	BMP Description	Estimated Pollutant Removal Efficiency (%)
Residential [1]	2.40	0.50	50.0	None	0
Residential-Swales	2.40	0.50	50.0	Grassed Swales	35
Residential-Street Sweeping	2.40	0.50	50.0	Street Sweeping	20
Residential-Detention Ponds	2.40	0.50	50.0	Detention Ponds	30
Industrial	1.80	0.30	95.0	None	0
Industrial-Swales	1.80	0.30	95.0	Grassed Swales	35
Industrial-Street Sweeping	1.80	0.30	95.0	Street Sweeping	20
Industrial-Detention Ponds	1.80	0.30	95.0	Detention Ponds	30
Commercial [2]	2.50	0.40	80.0	None	0
Commercial-Swales	2.50	0.40	80.0	Grassed Swales	35
Commercial-Street Sweeping	2.50	0.40	80.0	Street Sweeping	20
Commercial-Detention Ponds	2.50	0.40	80.0	Detention Ponds	30
Undeveloped [3]	1.10	0.05	8.0	None	0
Undeveloped-Swales	1.10	0.05	8.0	Grassed Swales	35
Undeveloped-Street Sweeping	1.10	0.05	8.0	Street Sweeping	20
Undeveloped-Detention Ponds	1.10	0.05	8.0	Detention Ponds	30
Golf Course-Detention Ponds	1.70	0.20	17.0	Detention Ponds	30
Park [4]	1.70	0.20	17.0	None	0
Park-Swales	1.70	0.20	17.0	Grassed Swales	35
Park-Street Sweeping	1.70	0.20	17.0	Street Sweeping	20
Park-Detention Ponds	1.70	0.20	17.0	Detention Ponds	30
Pond/Lake	1.60	0.10	3.10	None	0

NOTES:
1. Residential land use category is inclusive of both single-family and multi-family residential land uses.
2. Commercial land uses are inclusive of both light and heavy commercial uses.
3. Undeveloped land uses include land that has never been altered, and land that was historically developed but has since returned to, or near its pre-development state, both in respect to vegetative cover as well as to the natural topography of the site in relation to the adjacent land.
4. The Park land use category is inclusive of all municipally owned parks, recreation facilities, cemetaries and other miscellaneous low intensity, publically owned lands.

TABLE 12-2

BILLY CREEK CANAL WATERSHED - SUBCATCHMENT CHARACTERISTICS

SUBCATCHMENT NAME	LAND USES	AREA (Acres)	LAND USE %	BMPs EMPLOYED	ESTIMATED BMP EFFICIENCY (%)
NORTH-LUCKETT	Commercial-Detention Ponds	180.4	60	Detention Ponds	30
	Undeveloped	69.5	23	None	0
	Residential-Swales	49.5	17	Grassed Swales	35
	TOTAL AREA	***299.4***			
TICE/I-75	Commercial-Detention Ponds	124.3	76	Detention Ponds	30
	Undeveloped	20.3	12	None	0
	Residential-Swales	18.4	11	Grassed Swales	35
	TOTAL AREA	***163***			
NORTH-ORTIZ	Residential-Swales	17.4	42	Grassed Swales	35
	Undeveloped	24.4	58	None	0
	TOTAL AREA	***41.8***			
NUNA-SOUTH	Residential-Street Sweeping	51.9	25	Street Sweeping	20
	Residential-Swales	49.5	24	Grassed Swales	35
	Commercial	8.6	4	None	0
	Undeveloped	96.7	47	None	0
	TOTAL AREA	***206.7***			
NUNA-NORTH	Residential-Swales	25.8	19	Grassed Swales	35
	MF Residentuial-Swales	45.9	33	Grassed Swales	35
	Undeveloped	67.4	48	None	0
	TOTAL AREA	***139.1***			
BILLY BOWLEGS	Residential-Swales	91.2	58	Grassed Swales	35
	Park	15.5	10	None	0
	Undeveloped	51.3	32	None	0
	TOTAL AREA	***158***			
POLK STREET	Undeveloped	19.1	12	None	0
	Residential-Swales	145.5	88	Grassed Swales	35
	.	***164.6***			
MARION STREET	Park	44.6	48	None	0
	Undeveloped	15.8	17	None	0
	Commercial	31.8	34	None	0
	TOTAL AREA	***92.2***			
DEAN PARK	Commercial	28.5	36	None	0
	Undeveloped	26	33	None	0
	Residential-Swales	23.8	30	Grassed Swales	35
	TOTAL AREA	***78.3***			
SEABORD STREET	Commercial	20.1	20	None	0
	Undeveloped	54.8	54	None	0
	Residential-Swales	20.8	20	Grassed Swales	35
	Park	6.5	6	None	0
	TOTAL AREA	***102.2***			
CENTRAL	Commercial	126.8	45	None	0
	Residential-Street Sweeping	58.7	21	Street Sweeping	20
	Residential-Swales	97.5	34	Grassed Swales	35
	TOTAL AREA	***283***			
SOUTH-LUCKETT	Residential-Detention Ponds	106.4	17	Detention Ponds	30
	Commercial-Detention Ponds	45.2	7	Detention Ponds	30
	Commercial	23.5	4	None	0
	Undeveloped	412.6	66	None	0
	Pond/Lake	24	4	None	0
	Residential-Swales	17.9	3	Grassed Swales	35
	TOTAL AREA	***629.6***			
ORTIZ-NW	Commercial-Detention Ponds	205.6	28	Detention Ponds	30
	Residential-Detention Ponds	343.1	47	Detention Ponds	30
	Industrial	76.3	10	None	0
	Undeveloped	110.6	15	None	0
	TOTAL AREA	***735.6***			

TABLE 12-3

FORD STREET CANAL WATERSHED - SUBCATCHMENT CHARACTERISTICS

SUBCATCHMENT NAME	LAND USES	AREA (Acres)	LAND USE %	BMPs EMPLOYED	ESTIMATED BMP EFFICIENCY (%)
FORD-HANSON	Undeveloped	20.4	49	None	0
	Commercial-Swales	21.6	51	Grassed Swales	35
	TOTAL AREA	***42***			
FORD-CANAL	Residential-Swales	56.3	54	Grassed Swales	35
	Undeveloped	21.2	20	None	0
	Commercial	26.2	25	None	0
	TOTAL AREA	***103.7***			
FORD-FRANKLIN	Residential-Street Sweeping	40.3	28	Street Sweeping	20
	Industrial-Swales	9.4	6	Grassed Swales	35
	Residential-Swales	50.7	35	Grassed Swales	35
	Park-Swales	15.1	10	Grassed Swales	35
	Commercial	30.4	21	None	0
	TOTAL AREA	***145.9***			
FORD-EDISON	Residential-Street Sweeping	49.3	44	Street Sweeping	20
	Commercial-Street Sweeping	20.5	18	Street Sweeping	20
	Commercial-Swales	15.4	14	Grassed Swales	35
	Residential-Swales	27.4	24	Grassed Swales	35
	TOTAL AREA	***112.6***			
FORD-MARKET	Residential-Street Sweeping	62.3	61	Street Sweeping	20
	Residential-Swales	39.5	39	Grassed Swales	35
	TOTAL AREA	***101.8***			
FORD-MLK-S. LINCOLN	Residential-Street Sweeping	45.8	53	Street Sweeping	20
	Commercial	12.5	15	None	0
	Residential-Swales	27.9	32	Grassed Swales	35
	TOTAL AREA	***86.2***			
FORD - MLK N. BLOUNT	Residential-Street Sweeping	76.3	54	Street Sweeping	20
	Commercial-Street Sweeping	45.3	32	Street Sweeping	20
	Park-Street Sweeping	18.8	13	Street Sweeping	20
	TOTAL AREA	***140.4***			
FORD-APACHE	Park-Street Sweeping	13.7	32	Street Sweeping	20
	Residential-Street Sweeping	28.5	68	Street Sweeping	20
	TOTAL AREA	***42.2***			
FORD-CEMETERY	Park	26.1	62	None	0
	Undeveloped	10.7	25	None	0
	Industrial	5.6	13	None	0
	TOTAL AREA	***42.4***			

TABLE 12-4

SHOEMAKER CANAL WATERSHED - SUBCATCHMENT CHARACTERISTICS

SUBCATCHMENT NAME	LAND USES	AREA (Acres)	LAND USE %	BMPs EMPLOYED	ESTIMATED BMP EFFICIENCY (%)
VSS-9	Undeveloped	49	41	None	0
	Commercial	70.4	59	None	0
	TOTAL AREA	***119.4***			
VSS-8	Commercial-Detention Ponds	19.1	21	Detention Ponds	30
	Pond	44.1	49	None	0
	Park	27.3	30	None	0
	TOTAL AREA	***90.5***			
VSS-7	Residential-Street Sweeping	42.2	46	Street Sweeping	20
	Commercial-Detention Ponds	36.3	40	Detention Ponds	30
	Commercial	12.7	14	None	0
	TOTAL AREA	***91.2***			
VSS-6	Pond	19.5	45	None	0
	Commercial-Swales	14.6	33	Grassed Swales	35
	Industrial	9.5	22	None	0
	TOTAL AREA	***43.6***			
VSS-5	Residential	19.7	49	None	0
	Undeveloped	20.3	51	None	0
	TOTAL AREA	***40***			
VSS-4	Residential	12.2	34	None	0
	Undeveloped	5.8	16	None	0
	Commercial-Street Sweeping	18.1	50	Street Sweeping	20
	TOTAL AREA	***36.1***			
VSS-3	Residential-Street Sweeping	10.6	11	Street Sweeping	20
	Commercial-Street Sweeping	40	41	Street Sweeping	20
	MF Residential	46.82	48	None	0
	TOTAL AREA	***97.42***			
VSS-2	Commercial	41.5	59	None	0
	Residential-Swales	29.1	41	Grassed Swales	35
	TOTAL AREA	***70.6***			
VSS-1	Residential-Swales	136.9	100	Grassed Swales	35
	TOTAL AREA	***136.9***			

TABLE 12-5

ZAPATO CANAL WATERSHED - SUBCATCHMENT CHARACTERISTICS

SUBCATCHMENT NAME	LAND USES	AREA (Acres)	LAND USE %	BMPs EMPLOYED	ESTIMATED BMP EFFICIENCY (%)
ZAPATO-5-JAXROCK	Undeveloped	28.3	22	None	0
	Commercial-Swales	79.3	62	Grassed Swales	35
	Industrial	20.4	16	None	0
	TOTAL AREA	***128***			
ZAPATO-4-JACKSONVILLE	Commercial-Detention Ponds	11.4	20	Detention Ponds	30
	Industrial-Swales	18.2	32	Grassed Swales	35
	Undeveloped-Swales	7.1	12	Grassed Swales	35
	Industrial	20.9	36	None	0
	TOTAL AREA	***57.6***			
ZAPATO-3-MAYFLOWER	Residential-Swales	27.5	23	Grassed Swales	35
	Industrial-Swales	91	77	Grassed Swales	35
	TOTAL AREA	***118.5***			
ZAPATO-2-MICHIGAN	Residential-Street Sweeping	22.9	12	Street Sweeping	20
	MF Residential-Street Sweeping	52.3	28	Street Sweeping	20
	Commercial-Detention Ponds	112.3	60	Detention Ponds	30
	TOTAL AREA	***187.5***			
ZAPATO-1-BALLARD	Residential-Swales	137.7	77	Grassed Swales	35
	Undeveloped	40	23	None	0
	TOTAL AREA	***177.7***			

TABLE 12-6

MANUEL'S BRANCH CANAL WATERSHED - SUBCATCHMENT CHARACTERISTICS

SUBCATCHMENT NAME	LAND USES	AREA (Acres)	LAND USE %	BMPs EMPLOYED	ESTIMATED BMP EFFICIENCY (%)
CONCRETE INDUSTRIES	Industrial	134.12	100	None	0
	TOTAL AREA	***134.12***			
EVANS AVE-NORTH	Industrial	45.6	40	None	0
	Commercial-Swales	68.4	60	Grassed Swales	35
	TOTAL AREA	***114***			
CENTRAL-NORTH	Commercial-Swales	13.6	30	Grassed Swales	35
	Residential-Swales	31.6	70	Grassed Swales	35
	TOTAL AREA	***45.2***			
BROADWAY-NORTH	Residential-Swales	59.6	100	Grassed Swales	35
	TOTAL AREA	***59.6***			
GRAND AVE-NORTH	Residential-Swales	60.6	90	Grassed Swales	35
	Residential-Street Sweeping	6.7	10	Street Sweeping	20
	TOTAL AREA	***67.3***			
FMHS	Commercial-Swales	35.2	100	Grassed Swales	35
	TOTAL AREA	***35.2***			
EDISON PARK	Residential-Street Sweeping	50.4	50	Street Sweeping	20
	Residential-Swales	50.4	50	Grassed Swales	35
	TOTAL AREA	***100.8***			
POINCIANNA	Residential-Street Sweeping	4.2	10	Street Sweeping	20
	Residential-Swales	38	90	Grassed Swales	35
	TOTAL AREA	***42.2***			
CORTEZ	Residential-Street Sweeping	8.6	15	Street Sweeping	20
	Residential-Swales	48.8	85	Grassed Swales	35
	TOTAL AREA	***57.4***			
LINHART	Undeveloped-Swales	16.6	30	Grassed Swales	35
	Commercial	16.6	30	None	0
	Residential-Swales	22.2	40	Grassed Swales	35
	TOTAL AREA	***55.4***			
HANSON	Commercial	27.9	38	None	0
	Residential-Swales	45.4	62	Grassed Swales	35
	TOTAL AREA	***73.3***			
GRAND AVE-SOUTH	Residential-Swales	21.4	100	Grassed Swales	35
	TOTAL AREA	***21.4***			
BROADWAY-SOUTH	Commercial-Swales	13.3	45	Grassed Swales	35
	Residential-Swales	16.3	55	Grassed Swales	35
	TOTAL AREA	***29.6***			
CENTRAL-SOUTH	Commercial-Swales	16	55	Grassed Swales	35
	Residential-Swales	13.1	45	Grassed Swales	35
	TOTAL AREA	***29.1***			
EVANS AVE-SOUTH	Industrial	40.9	55	None	0
	Commercial	33.5	45	None	0
	TOTAL AREA	***74.4***			

TABLE 12-7

CARRELL CANAL WATERSHED - SUBCATCHMENT CHARACTERISTICS

SUBCATCHMENT NAME	LAND USES	AREA (Acres)	LAND USE %	BMPs EMPLOYED	ESTIMATED BMP EFFICIENCY (%)
CARRELL-PALM AVE	Residential-Street Sweeping	29.1	50	Street Sweeping	20
	Residential-Swales	29.1	50	Grassed Swales	35
	TOTAL AREA	***58.2***			
CARRELL-EVANS NORTH	Residential-Street Sweeping	21.1	25	Street Sweeping	20
	Residential-Swales	63.2	75	Grassed Swales	35
	TOTAL AREA	***84.3***			
CARRELL-FOWLER NORTH	Residential-Swales	64.6	100	Grassed Swales	35
	TOTAL AREA	***64.6***			
CARRELL-CENTRAL NORTH	Residential-Street Sweeping	4.5	5	Street Sweeping	20
	Residential-Swales	84.6	95	Grassed Swales	35
	TOTAL AREA	***89.1***			
CARRELL-BROADWAY NORTH	Residential-Swales	149	100	Grassed Swales	35
	TOTAL AREA	***149***			
CARRELL-CLEVELAND	Commercial	55.6	100	None	0
	TOTAL AREA	***55.6***			
CARRELL-SUNSET	Golf Course-Detention Ponds	55.8	40	Detention Ponds	30
	Residential-Street Sweeping	13.9	10	Street Sweeping	20
	Residential-Swales	69.7	50	Grassed Swales	35
	TOTAL AREA	***139.4***			
CARRELL-CORTEZ	Golf Course-Detention Ponds	24	30	Detention Ponds	30
	Residential-Street Sweeping	8	10	Street Sweeping	20
	Residential-Swales	47.9	60	Grassed Swales	35
	TOTAL AREA	***79.9***			
CARRELL-OLMEADA	Golf Course-Detention Ponds	13.5	50	Detention Ponds	30
	Residential-Street Sweeping	5.4	20	Street Sweeping	20
	Residential-Swales	8.1	30	Grassed Swales	35
	TOTAL AREA	***27***			
CARRELL-PARK WINDSOR	Commercial	17.9	35	None	0
	MF Residential-Street Sweeping	33.2	65	Street Sweeping	20
	TOTAL AREA	***51.1***			
CARRELL-FOWLER SOUTH	Commercial	20.6	100	None	0
	TOTAL AREA	***20.6***			
CARRELL-CENTRAL SOUTH	MF Residential-Street Sweeping	25	100	Street Sweeping	20
	TOTAL AREA	***25***			
CARRELL-SCHOOL	MF Residential-Street Sweeping	5	40	Street Sweeping	20
	Commercial	7.5	60	None	0
	TOTAL AREA	***12.5***			
CARRELL-BROADWAY SOUTH	Undeveloped-Swales	5.4	15	Grassed Swales	35
	MF Residential-Street Sweeping	10.7	30	Street Sweeping	20
	Commercial-Swales	19.7	55	Grassed Swales	35
	TOTAL AREA	***35.8***			
CARRELL-MARVAEZ	Golf Course-Detention Ponds	15.4	40	Detention Ponds	30
	Residential-Street Sweeping	11.5	30	Street Sweeping	20
	Residential-Swales	11.5	30	Grassed Swales	35
	TOTAL AREA	***38.4***			
CARRELL-CECIL	Golf Course-Detention Ponds	16.7	70	Detention Ponds	30
	Residential-Street Sweeping	7.1	30	Street Sweeping	20
	TOTAL AREA	***23.8***			
CARRELL-HILL	Golf Course-Detention Ponds	18	65	Detention Ponds	30
	Residential-Street Sweeping	9.7	35	Street Sweeping	20
	TOTAL AREA	***27.7***			

TABLE 12-8

WINKLER CANAL WATERSHED - SUBCATCHMENT CHARACTERISTICS

SUBCATCHMENT NAME	LAND USES	AREA (Acres)	LAND USE %	BMPs EMPLOYED	ESTIMATED BMP EFFICIENCY (%)
EVANS-NORTH	Commercial-Swales	27.1	60	Grassed Swales	35
	Commercial-Street Sweeping	18	40	Street Sweeping	20
	TOTAL AREA	***45.1***			
FOWLER-NORTH	Commercial-Swales	13.2	35	Grassed Swales	35
	Commercial-Street Sweeping	13.2	35	Street Sweeping	20
	MF Residential-Street Sweeping	11.3	30	Street Sweeping	20
	TOTAL AREA	***37.7***			
COLLIER	MF Residential-Street Sweeping	25.9	40	Street Sweeping	20
	Commercial-Street Sweeping	38.8	60	Street Sweeping	20
	TOTAL AREA	***64.7***			
US-41-NORTH	Commercial	7.7	20	None	0
	Commercial-Swales	30.6	80	Grassed Swales	35
	TOTAL AREA	***38.3***			
JEFFERSON	Residential-Swales	29.2	70	Grassed Swales	35
	Residential-Street Sweeping	12.5	30	Street Sweeping	20
	TOTAL AREA	***41.7***			
HANOVER	Residential-Swales	44.9	100	Grassed Swales	35
	TOTAL AREA	***44.9***			
ARLINGTON	Residential-Swales	29.7	100	Grassed Swales	35
	TOTAL AREA	***29.7***			
ROGERS	Residential-Swales	50.2	100	Grassed Swales	35
	TOTAL AREA	***50.2***			
TERRA PALMA	Residential-Street Sweeping	42.9	70	Street Sweeping	20
	Undeveloped-Swales	18.4	30	Grassed Swales	35
	TOTAL AREA	***61.3***			
McGREGOR PRESERVE	Residential-Street Sweeping	39.9	50	Street Sweeping	20
	Residential-Detention Ponds	39.9	50	Detention Ponds	30
	TOTAL AREA	***79.8***			
PRINCETON-SOUTH	MF Residential-Street Sweeping	2.7	15	Street Sweeping	20
	MF Residential-Detention Ponds	15	85	Detention Ponds	30
	TOTAL AREA	***17.7***			
ORANGEWOOD CIRCLE	Undeveloped-Swales	24.9	60	Grassed Swales	35
	Residential-Street Sweeping	8.3	20	Street Sweeping	20
	Residential-Detention Ponds	8.3	20	Detention Ponds	30
	TOTAL AREA	***41.5***			
DeLEON	Residential-Swales	22.5	40	Grassed Swales	35
	Residential-Detention Ponds	22.5	40	Detention Ponds	30
	MF Residential-Swales	11.2	20	Grassed Swales	35
	TOTAL AREA	***56.2***			
MARAVEZ	Residential-Swales	7.3	50	Grassed Swales	35
	Commercial-Street Sweeping	7.3	50	Street Sweeping	20
	TOTAL AREA	***14.6***			
US-41-SOUTH	Commercial	27.7	90	None	0
	Residential-Street Sweeping	3.1	10	Street Sweeping	20
	TOTAL AREA	***30.8***			
EDISON MALL	Commercial	56.9	70	None	0
	MF Residential-Street Sweeping	24.4	30	Street Sweeping	20
	TOTAL AREA	***81.3***			
FOWLER-SOUTH	Commercial-Street Sweeping	37.4	100	Street Sweeping	20
	TOTAL AREA	***37.4***			
EVANS-SOUTH	Commercial-Street Sweeping	47.8	100	Street Sweeping	20
	TOTAL AREA	***47.8***			

TABLE 12-9

POLLUTANT CONCENTRATIONS FOR SIMULATED 3YR. / 1 DAY RAIN EVENT AND SELECT WATER QUALITY MONITORING STATIONS

OUTFALL LOCATION	TOTAL NITROGEN (mg/L)		TOTAL PHOSPHOROUS (mg/L)		TOTAL SUSPENDED SOLIDS (mg/L)	
	Max. per SWMM Model [1]	NPDES Sampling Data Range[2]	Max. per SWMM Model [1]	NPDES Sampling Data Range[2]	Max. per SWMM Model [1]	NPDES Sampling Data Range[2]
Billy Creek [3]	1.57	0.18 - 2.38	0.27	0.12 - 0.49	38	1.90 - 13.0
Manuel's Branch [4]	1.8	0.53 - 1.70	0.31	0.10 - 0.42	77	0.60 - 52.5
Carrell Canal [5]	1.7	0.29 - 1.33	0.32	0.04 - 0.52	38	0.60 - 79.5
Winkler Canal [6]	1.95	0.09 - 1.00	0.34	0.06 - 0.39	57	0.60 - 14.0

Notes:

1) Simulated, peak pollutant concentration at the watershed's outfall point during the 3 Year / 1 Day rainfall event.

2) Data range (min. - max.) per the results of monthly grab samples collected per the City's existing NPDES permit. The data range includes monthly samples collected between April 2005 and July 2007.

3) Billy Creek Canal Outfall = NPDES Sampling I.D. "CFMBILLY1" located in Billy Creek Canal at Seabord Street.

4) Manuel's Branch Canal Outfall = NPDES Sampling I.D. "CFMMANUEL" located at Manuel's Branch Canal, upstream of Cortez Blvd.

5) Carrell Canal Outfall = NPDES Sampling I.D. "CFMCARRELL" located upstream of weir at Fort Myers Country Club

6) Winkler Canal Outfall = NPDES Sampling I.D. "CFMWINK" located at Winkler Canal box culvert at McGregor Blvd.

TABLE 12-10

SIMULATED AND PROJECTED LOADINGS FOR TOTAL NITROGEN (Total-N)

WATERSHED	EVENT SPECIFIC POLLUTANT LOADING (lbs)	POLLUTANT LOADING (lbs) / INCH OF RAINFALL	PROJECTED ANNUAL LOADING (lbs)
Billy Creek	4,495	999	53,071
Manuel's Branch	820	182	9,681
Carrell Canal	824	183	9,729
Winkler Canal	969	215	11,441
TOTAL (lbs)	**7,108**	**1,580**	**83,922**

TABLE 12-11

SIMULATED AND PROJECTED LOADINGS FOR TOTAL PHOSPHOROUS (Total-P)

WATERSHED	EVENT SPECIFIC POLLUTANT LOADING (lbs)	POLLUTANT LOADING (lbs) / INCH OF RAINFALL	PROJECTED ANNUAL LOADING (lbs)
Billy Creek	767	170	9,056
Manuel's Branch	151	34	1,783
Carrell Canal	157	35	1,854
Winkler Canal	175	39	2,066
TOTAL (lbs)	**1,250**	**278**	**14,758**

TABLE 12-12

SIMULATED AND PROJECTED LOADINGS FOR TOTAL SUSPENDED SOLIDS (TSS)

WATERSHED	EVENT SPECIFIC POLLUTANT LOADING (lbs)	POLLUTANT LOADING (lbs) / INCH OF RAINFALL	PROJECTED ANNUAL LOADING (lbs)
Billy Creek	104,587	23,242	1,234,824
Manuel's Branch	26,123	5,805	308,426
Carrell Canal	17,843	3,965	210,666
Winkler Canal	25,485	5,663	300,893
TOTAL (lbs)	**174,038**	**38,675**	**2,054,809**

TABLE 12-13

WINKLER CANAL WATERSHED
PROJECTED POLLUTANT LOADINGS W/ PROPOSED WATER QUALITY IMPROVEMENT PROJECTS

POLLUTANT	PROJECTED ANNUAL LOADING (lbs)	REDUCTION FACTOR (%)		PROJECTED ANNUAL LOADING (lbs) w/ IMPROVEMENTS		PROJECTED REDUCTION (lbs)	
		MIN	MAX	MAX	MIN	MIN	MAX
TOTAL NITROGEN	11,441	3	6	11,098	10,754	343	687
TOTAL PHOSPHOROUS	2,066	3	9	2,004	1,880	62	186
TOTAL SUSPENDED SOLIDS	300,893	9	12	273,813	264,786	27,080	36,107

TABLE 12-14

CARRELL CANAL WATERSHED
PROJECTED POLLUTANT LOADINGS W/ PROPOSED WATER QUALITY IMPROVEMENT PROJECTS

POLLUTANT	PROJECTED ANNUAL LOADING (lbs)	REDUCTION FACTOR (%)		PROJECTED ANNUAL LOADING (lbs) w/ IMPROVEMENTS		PROJECTED REDUCTION (lbs)	
		MIN	MAX	MAX	MIN	MIN	MAX
TOTAL NITROGEN	9,729	6	13	9,145	8,464	584	1,265
TOTAL PHOSPHOROUS	1,854	13	19	1,613	1,502	541	352
TOTAL SUSPENDED SOLIDS	210,666	25	28	157,999	151,679	52,667	58,987

TABLE 12-15

MANUEL'S BRANCH WATERSHED
PROJECTED POLLUTANT LOADINGS WITH PROPOSED WATER QUALITY IMPROVEMENT PROJECTS

POLLUTANT	PROJECTED ANNUAL LOADING (lbs)	REDUCTION FACTOR (%)		PROJECTED ANNUAL LOADING (lbs) w/ IMPROVEMENTS		PROJECTED REDUCTION (lbs)	
		MIN	MAX	MAX	MIN	MIN	MAX
TOTAL NITROGEN	9,681	4	15	9,294	8,229	387	1,452
TOTAL PHOSPHOROUS	1,783	15	25	1,516	1,337	267	446
TOTAL SUSPENDED SOLIDS	308,426	38	47	191,224	163,466	117,202	144,960

TABLE 12-16

BILLY CREEK WATERSHED
PROJECTED POLLUTANT LOADINGS WITH PROPOSED WATER QUALITY IMPROVEMENT PROJECTS

POLLUTANT	PROJECTED ANNUAL LOADING (lbs)	REDUCTION FACTOR (%)		PROJECTED ANNUAL LOADING (lbs) w/ IMPROVEMENTS		PROJECTED REDUCTION (lbs)	
		MIN	MAX	MAX	MIN	MIN	MAX
TOTAL NITROGEN	53,071	5	12	50,417	46,702	2,654	6,369
TOTAL PHOSPHOROUS	9,056	7	18	8,422	7,426	634	1,630
TOTAL SUSPENDED SOLIDS	1,234,824	19	25	1,000,207	926,118	234,617	308,706

FIGURE 12-1: TOTAL NITROGEN (mg/L) at BILLY CREEK OUTFALL – 3 DAY / 1 YEAR EVENT

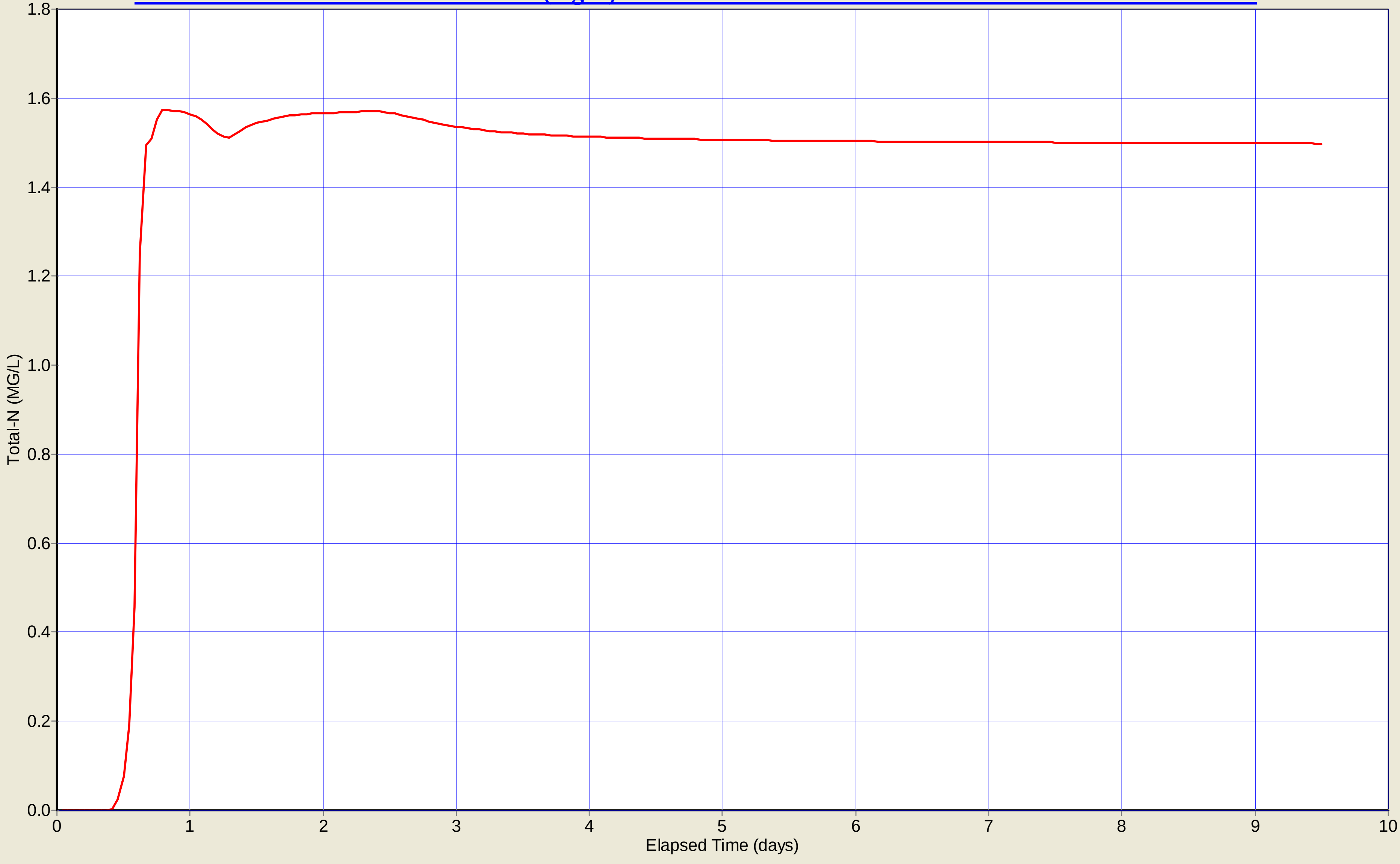


FIGURE 12-2: TOTAL PHOSPHOROUS (mg/L) at BILLY CREEK OUTFALL – 3 DAY / 1 YEAR EVENT

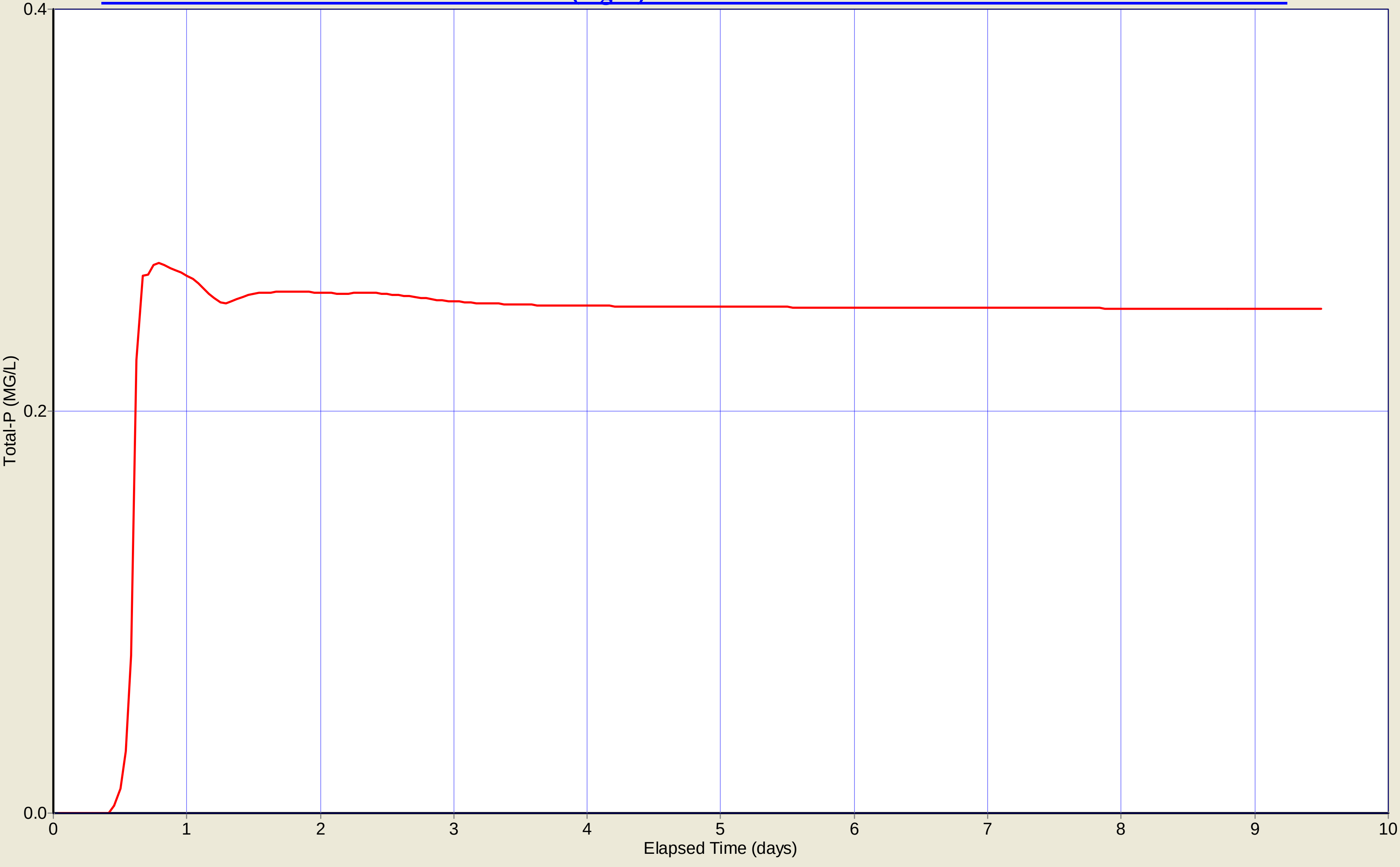


FIGURE 12-3: TOTAL SUSPENDED SOLIDS (mg/L) at BILLY CREEK OUTFALL – 3 DAY / 1 YEAR EVENT

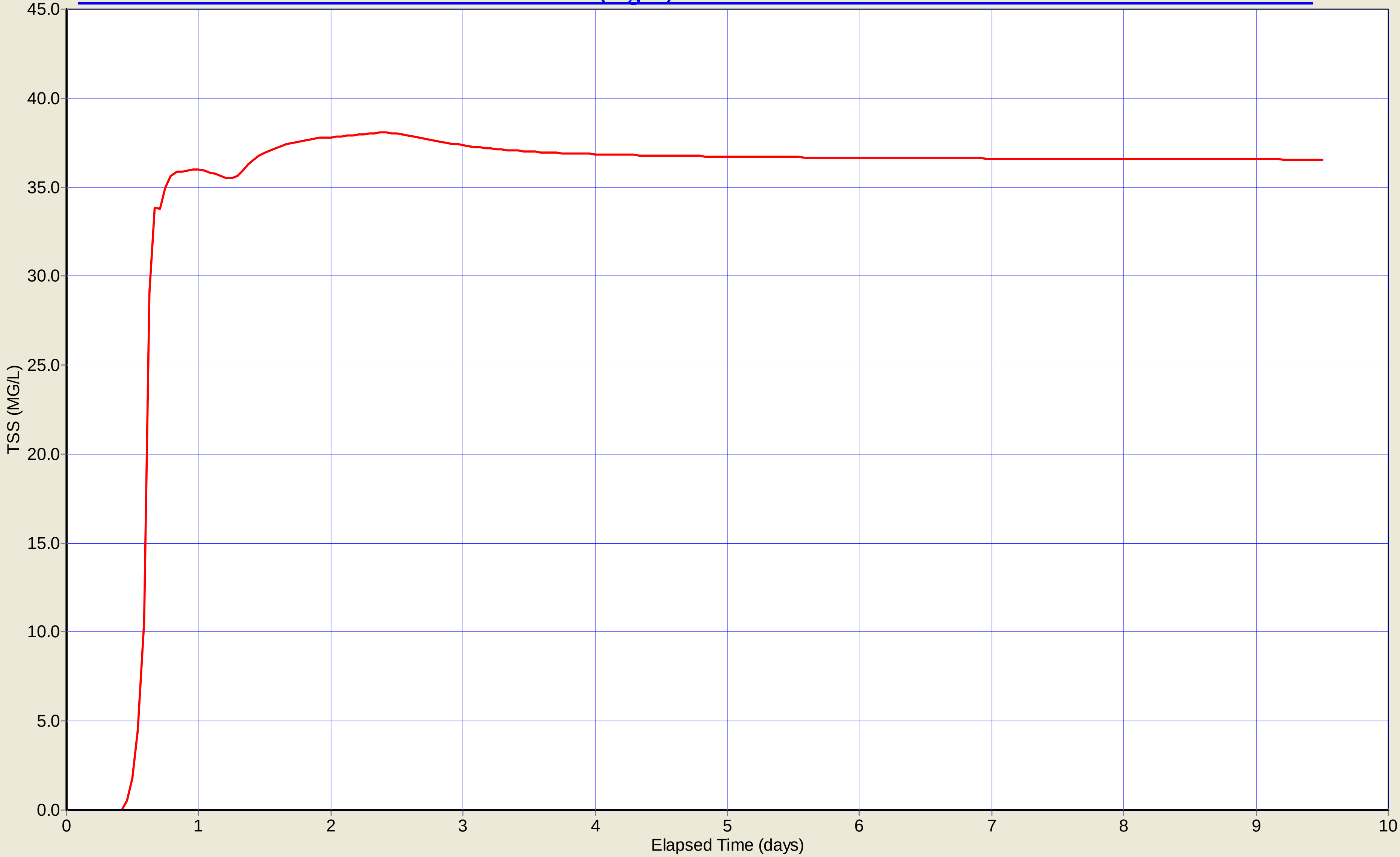


FIGURE 12-4: TOTAL NITROGEN (mg/L) – MANUEL'S BRANCH (POINCIANNA OUTFALL) – 3 DAY / 1 YEAR EVENT

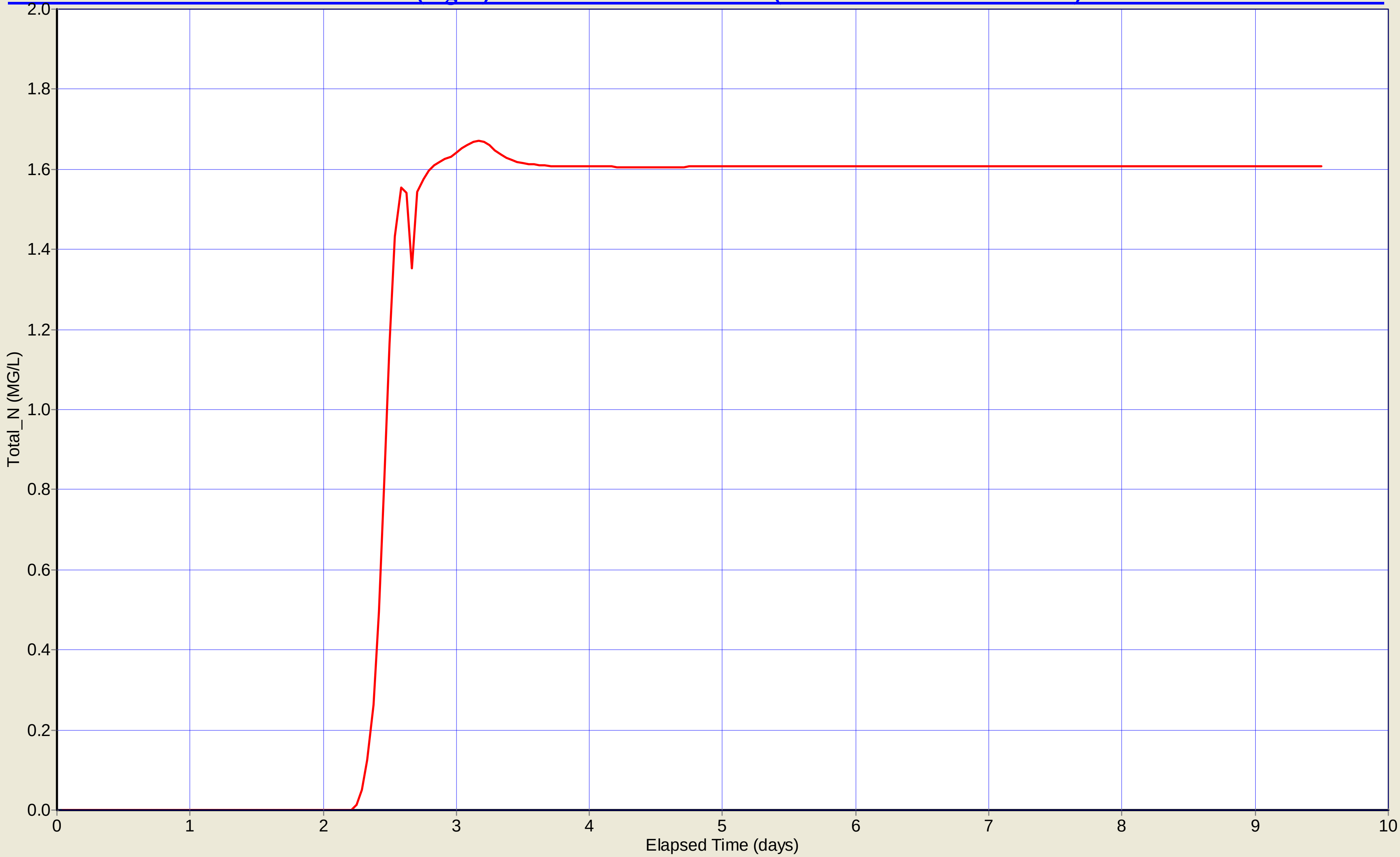


FIGURE 12-5: TOTAL PHOSPHOROUS (mg/L) - MANUEL'S BRANCH (POINCIANNA OUTFALL) – 3 DAY / 1 YEAR EVENT

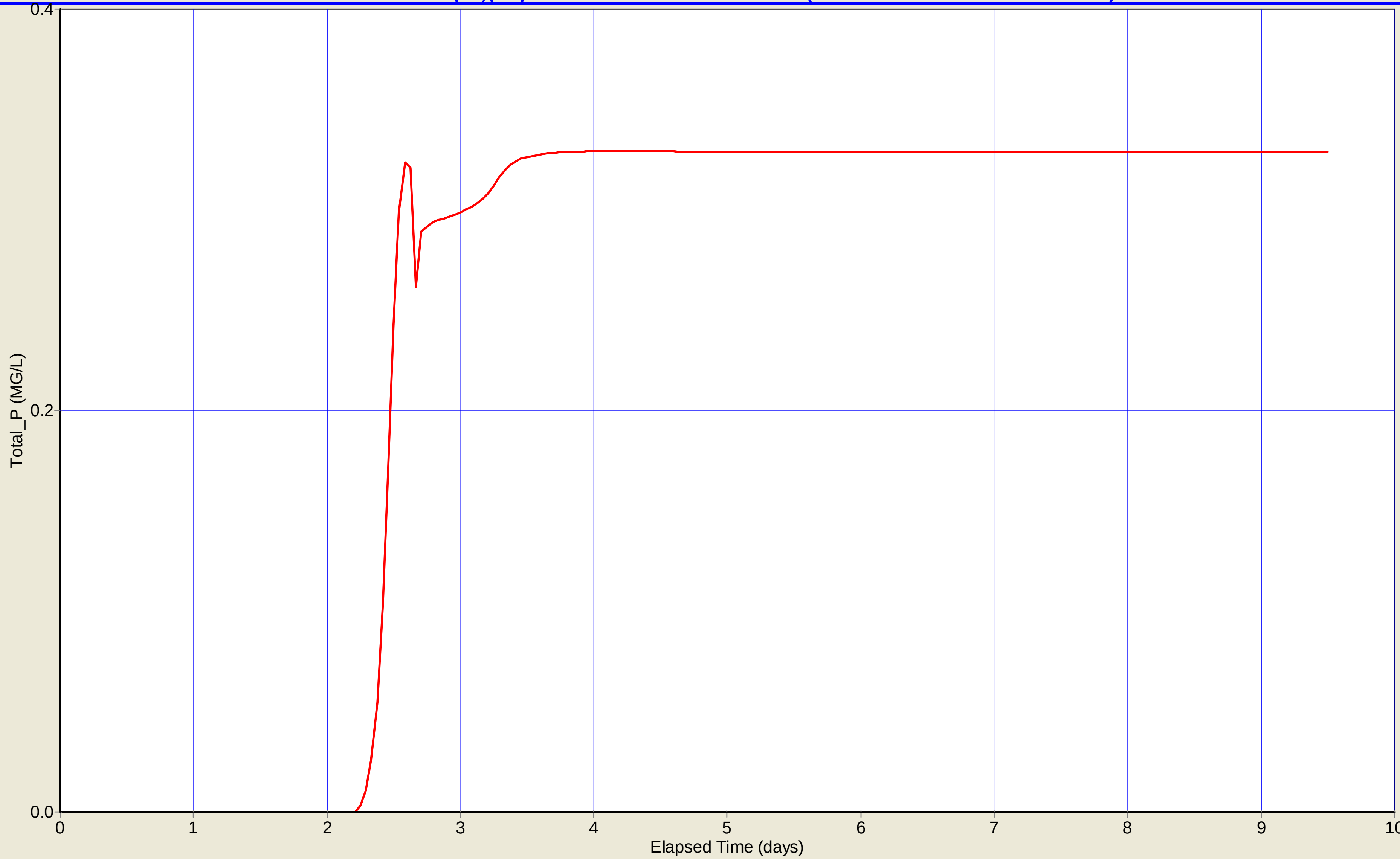
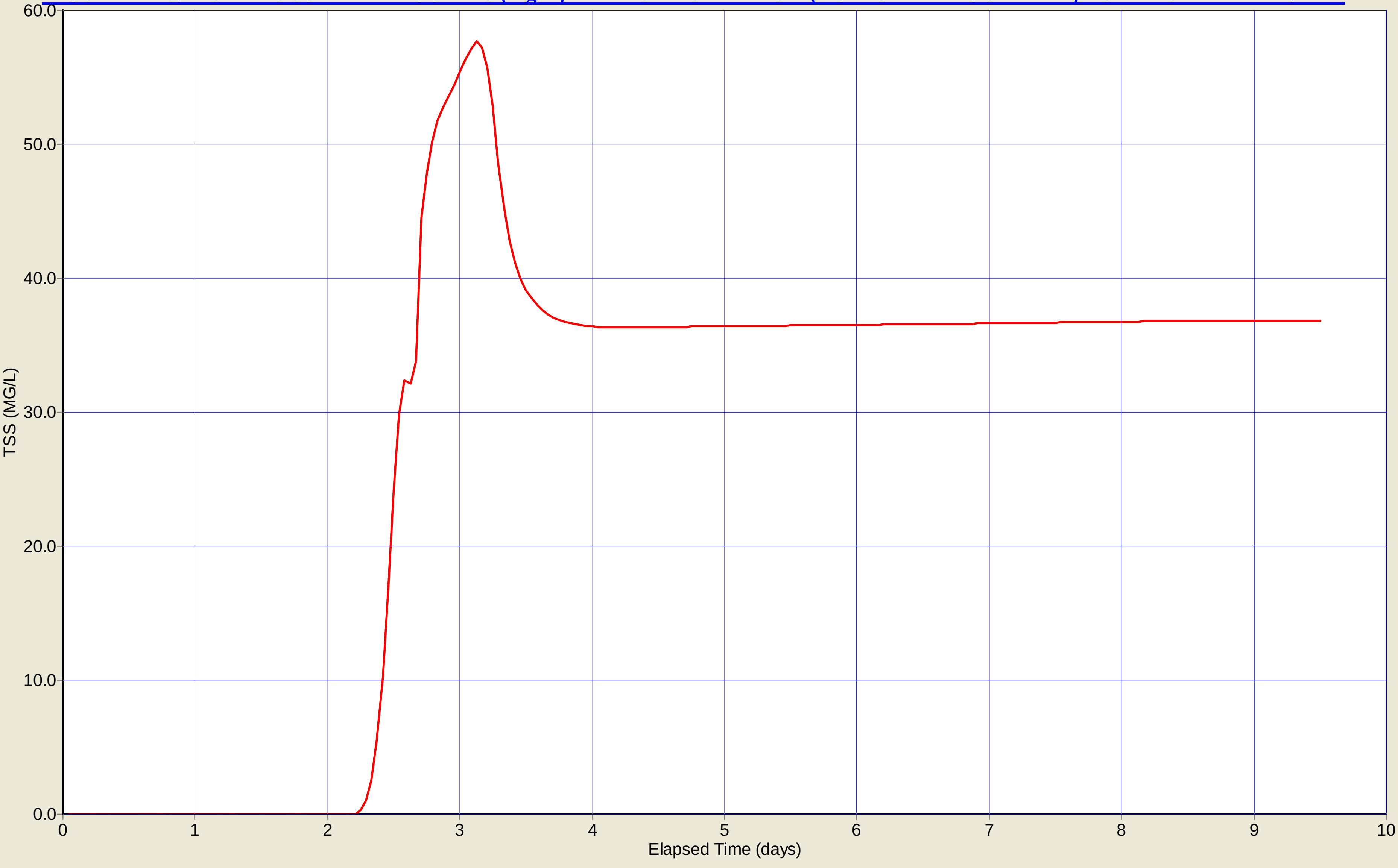


FIGURE 12-6: TOTAL SUSPENDED SOLIDS (mg/L) - MANUEL'S BRANCH (POINCIANNA OUTFALL) – 3 DAY / 1 YEAR EVENT



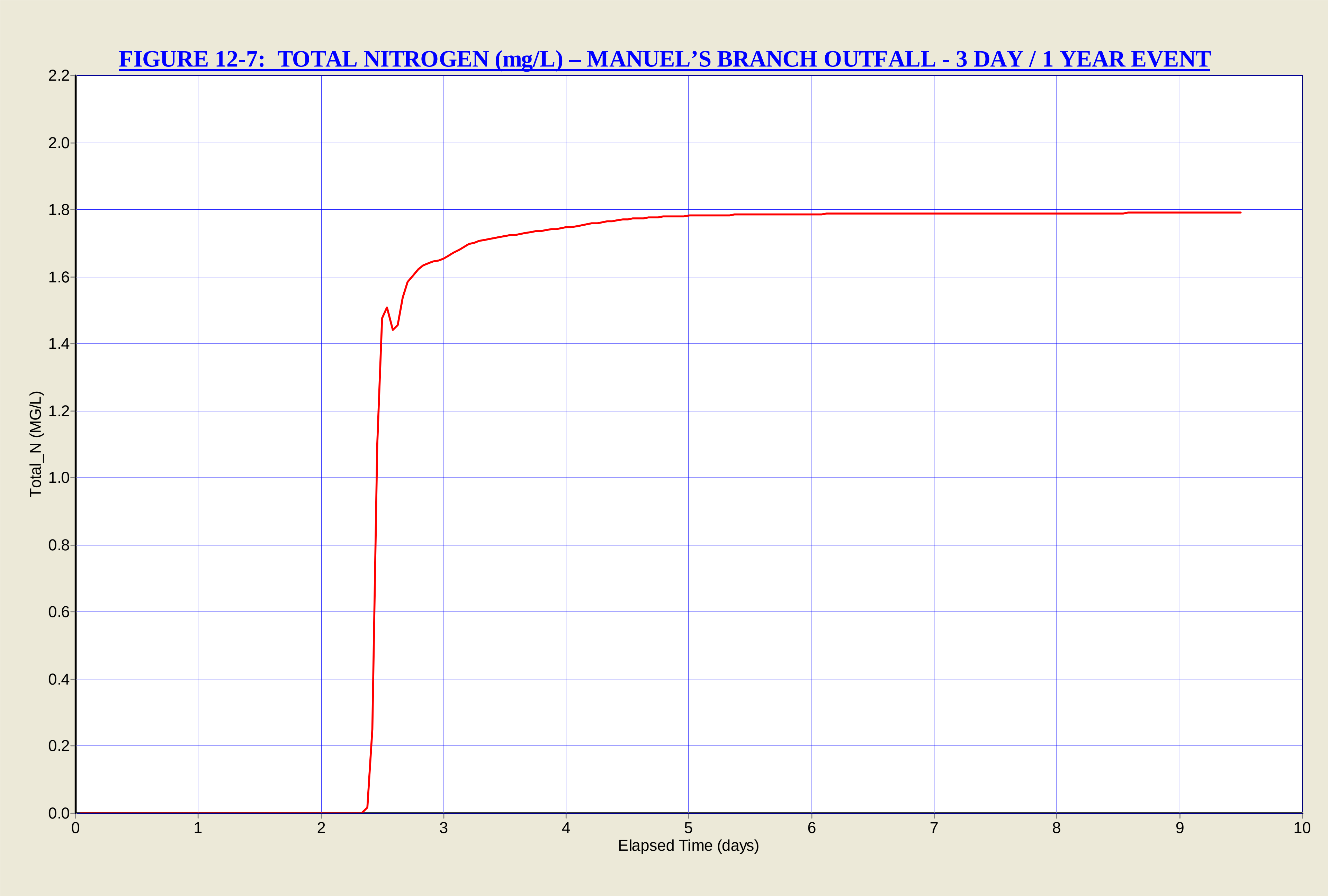


FIGURE 12-7: TOTAL NITROGEN (mg/L) – MANUEL'S BRANCH OUTFALL - 3 DAY / 1 YEAR EVENT
Total_N (MG/L)
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0
1
2
3
4
5
6
7
8
9
10
Elapsed Time (days)

FIGURE 12-8: TOTAL PHOSPHOROUS (mg/L) – MANUEL'S BRANCH OUTFALL - 3 DAY / 1 YEAR EVENT

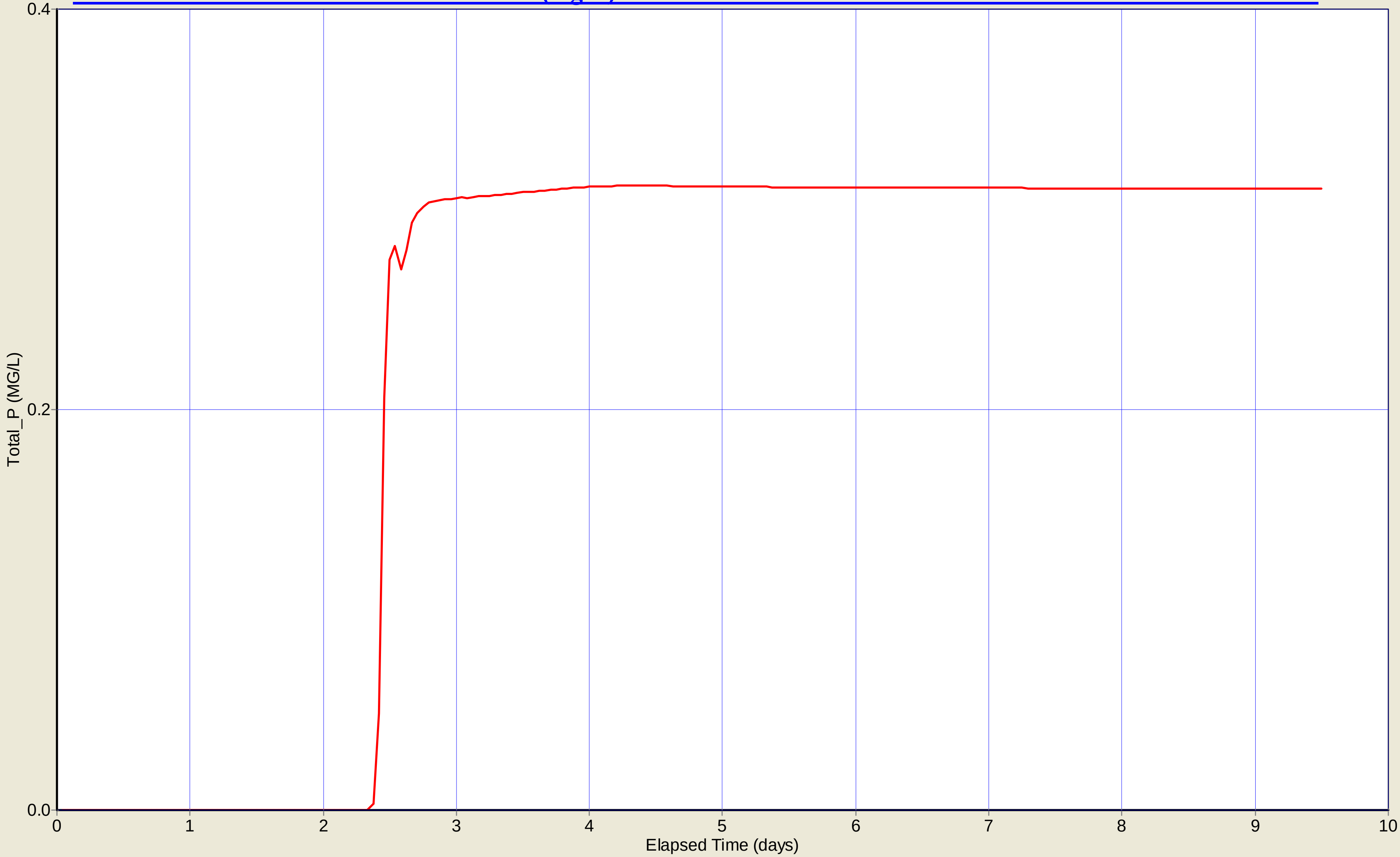


FIGURE 12-9: TOTAL SUSPENDED SOLIDS (mg/L) – MANUEL'S BRANCH OUTFALL - 3 DAY / 1 YEAR EVENT

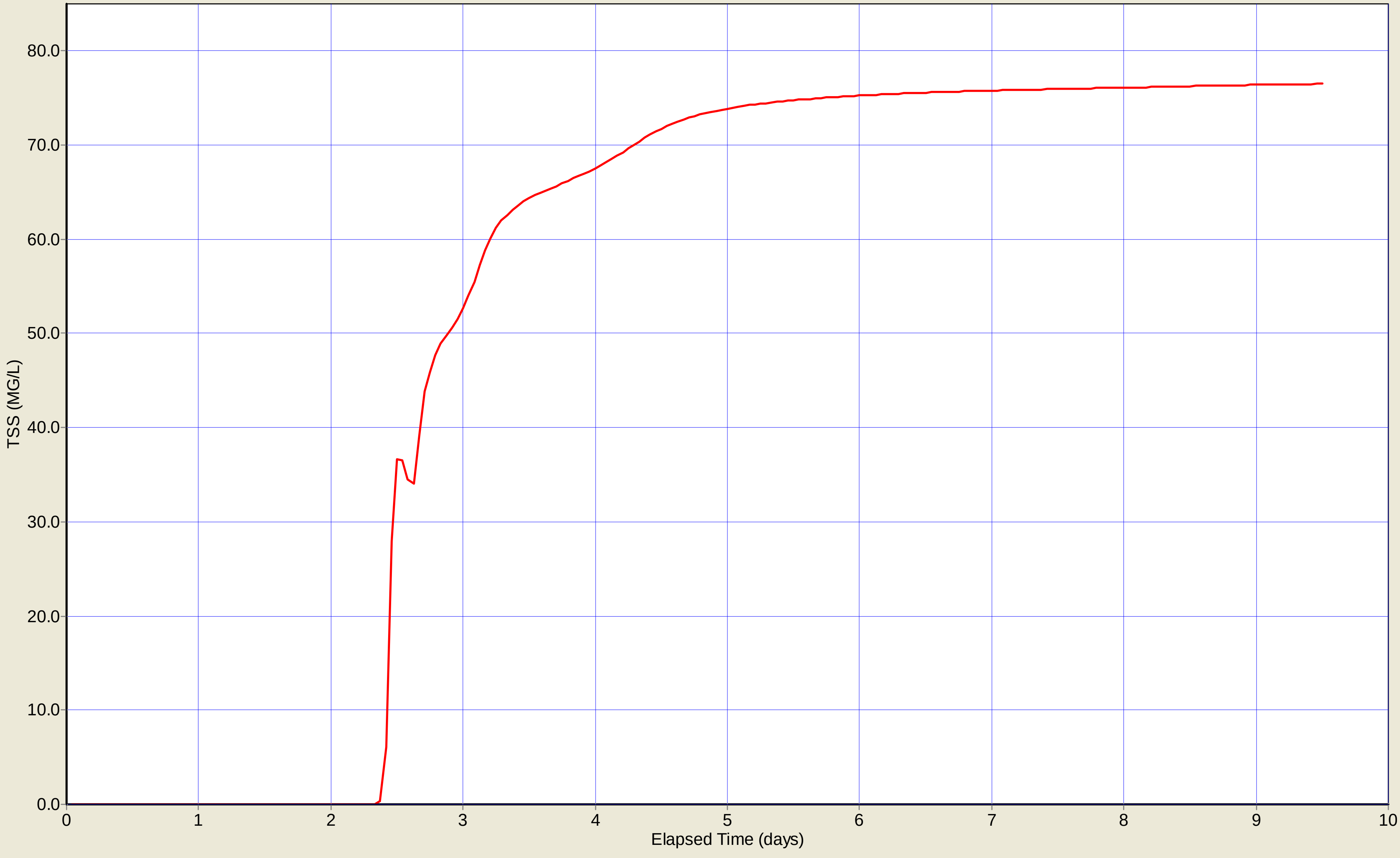


FIGURE 12-10: TOTAL NITROGEN (mg/L) – CARRELL CANAL OUTFALL - 3 DAY / 1 YEAR EVENT

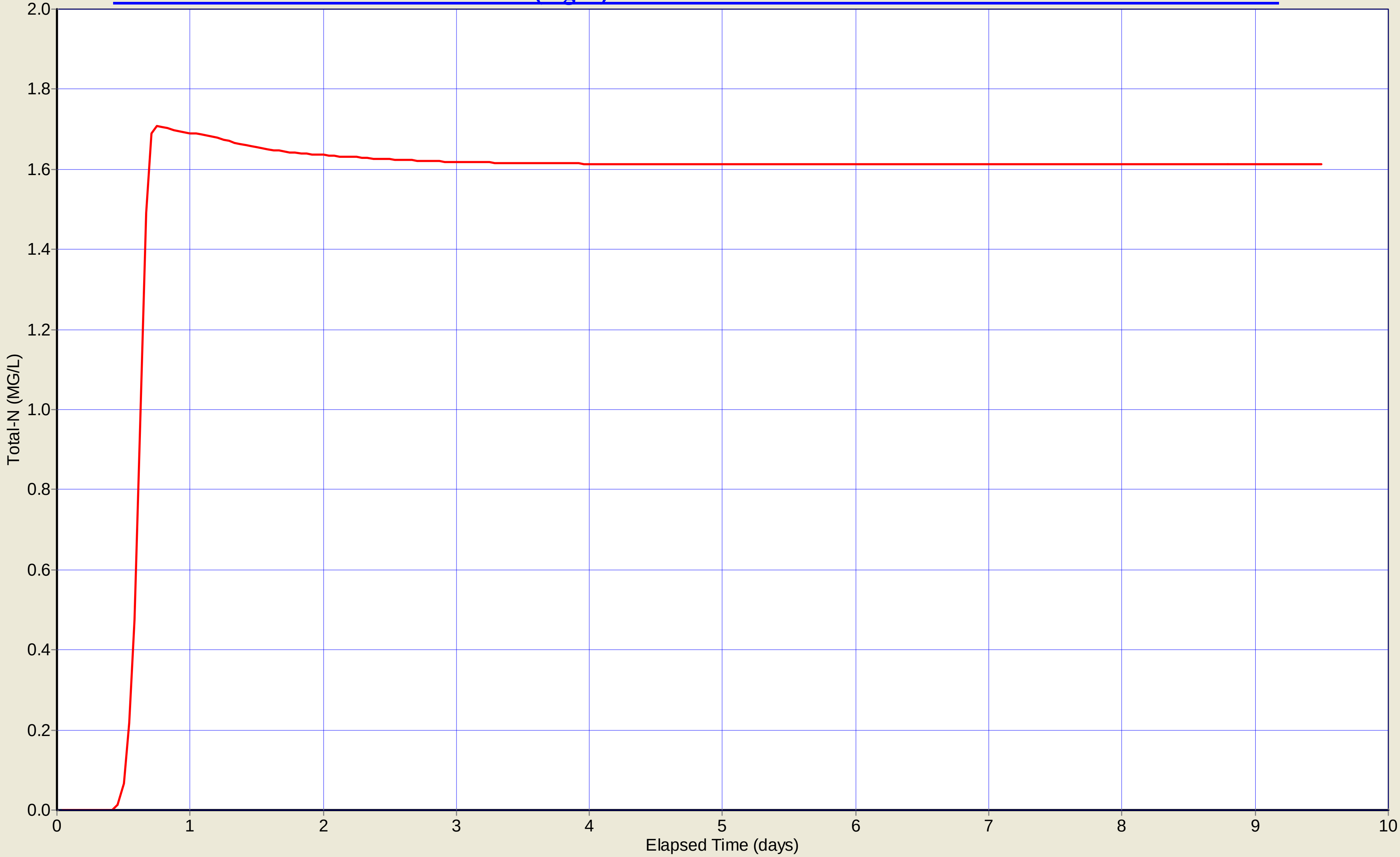


FIGURE 12-11: TOTAL PHOSPHOROUS (mg/L) – CARRELL CANAL OUTFALL - 3 DAY / 1 YEAR EVENT

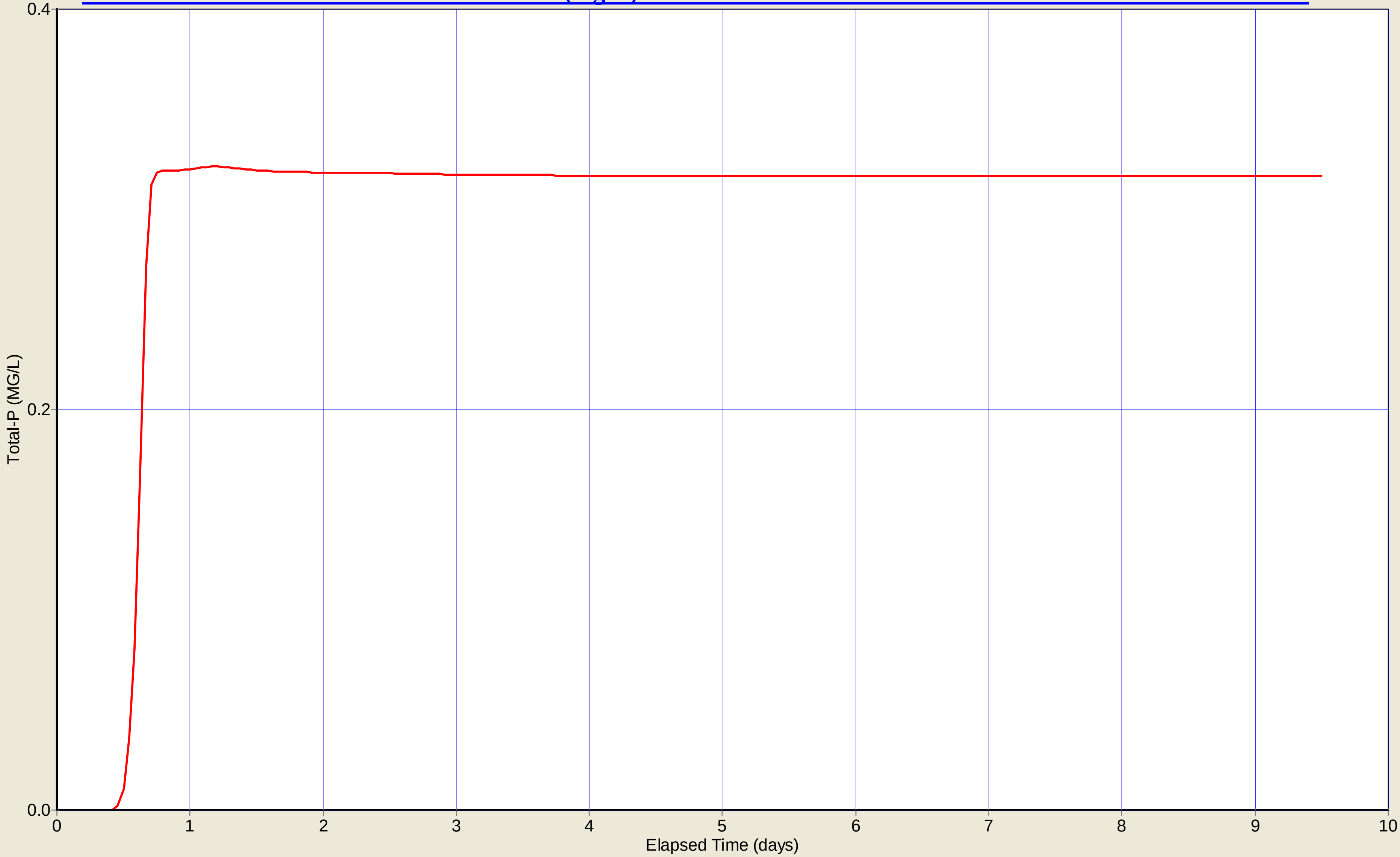
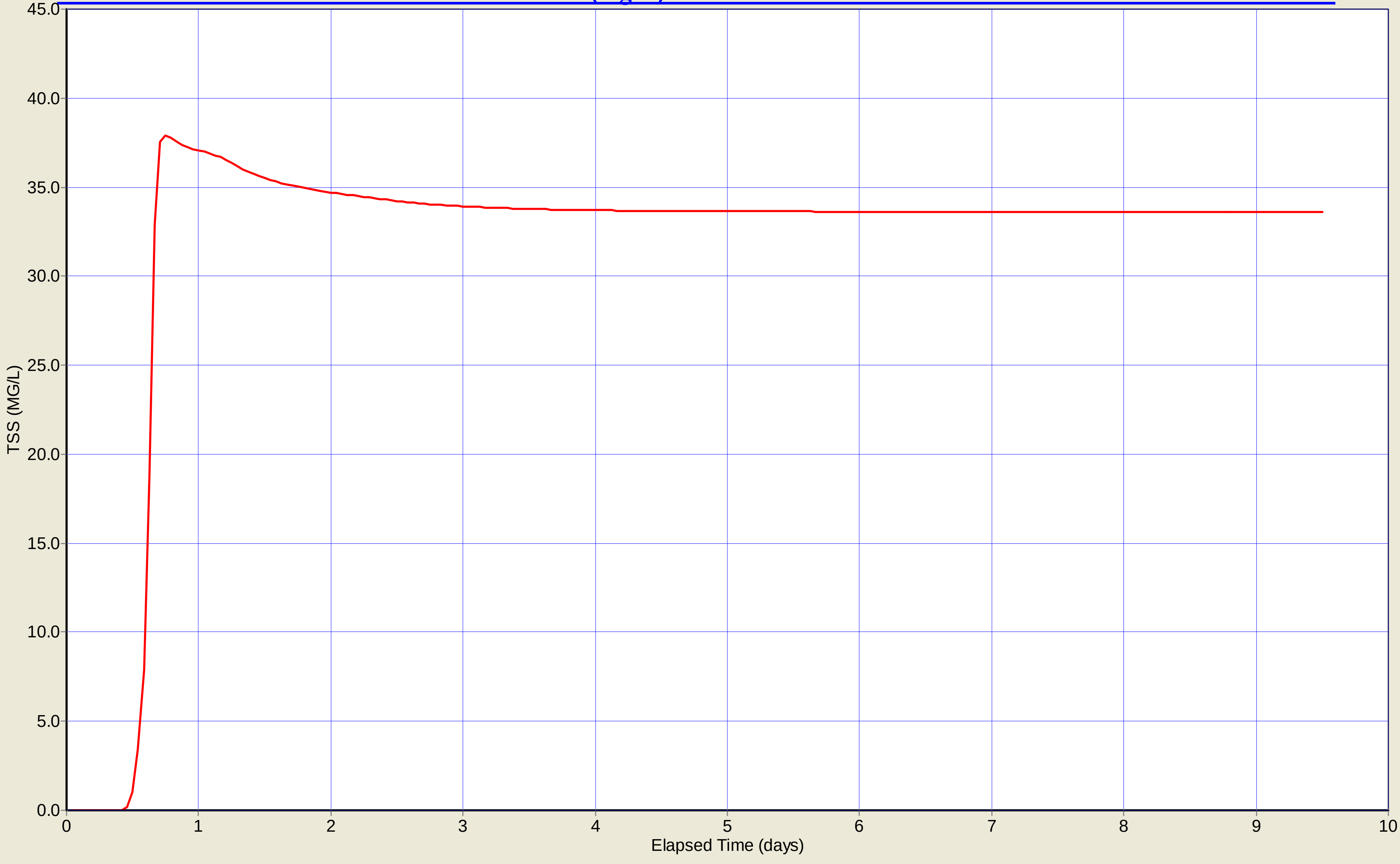


FIGURE 12-12: TOTAL SUSPENDED SOLIDS (mg/L) – CARRELL CANAL OUTFALL - 3 DAY / 1 YEAR EVENT



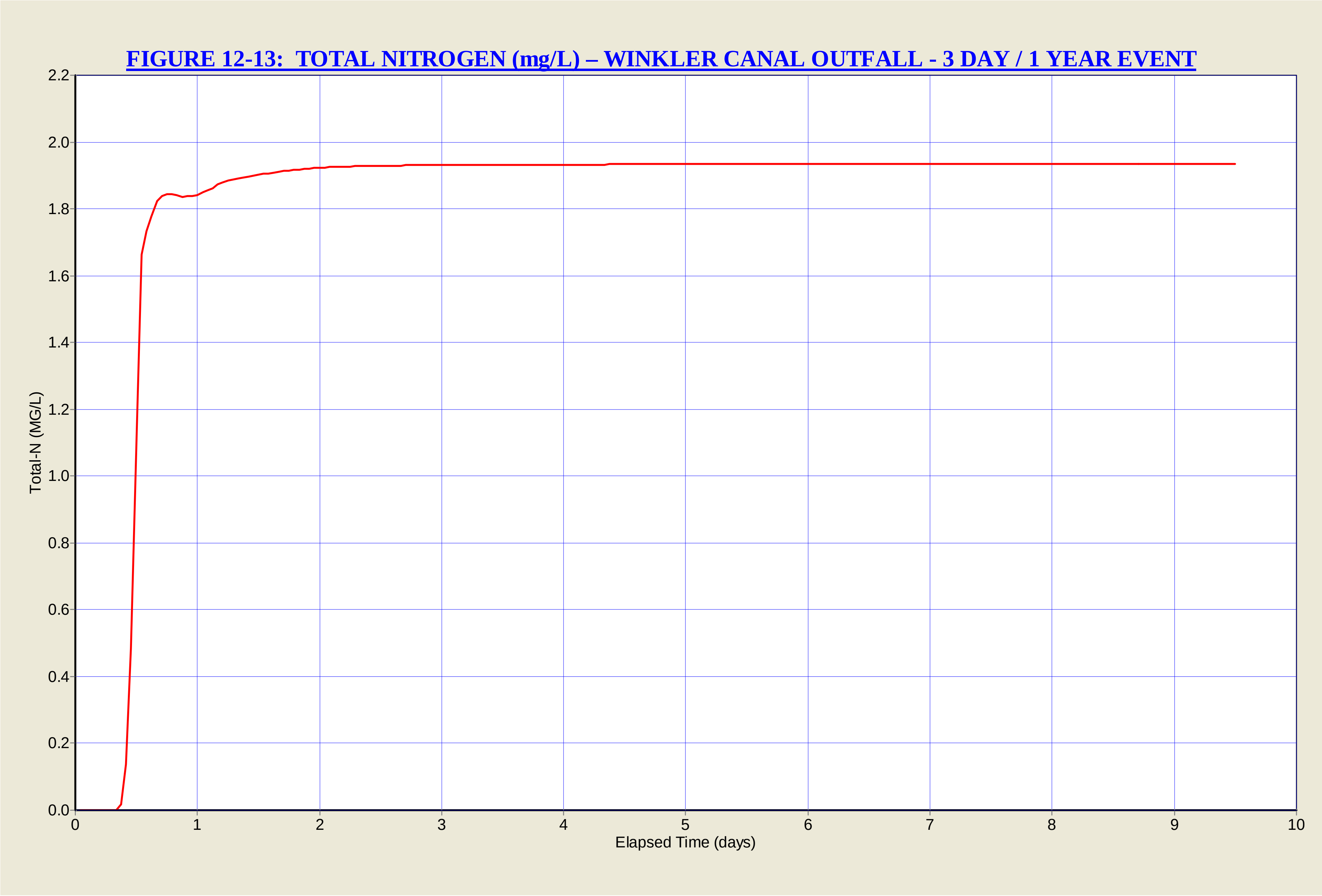


FIGURE 12-13: TOTAL NITROGEN (mg/L) – WINKLER CANAL OUTFALL - 3 DAY / 1 YEAR EVENT
Total-N (MG/L)
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0
1
2
3
4
5
6
7
8
9
10
Elapsed Time (days)

FIGURE 12-14: TOTAL PHOSPHOROUS (mg/L) – WINKLER CANAL OUTFALL - 3 DAY / 1 YEAR EVENT

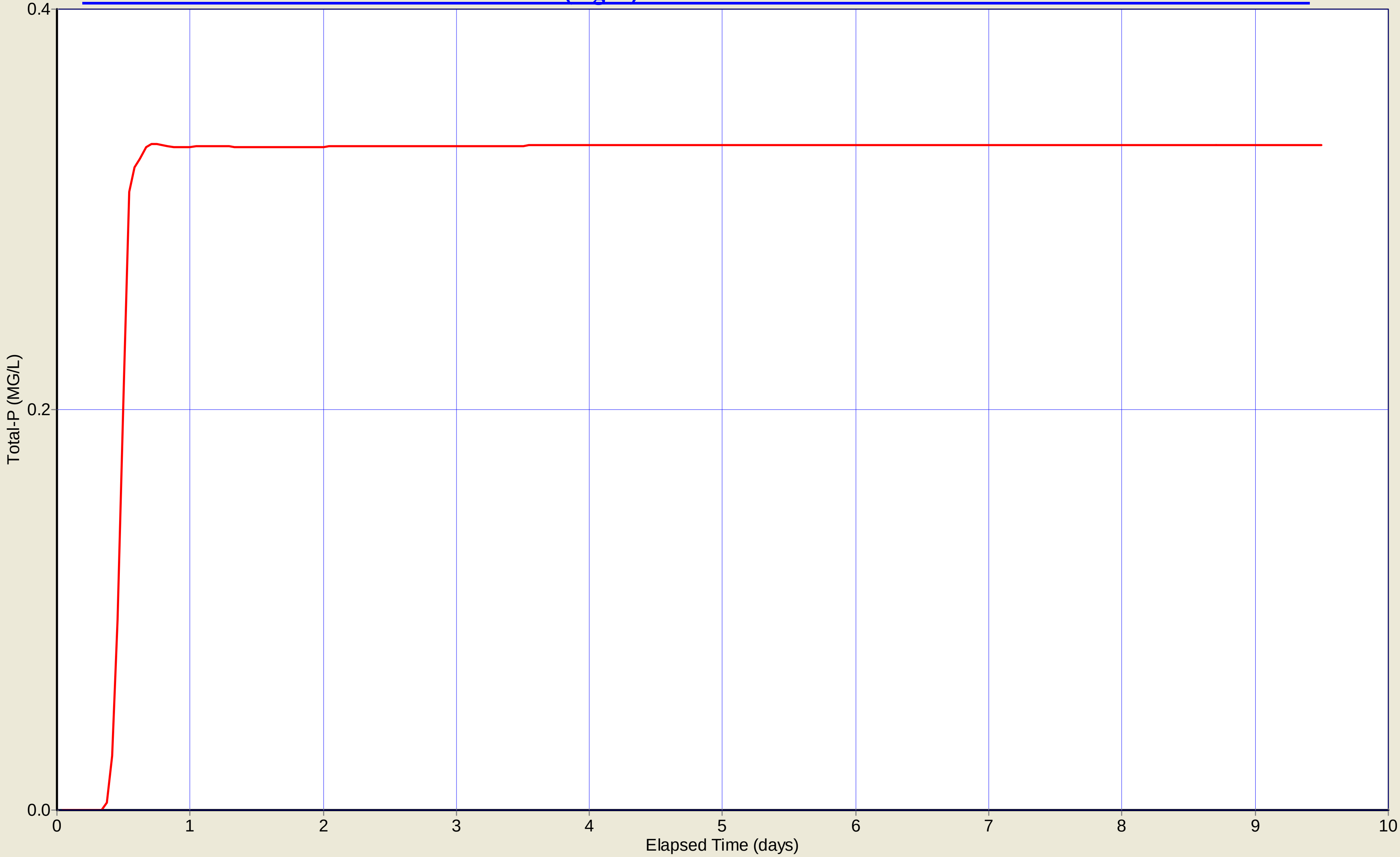
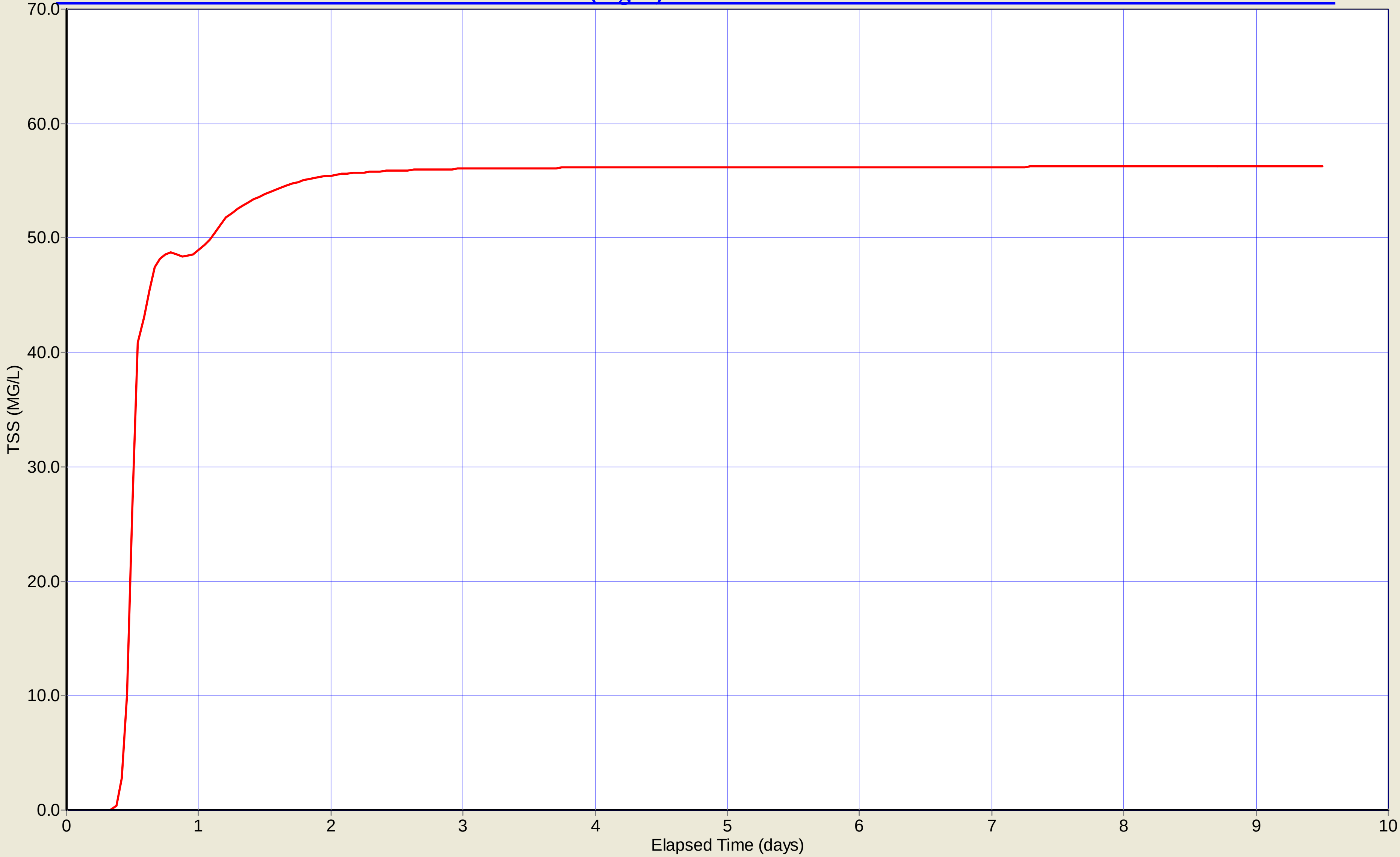


FIGURE 12-15: TOTAL SUSPENDED SOLIDS (mg/L) – WINKLER CANAL OUTFALL - 3 DAY / 1 YEAR EVENT



13.0 PROPOSED FACILITIES and COST ESTIMATES

13.1 RECOMMENDED CAPITAL IMPROVEMENTS

A primary focus of this study was to formulate and evaluate a series of water quality improvement projects and to mitigate for the vacant and pending designation by the state of several watersheds within the City limits as being impaired due to water quality issues. Below is a listing of proposed Capital Improvement Projects (CIP), by watersheds that are intended in aggregation to mediate this situation. Appended to this section are generalized descriptions, associated summary cost estimates, and a project location map for the proposed projects (Figure 13-1A and 13-1B).

Billy Creek

Billy Creek Filter Marsh Park

Ford Street Canal

Ford Street Canal Filter Marsh Park

Shoemaker Canal

Shoemaker - Zapato Canal Stormwater Treatment

Zapato Canal

Shoemaker - Zapato Canal Stormwater Treatment

Manuel's Branch

Manuel's Branch East Weir (Royal Palm)
Manuel's Branch West Weir (Grand Avenue)
Manuel's Branch Siltation Structure
Manuel's Branch - Carrell Canal Interconnect
North Ten Mile Canal Stormwater Treatment System*

Carrell Canal

Carrell Canal (FMCC) Water Quality Improvements

Carrell Canal East Weir (Royal Palm)

Broadway Canal Stormwater System Evaluation

Manuel's Branch - Carrell Canal Interconnect

North Ten Mile Canal Stormwater Treatment System*

Winkler Canal

Winkler Canal Filter Marsh

Winkler - Galloway Canal Interconnect

Galloway Canal Stormwater Treatment Area

Ten Mile Canal

City Industrial Park (FPL) Stormwater Improvements

13.2 PROPOSED IMPLEMENTATION SCHEDULE (5 YEARS)

Below is a proposed implementation schedule for the recommended capital improvement projects listed in this report. Most of the projects could be considered as candidates for cost sharing or matching funds from other State or Federal sources as are outlined in Section 14.

Fiscal Year 2007 – 2008 (YEAR 1)

Billy Creek Filter Marsh Park (50% Cost Share)	1,000,000
Manuel's Branch East Weir @ Royal Palm	135,000
Manuel's Branch West Weir @ Grand Avenue	115,000
	1,250,000

Fiscal Year 2008 – 2009 (YEAR 2)

Carrell Canal East Weir @ Royal Palm	135,000
North Ten Mile Canal Stormwater Treatment System (50% Cost Share)	300,000
Manuel's Branch Siltation Structure	150,000
	585,000

Fiscal Year 2009 – 2010 (YEAR 3)

Carrell Canal (FMCC) Water Quality Improvements* (50% Cost Share)	250,000
Shoemaker - Zapato Canal Stormwater Treatment (50% Cost Share)	187,500
City Industrial Park (FPL) Drainage Improvements	175,000
Winkler - Galloway Canal Interconnect (Design & Permitting)	30,000
	642,500

*Project to be constructed concurrently with the FMCC greens and tees rehabilitation.

Fiscal Year 2010 – 2011 (YEAR 4)

Ford Street Canal Filter Marsh Park (50% Cost Share)	750,000
Manuel's Branch - Carrell Canal Interconnect (Design & Permitting)	30,000
Broadway Canal Stormwater System Evaluation	30,000
	690,000

Fiscal Year 2011 – 2012 (YEAR 5)

Galloway Canal Stormwater Treatment Area (50% Cost Share)	250,000
Winkler Canal Filter Marsh (50% Cost Share)	332,500
	582,500

Total estimated five (5) year Capital Improvement budget is $3,750,000.

13.3 ALTERNATIVE ANNUAL CAPITAL BUDGET ACCOUNT

As an alternative to an individual line item capital budget by project, the City may elect to create a specialized account budget item request in the amount of $250,000 to $500,000 per fiscal year as a restricted funding source to provide capital funding matches and "in-kind" services for State and Federal grant funded projects. This would also allow the City to respond to any such project opportunities that may require a time sensitive schedule.

13.4 FIGURES

Figure 13-1A and 13-1B: "Proposed Capital Improvements"

Billy Creek Filter Marsh Park

General Description

This project is located between Marsh Avenue and Nuna Avenue along Billy Creek and adjacent to that area known as Billy Bowlegs Park.

The project proposes to create a Stormwater Treatment Area (STA) via quiescent settling pond(s), constructed wetlands and marshes, and ecotonal environs within portions of the currently vacant lands (55 acres ±) located adjacent to and easterly of the Billy Bowlegs Park. The project will also provide for the future inclusion of pedestrian/bike pathway(s), recreational, and interpretive facilities.

This facility will also work collectively with a number of other individual stormwater treatment areas along Billy Creek and its tributaries currently being considered or implemented in order to improve the overall water quality of Billy Creek and the stormwater discharges to the Caloosahatchee River. The proposed project will reduce the characteristic pollutants of nutrients, suspended solids, and sediments associated with the contributory land uses. Other benefits would also accrue from the creation of wild life habitat and increased contributions to the overall and useable community open space. Additionally, the project is consistent with the goals and objectives for those identified as "Priority Waterbodies" for the Lower Charlotte Harbor by the South Florida Water Management District (SFWMD).

Estimated Costs:

Administrative (City):	$55,000
Approx. Design and Permitting:	$95,000
Estimated Right of Way:	None (County owned lands)
Estimated Construction:	$1,850,000

TOTAL ESTIMATED PROJECT COST = $2,000,000

(*** Anticipate 50% Cost Share with State and/or Federal Agency)

Ford Street Canal Filter Marsh Park

General Description

This project is located between Seaboard Street, Michigan Avenue, and Veronica Shoemaker Boulevard along Billy Creek and adjacent to that area known as the City of Fort Myers Cemetery.

The project proposes to create a Stormwater Treatment Area (STA) via quiescent settling pond(s), constructed wetlands and marshes, and ecotonal environs within portions of the currently vacant lands (10 acres ±) located northerly of the Cemetery and easterly of the Central AWWT facility (Raleigh Street). The project will also provide for the future inclusion of pedestrian/bike pathway(s), recreational, and interpretive facilities.

This facility will also work collectively with a number of other individual stormwater treatment areas along Billy Creek and its tributaries currently being considered or implemented in order to improve the overall water quality of Billy Creek and the stormwater discharges to the Caloosahatchee River. The proposed project will reduce the characteristic pollutants of nutrients, suspended solids, and sediments associated with the contributory land uses. Other benefits would also accrue from the creation of wild life habitat and increased contributions to the overall and useable community open space. Additionally, the project is consistent with the goals and objectives for those identified as "Priority Waterbodies" for the Lower Charlotte Harbor by the South Florida Water Management District (SFWMD).

Estimated Costs:

Administrative (City):	$25,000
Approx. Design and Permitting:	$75,000
Estimated Right of Way:	None (City owned lands)
Estimated Construction:	$1,400,000

TOTAL ESTIMATED PROJECT COST = $1,500,000

(*** Anticipate 50% Cost Share with State and/or Federal Agency)

Shoemaker - Zapato Canal Stormwater Treatment

This project is located in the vicinity of the Michigan Avenue and the Lee County Vocational -Technical (Vo-Tech) training facility.

The project proposes to install weir/control structures upstream of Michigan Avenue to improve the function and operations of the interconnection along the southerly boundary of the Vo-Tech facility between the Shoemaker and Zapato Canals. The project will provide for peak flow attenuation through increased channel storage and the “balancing” of outfalling stormwater volumes between the two canal systems so as to improve the water quality and reduce erosion and siltation into Billy Creek.

This facility will also work collectively with a number of other individual stormwater treatment areas along Billy Creek and its tributaries currently being considered or implemented in order to improve the overall water quality of Billy Creek and the stormwater discharges to the Caloosahatchee River. The proposed project will reduce the characteristic pollutants of nutrients, suspended solids, and sediments associated with the contributory land uses. Additionally, the project is consistent with the goals and objectives for those identified as “Priority Waterbodies” for the Lower Charlotte Harbor by the South Florida Water Management District (SFWMD).

Estimated Costs:

Administrative (City):	$5,000
Approx. Design and Permitting:	$70,000
Estimated Right of Way:	None (existing canal rights of way)
Estimated Construction:	$300,000

TOTAL ESTIMATED PROJECT COST = $375,000

(*** Anticipate 50% Cost Share with State and/or Federal Agency)

North Ten Mile Canal Stormwater Treatment System

General Description

This project is located in the vicinity of Ten Mile Canal from Canal Street to Carrell Road and borders along the westerly boundary of the CSX/Seminole Gulf railroad.

The project proposes to create a linear stormwater storage attenuation and water quality treatment facility within that area adjacent to and along the Seminole Gulf (CSX) for that area commonly known as Ten Mile Canal. Specifically the project will modify that portion south of Hanson Street and create an excavated section for that portion north of Hanson Street. The project also proposes to install additional culverts under Hanson Street and a sheet pile structure within the existing Ten Mile Canal section just upstream of the North Colonial Waterway outfall to provide a boundary separation for this system.

As a structural measure to abate the adverse stormwater runoff effects of past land treatment activities, urbanization, and development practices, this project proposes to create a large scale detention storage/treatment area for those portions of the watersheds encompassing the Fowler commercial corridor and easterly industrial areas. This project will also work in conjunction with the proposed easterly weir/control structures for Manuel's Branch and Carrell Canal near Royal Palm Avenue.

By constructing this project, the storm water runoff can better mimic a pre-developed hydrologic response condition(s). This, in turn, will attenuate peaking flows, decrease the degree of flooding in the downstream portions of the watershed, and decrease the pollutant constituency concentrations for enhanced water quality within the Manuel's Branch and Carrell Canal waterways and the outfalling stormwater flows to the Caloosahatchee. Additionally, the project is consistent with the goals and objectives of that identified as "Priority Waterbodies" for the Lower Charlotte Harbor by the South Florida Water Management District (SFWMD).

Estimated Costs:

Administrative (City):	$5,000
Approx. Design and Permitting:	$45,000
Estimated Right of Way:	None (existing canal right of way)
Estimated Construction:	$550,000

TOTAL ESTIMATED PROJECT COST = $600,000

(*** Anticipate 50% Cost Share with State and/or Federal Agency)

Manuel's Branch East Weir

General Description

This project is located in the vicinity of Canal Street near the intersection of Royal Palm Avenue.

The project proposes to install a weir/control structure within the existing canal section. This project will create a linear storage feature within the upstream reach of the existing canal in order to further improve water quality and attenuate the peaking effects of past urbanization and development practices within that portion of the watershed encompassing the Fowler commercial corridor and easterly industrial areas. This structure will also work in conjunction with the proposed weir for Carrell Canal near the intersection of Royal Palm Avenue and the North Ten Mile Canal Stormwater Treatment Area.

The proposed project will reduce the characteristic pollutants of nutrients, suspended solids, and sediments associated with the contributory land uses for the stormwater discharges to the Caloosahatchee River. Additionally, the project is consistent with the goals and objectives for those identified as "Priority Waterbodies" for the Lower Charlotte Harbor by the South Florida Water Management District (SFWMD).

Estimated Costs:

Administrative (City):	$5,000
Approx. Design and Permitting:	$35,000
Estimated Right of Way:	None (existing canal rights of way)
Estimated Construction:	$95,000

TOTAL ESTIMATED PROJECT COST = $135,000

Manuel's Branch West Weir

General Description

This project is located in the vicinity of Canal Street near the intersection of Grand Avenue.

The project proposes to install a weir/control structure within the existing canal section. This project will create a linear storage feature within the upstream reach of the existing canal in order to further improve water quality and attenuate the peaking effects of past urbanization and development practices within that portion of the watershed. This structure would also work in conjunction with the proposed weir/control structure upstream of the intersection of Royal Palm Avenue.

The proposed project will reduce the characteristic pollutants of nutrients, suspended solids, and sediments associated with the contributory land uses for the stormwater discharges to the Caloosahatchee River. Additionally, the project is consistent with the goals and objectives for those identified as "Priority Waterbodies" for the Lower Charlotte Harbor by the South Florida Water Management District (SFWMD).

Estimated Costs:

Administrative (City):	$5,000
Approx. Design and Permitting:	$35,000
Estimated Right of Way:	None (existing canal rights of way)
Estimated Construction:	$75,000

TOTAL ESTIMATED PROJECT COST = $115,000

Manuel's Branch Siltation Structure

General Description

This project is located in the vicinity of McGregor Boulevard, Manuel's Drive, Cortez Boulevard, and Fort Myers High School.

The project proposes to install siltation reduction measures within the existing channel section in the vicinity of the Cortez Boulevard crossing. The proposed project will reduce the siltation associated with the stream bank scour, erosion, and degradation. Additionally, the project is consistent with the goals and objectives of that identified as "Priority Waterbodies" for the Lower Charlotte Harbor by the South Florida Water Management District (SFWMD).

Estimated Costs:

Administrative:	$10,000
Approx. Design and Permitting:	$15,000
Estimated Right of Way:	None (existing canal right of way)
Estimated Construction:	$125,000

TOTAL ESTIMATED PROJECT COST = $150,000

Carrell Canal (FMCC) Water Quality Improvements

General Description

This project is located between McGregor Boulevard and US 41 within that area known as the Fort Myers Country Club (FMCC).

The project proposes to create a Stormwater Treatment Area (STA) via diversion structures, quiescent settling ponds, and constructed marshes within the "non-play" areas (5.5 acres ±) of the existing golf course facility.

The proposed project will reduce the characteristic pollutants of nutrients, suspended solids, and sediments associated with the contributory land uses. This facility will also work collectively with a number of other individual stormwater treatment projects currently being considered or implemented in order to improve the overall water quality of Carrell Canal and the stormwater discharges to the Caloosahatchee River. Additionally, the project is consistent with the goals and objectives for those identified as "Priority Waterbodies" for the Lower Charlotte Harbor by the South Florida Water Management District (SFWMD).

Estimated Costs:

Administrative (City):	$15,000
Approx. Design and Permitting:	$35,000
Estimated Right of Way:	None (City owned lands)
Estimated Construction:	$450,000

TOTAL ESTIMATED PROJECT COST = $500,000

(*** Anticipate 50% Cost Share with State and/or Federal Agency)

**Note: This project may be implemented in conjunction with the proposed golf course "greens" improvements scheduled for 2008 – 2009.

Carrell Canal East Weir

General Description

This project is located in the vicinity of Carrell Road upstream of the intersection of Royal Palm Avenue.

The project proposes to install a weir/control structure within the existing canal section. This project will create a linear storage feature within the upstream reach of the existing canal in order to further improve water quality and attenuate the peaking effects of past urbanization and development practices within that portion of the watershed encompassing the Fowler commercial corridor and easterly industrial areas. This structure will also work in conjunction with the proposed weir located in Manuel's Branch near the intersection of Royal Palm Avenue and the North Ten Mile Canal Stormwater Treatment System.

The proposed project will reduce the characteristic pollutants of nutrients, suspended solids, and sediments associated with the contributory land uses for the stormwater discharges to the Caloosahatchee River. Additionally, the project is consistent with the goals and objectives for those identified as "Priority Waterbodies" for the Lower Charlotte Harbor by the South Florida Water Management District (SFWMD).

Estimated Costs:

Administrative (City):	$5,000
Approx. Design and Permitting:	$35,000
Estimated Right of Way:	None (existing canal rights of way)
Estimated Construction:	$95,000

TOTAL ESTIMATED PROJECT COST = $135,000

Winkler Canal Filter Marsh

General Description

This project is located near Princeton Street and Oakley Avenue, north of Colonial Boulevard and west of US 41.

The project proposes to create a Stormwater Treatment Area (STA) via diversion structures, quiescent settling ponds, and constructed marshes within the currently vacant lands (4.5 acres ±) of a residential subdivision.

The proposed project will reduce the characteristic pollutants of nutrients, suspended solids, and sediments associated with the contributory land uses. This facility will also work collectively with a number of other individual stormwater treatment projects currently being considered or implemented in order to improve the overall water quality of Winkler Canal and the stormwater discharges to the Caloosahatchee River. Additionally, the project is consistent with the goals and objectives for those identified as "Priority Waterbodies" for the Lower Charlotte Harbor by the South Florida Water Management District (SFWMD).

Estimated Costs:

Administrative (City):	$10,000
Approx. Design and Permitting:	$30,000
Estimated Right of Way:	$375,000
Estimated Construction:	$250,000

TOTAL ESTIMATED PROJECT COST = $665,000

(*** Anticipate 50% Cost Share with State and/or Federal Agency)

Galloway Canal Stormwater Treatment Area

This project is located in the vicinity of North Airport Road, south of Colonial Boulevard, and east of US 41.

The project proposes to create an additional storage feature upon portions of the currently vacant lands (15 acres ±) owned by Lee County adjacent to the Galloway Canal. This facility would also work in conjunction with the existing weir/control structures for Winkler and Galloway Canal to further attenuate and enhance water quality for stormwater flows from those portions of the watersheds encompassing the easterly commercial areas east of US 41 between Colonial Boulevard (south), Collier Boulevard (north), and Ten Mile Canal. Additionally, this project would need to be coordinated with Lee County Port Authority and the FAA being that it is within the approach/departure of runway 13/31 at Page Field.

The project is also consistent with the goals and objectives of that identified as "Priority Waterbodies" for the Lower Charlotte Harbor by the South Florida Water Management District (SFWMD).

Estimated Costs:

Administrative (City):	$30,000 (Lee Co. Port Auth./FAA)
Approx. Design and Permitting:	$70,000
Estimated Right of Way:	None (County owned lands)
Estimated Construction:	$400,000

TOTAL ESTIMATED PROJECT COST = $500,000

(*** Anticipate 50% Cost Share with State and/or Federal Agency)

City Industrial Park (FPL) Stormwater Improvements

This project is located in the vicinity of the City Industrial Park located south of Hanson Street, east of Metro Parkway, and north of the North Colonial Waterway.

The project proposes to rehabilitate and enhance the existing drainage facilities from Hanson to the Colonial Waterway. This improvement will provide for a positive outfall and water quality treatment (vegetative waterway) for the surrounding properties and roadways.

Estimated Costs:

Administrative (City):	$5,000
Approx. Design and Permitting:	$30,000 (excl. boundary/title survey)
Estimated Right of Way:	$15,000 (FPL easement agreement)
Estimated Construction:	$125,000

TOTAL ESTIMATED PROJECT COST = $175,000

Manuel's Branch – Carrell Canal Interconnect

The project proposes to evaluate the extent, capacity, and viability of an inter-watershed connection using the existing drainage systems for Evans Avenue and Central Avenue in order to distribute and further attenuate stormwater flows from isolated convective rainfalls, improve water quality, and reduce the peaking effects of past urbanization and development practices.

This interconnect would also work in conjunction with the proposed weir/control structures for Manuel's Branch and Carrell Canal.

Estimated Costs:

Administrative (City):	$5,000
Approx. Design and Permitting:	$25,000
Estimated Right of Way:	None (existing rights of way)
Estimated Construction:	TBD

TOTAL ESTIMATED PROJECT COST = $30,000

Winkler – Galloway Canal Interconnect

The project proposes to evaluate the extent, capacity, and viability of multiple watershed interconnections using the existing subsurface drainage systems for Evans Avenue and Edison Mall culverts in order to distribute and further attenuate stormwater flows from isolated convective rainfalls and reduce the peaking effects of past urbanization and development practices.

This interconnect would also work in conjunction with the existing or proposed weir/control structures for Carrell, Winkler, and Galloway Canals.

Estimated Costs:

Administrative (City):	$5,000
Approx. Design and Permitting:	$25,000
Estimated Right of Way:	None (existing rights of way)
Estimated Construction:	TBD

TOTAL ESTIMATED PROJECT COST = $30,000

Broadway Canal Stormwater System Evaluation

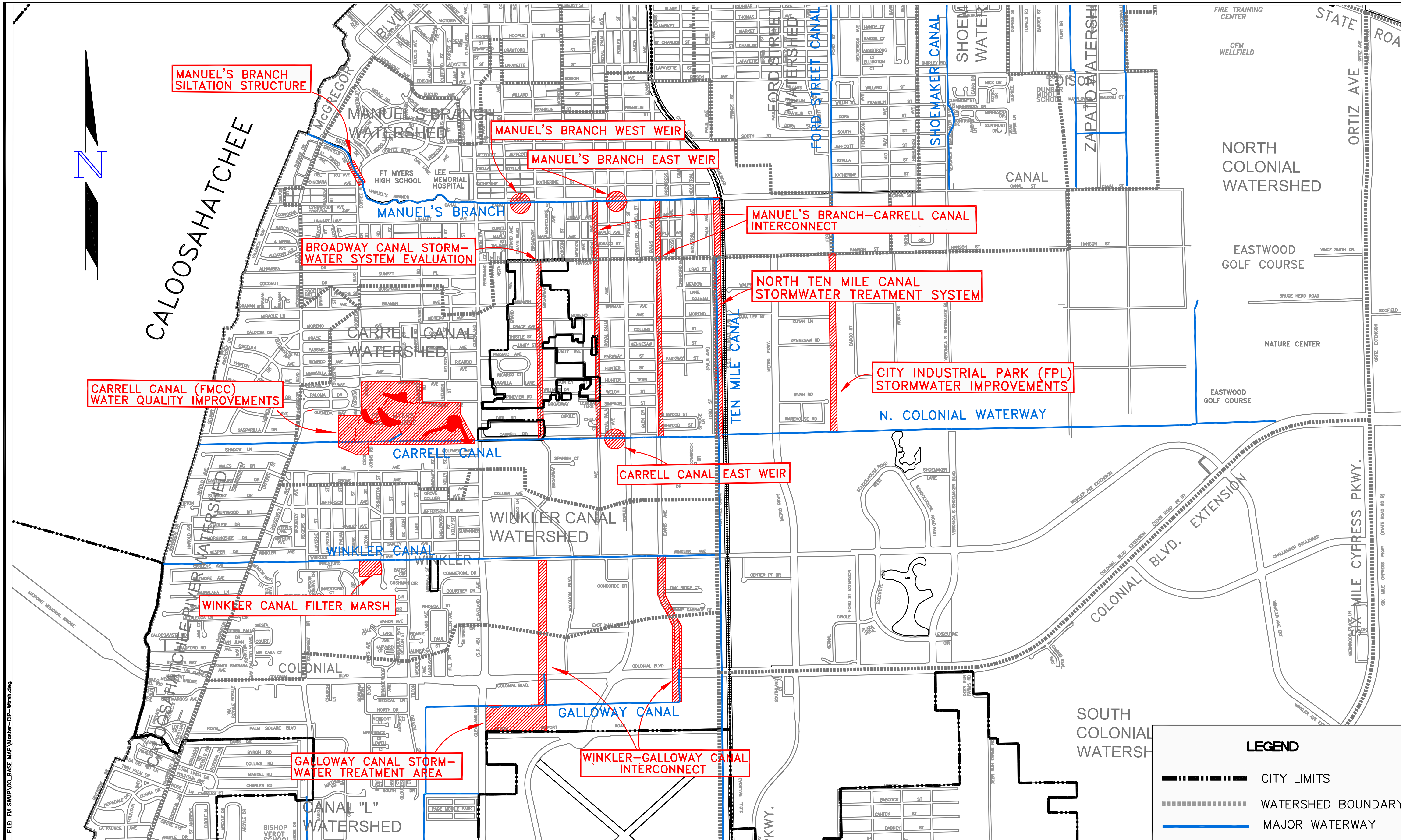
The project proposes to evaluate the extent, capacity, and viability of modifying the existing drainage canal along Broadway Avenue in order to further improve water quality and attenuate the peaking effects of past urbanization and development practices within that portion of the watershed.

This project would also work in conjunction with the proposed weir/control structure for the Carrell Canal (FMCC) Water Quality Improvements proposed within the Fort Myers Country Club.

Estimated Costs:

Administrative (City):	$5,000
Approx. Design and Permitting:	$25,000
Estimated Right of Way:	None (existing rights of way/canal)
Estimated Construction:	TBD

TOTAL ESTIMATED PROJECT COST = $30,000



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SOURCE: ECT 11-2007, F.M.

ECT
4100 Center Pointe Drive, Suite 112
Fort Myers, Florida 33916
Phone: (239) 277-0003 CA#5520

STORMWATER MASTER PLAN UPDATE

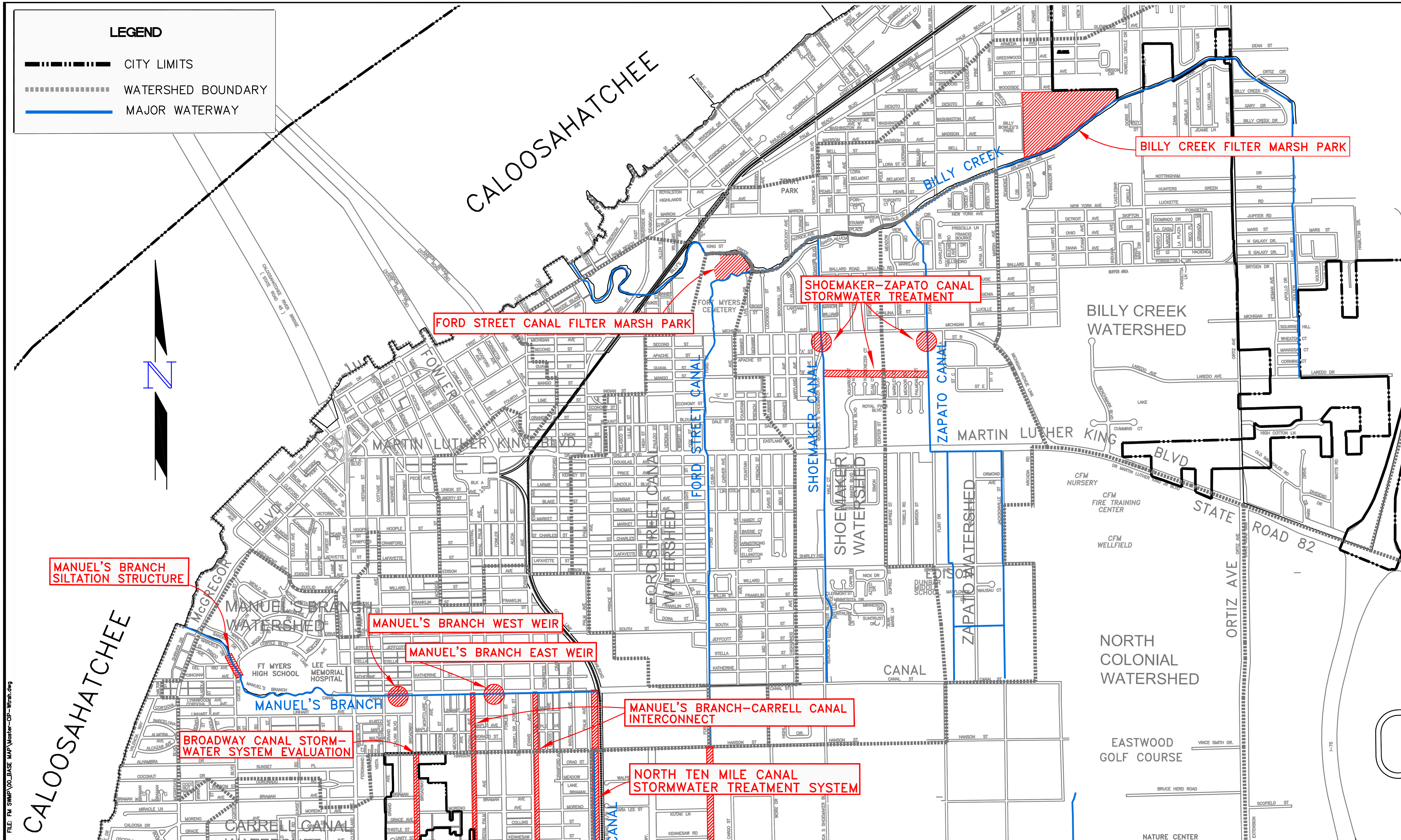
PROPOSED CAPITAL IMPROVEMENTS

CITY OF FORT MYERS, FLORIDA — City of Palms

CITY OF FORT MYERS, FL
PUBLIC WORKS DEPT.
ENGINEERING DIVISION

FIGURE 13-1A

1 of 2



ECT
4100 Center Pointe Drive, Suite 112
Fort Myers, Florida 33916
Phone: (239) 277-0003 CA#5520

STORMWATER MASTER PLAN UPDATE

PROPOSED CAPITAL IMPROVEMENTS

CITY OF FORT MYERS, FL
PUBLIC WORKS DEPT.
ENGINEERING DIVISION

FIGURE 13-1B

2 of 2

14.0 FUNDING ALTERNATIVES

14.1 FUNDING CONSIDERATIONS

Traditionally, funding for stormwater management projects has come from general revenue funds. In recent years local governments have faced fiscal limitations on traditional funding sources. Given the increased focus by Federal and State Governments, these agencies have begun to make funds available to local governments to use as cost sharing funds for implementing stormwater management projects and programs. Traditional local sources of funding, such as ad valorem taxes and bonds, are being supplemented by state and federal cost share agreements and grants.

Given the proliferation of these programs, there may be several funding alternatives for a particular project. Typically capital cost, operating costs and cost effectiveness must be carefully analyzed before choosing a funding scenario. Local governments must consider the legal and administrative workability of a particular financing mechanism and the public's willingness to be assessed for a particular project or program.

14.2 LOCAL FUNDING SOURCES – CITY OF FORT MYERS

Ad Valorem

These funds are derived from property taxes levied on the assessed value of all non-exempt real and personal property, and is a primary source of revenue for the City. These are compulsory charges levied by a government to finance services performed for the common benefit. These charges do not include specific assessments made against persons or properties for specific improvements intended to benefit a specific area. They also do not include other charges for municipal services such as solid waste, potable water, and sanitary sewer service charges.

Other Fees

User fees are charges for services rendered and are a mechanism used by local governments to recover the costs of providing certain services to only that aspect of the public that benefit from said services. Although laws vary widely, the state requires that fees be set at rates that cover only the actual costs of the services provided, including administrative services.

Storm water utility fees are imposed on property owners to pay specifically for stormwater management. The charge can be based on the amount of runoff generated from the amount of impervious area, or the assessed value of a property. This fee is becoming widely used across the state to generate dedicated funding for improvements of deficient stormwater systems and is not dissimilar to the widely used water and sewer charges.

Impact fees generate funds for the cost of infrastructure (roadways, water, sewer, stormwater treatment, etc.) improvements needed to support new developments. Unlike user fees, which recover costs over the life of a project, impact fees are usually collected in one lump sum at the beginning of a project and in theory maintain the existing level of service(s). These fees are particularly attractive to local governments because they relieve up-front financing pressures on local budgets.

Capacity credits are a form of financing in which private interests (usually developers) purchase future capacity in a public facility such as a stormwater treatment facility. Applicants are guaranteed future access to the excess capacity of that particular facility. Where project construction hinges on adequate funding, capacity credits can contribute to project completion.

Municipal Bonds

Bonds are a mechanism to borrow capital for a project and distribute the burden of repayment over the life span of the project among those who benefit from it. Just as individuals borrow to finance their homes through bank-issued mortgages, governments borrow funds from investors by issuing debt in the form of bonds. Bonds usually finance capital facilities, such as stormwater treatment facilities. Typically bonds are used only to finance projects that have both known and proven life expectancies.

Short-term Bonds are usually payable within one (1) year. Establishing short-term debt provides interim funding of projects waiting to receive long-term financing. There are two categories of short-term bonds: notes and tax-exempt commercial paper. Notes are loans issued in anticipation of grants, bonds or taxes. Tax-exempt commercial paper is a form of unsecured debt backed by a letter or line of credit.

Long-term Bonds traditionally match the term of financing with the life expectancy of the project. A storm water treatment facility, for example, might be expected to perform adequately for 30 years; therefore, the community could issue bonds that have a term of up to 30 years. There are two categories of long-term bonds. Term bonds are loans for which the entire loan amount and interest are payable on the final maturity date. Serial bonds are similar to traditional home mortgages: the principal and interest are repaid in periodic installments over the life of the bond. Long-term bonds can be issued as general obligation bonds or as revenue bonds, as described below.

General Obligation Bonds are long-term municipal bonds that are backed by the full faith and credit of the local government. This means that the state or local government pledges to use all of its taxing and other revenue-raising powers to repay bond holders.

Revenue Bonds are long-term municipal bonds guaranteed solely by the dedication of project income or system funds (e.g., user fees from the infrastructure where capital costs are covered by the bond) rather than by a general tax.

Municipal Services Benefit/Taxing Unit

These are defined geographic areas within City created by ordinance and defining a specific improvement or service. Property owners within these units pay for services that benefit their particular area. These benefits are created to maintain and improve infrastructure, such as roads, lighting, sidewalks, and drainage. The source of revenue used to pay for the services is the difference between an MSBU and an MSTU.

A Municipal Services Benefit Unit (MSBU) is a special assessment district authorized by Florida Statutes to provide for improvements and/or services to a specifically defined area and financed by a special assessment on only those properties receiving benefits of those improvements or services. Revenue for services performed in an MSBU comes from non-ad valorem (non-value) assessments.

A Municipal Services Taxing Unit (MSTU) is a taxing district authorized by the State Constitution and Florida Statutes. The MSTU is a legal and financial mechanism for providing specific services and/or improvements to a defined geographical area. An MSTU may levy ad valorem taxes to provide funds for the improvements.

Stormwater Utility

Stormwater user charges or fees are charges based on some indicator or proxy for the actual volume of stormwater runoff that leaves a property. The most common type of charge is based on the amount of impervious area on a parcel. Other bases for stormwater charges include the area and proportion of impervious cover on a parcel, the intensity of development, the type of land use or some combination thereof. In some instances, an estimate of the actual volume of runoff or some estimate of the concentration of pollutants in runoff may be used as the basis of charges.

Stormwater utility fees include costs for developing and implementing municipal management programs, including capital costs for structural controls or other BMPs. These costs may also include operation and maintenance costs, costs of land acquisition, permitting costs, costs of developer-financed improvements, and the associated administrative costs. The stormwater charges usually are administered by a stormwater utility, an administrative unit or institution established by ordinance for the purpose of managing stormwater and related issues. Revenues collected by stormwater utilities are placed in separate enterprise funds or accounts and can be used only for stormwater related expenditures.

Stormwater utilities and user fees offer a number of advantages over ad valorem funding of stormwater projects, however there are issues that should be considered. First, stormwater fees require the establishment of a procedure to levee and collect the fees, requiring legislation and administrative action by the municipality. User fees are not deductible from federal and state income taxes as are property taxes. Property tax revenues increase as property values appreciate without explicit decisions by officials to increase rates or levies. Revenues from user charges increase only if officials vote to increase rates.

Despite these limitations, reliance on stormwater user charges is increasing, partly because user charges are perceived as a more stable source of revenues. As noted above, revenues from charges are placed in enterprise funds and can be used only for stormwater related expenditures, whereas, funding from general revenue sources are never secure due to competition for scarce dollars. Under the property tax system, stormwater managers often cannot count on consistent budget allocations, do not have as much control over the final budget, and as such cannot conduct viable long range planning efforts.

Perhaps the most important reason that the number of user charge systems is increasing is that property owners believe the charges are equitable. The use of impervious area as the basis for stormwater charges can be physically and objectively measured. The concept that property owners pay in proportion to the amount of impervious surface on their property appear to be more equitable. Property values, conversely, are unrelated to the problem of runoff and perceived as highly subjective.

A final reason that charges are preferable to taxes is that they provide incentives for property owners to reduce the amount of impervious area on their property and thereby reduce volumes of runoff. Depending on how credits against charges are structured, they also can provide incentives for on-site management. Experience of local jurisdictions that have successfully established utilities demonstrates that there is not a single, correct approach. Innovative applications of basic concepts can help provide the funds necessary for such programs.

Pollutant Trading

Point and nonpoint source pollutant trading involves financing reductions in nonpoint source pollution in lieu of undertaking more expensive point source pollution reduction efforts. A trading program is intended to produce cost savings to point source dischargers while improving water quality by providing a means for discharges to provide funds for treatments systems off site and elsewhere in the watershed. Implementing a trading program requires a water body identifiable as a watershed or segment, as well as a measurable combination of point sources and controllable nonpoint sources. There must be significant load reductions for which the cost per pound reduced for nonpoint source controls is lower than the cost for upgrading point source controls. Lastly, point source dischargers must face requirements to either upgrade facility treatment capabilities or trade for nonpoint source reductions in order to meet water quality goals.

Such a program allows the private sector to allocate its resources to reduce pollutants in the most cost-effective manner, and it encourages the development of a watershed-wide or basin-wide approach to water quality protection. Such a program also entails cooperation between agencies, however, and requires a system to arrive at trading ratios between point and nonpoint source controls.

14.3 STATE FUNDING SOURCES

Section 319 Grants

The Clean Water Act allocates federal funds to states for implementing approved nonpoint source (NPS) management programs. Grant money can also be used for post implementation monitoring and groundwater assessment as part of an approved NPS pollution control program. The FDEP Nonpoint Source Management Section administers grant money it receives from EPA through Section 319(h) of the Federal Clean Water Act. These grant funds can be used to implement projects or programs that will help to reduce nonpoint sources of pollution. Projects or programs must be conducted within the state's NPS priority watersheds, which are the state's Surface Water Improvement and Management (SWIM) watersheds and National Estuary Program (NEP) waters. All projects must include at least a 40% nonfederal match.

Examples of fundable projects include: demonstration and evaluation of Best Management Practices (BMPs), nonpoint pollution reduction in priority watersheds, ground water protection from nonpoint sources, public education programs on nonpoint source management, etc. All approved projects are contracted with the Florida Department of Environmental Protection (FDEP) and managed by the staff of the Nonpoint Source Management Section. Project proposals are due each year in early July with project selection completed by September.

Other grant programs under the Clean Water Act include section 604(b) (Water Quality Management Planning), section 320 (National Estuary Program), section 104(b)(3) (Water Quality Cooperative Agreements), and section 104(g) (Small Community Outreach). Section 6217 of the Coastal Zone Act Reauthorization Amendments of 1990 (CZARA) requires states to establish Coastal Nonpoint Source Programs, which must be approved by both NOAA and EPA. Approved programs will be implemented through changes to the state nonpoint source management program approved and funded by EPA under section 319 of the Clean Water Act and through changes to the state coastal zone management program approved by NOAA under section 306 of the Coastal Zone Management Act.

Community Budget Issue Request (CBIR)

In 1987, the Florida Legislature created the Surface Water Improvement and Management program (SWIM) to address these "non-point" pollutant sources. The Watershed Management Program was created in October 1999 to implement the provisions of the Florida Watershed Restoration Act of 1999, Section 403.076, Florida Statutes. The Lower Charlotte Harbor (incl. Charlotte Harbor, Estero Bay, and Caloosahatchee River & Estuary) is listed as a priority water body by the South Florida Water Management District (SFWMD). As such, the City may participate in the Community Budget Issue Request (CBIR) process and apply for stormwater and surface water restoration project funding.

During the 2006 legislative session, the legislature substantially amended section 403.885, F.S., the statute that generally guides water project funding. The revisions, which were made in section 73 of Senate Bill 888 are now included in chapter 2006-230, Laws of Florida.

Currently in the 2007 Legislature, House Bill 7157 and Senate Bill 392 changes the "Lake Okeechobee Protection Program" to the "Northern Everglades and Estuaries

Protection Program". This bill expands the use of "Save Our Everglades Trust Fund" appropriations through Fiscal Year 2019-2020 to be used for the Lake Okeechobee Protection Plan and Caloosahatchee and St. Lucie River Watershed Protection Plans. The bill allows funds to be distributed for implementation of the River Watershed Protection Plans, including a local match requirement for Lee and Martin counties; and allows funds to be distributed to the Department of Agriculture and Consumer Services for implementation of agricultural nonpoint source controls. The bill took effect July 1, 2007.

The FDEP may reserve a minimum of $10 million annually, to the extent that funds are available, from the "Save Our Everglades Trust Fund" for the implementation of the River Watershed Protection Plans within the Northern Everglades. Distribution of funds from the "Save Our Everglades Trust Fund" for the implementation of the River Watershed Protection Plans shall be equally matched by the SFWMD and Lee and Martin Counties by fiscal year 2019-2020 by providing funding or credits toward project components. The dollar value of in-kind project design and construction work by the SFWMD and the counties are credits towards the SFWMD's and counties' contributions.

TMDL Water Quality Restoration Grants

The Florida Department of Environmental Protection (FDEP) receives documentary stamp funding for the implementation of projects to reduce urban nonpoint source pollution discharged to impaired waters. These funds are restricted to projects that reduce pollutant loadings to water bodies on the state's verified list of impaired waters or to water bodies with an EPA/FDEP proposed or adopted Total Maximum Daily Loads (TMDL). These funds primarily are used for stormwater retrofitting projects undertaken by local governments. Typically, FDEP will provide up to $1,000,000 in grant funding for these water quality improvement projects. All projects will require a minimum of 50% matching funds. The TMDL Water Quality Restoration Grant funds primarily are for projects that are ready for construction within the next six to ten months. Land acquisition, design, and permitting should be complete or nearing completion. While the department will not fund these preliminary project elements, the cost of these elements are eligible as matching funds. Most projects will require storm event monitoring to document the project's effectiveness in removing pollutants and all data will be entered into the Florida BMP Data Base. Projects will be selected for funding based on the following: (1) project will reduce loadings of pollutants of concern discharged to impaired waters (those on the basin specific verified list of impaired waters); (2) anticipated load reduction of the pollutants of concern; (3) cost effectiveness of the project in terms of cost per pound of pollutant removed; (4) amount of matching funds; (5) establishment by the local government of a dedicated funding source for stormwater management, such as a storm water utility.

State Revolving Fund Loan Program

Established by the Clean Water Act Amendments of 1987, the State Revolving Fund (SRF) Water Pollution Control Program provides low-interest loans for planning, designing, and constructing water pollution control facilities. It is a "revolving" fund because loan repayments are used to make additional loans. By federal law, the SRF is to be operated in perpetuity. The Florida Department of Environmental Protection (FDEP) solicits project information each year. The information is used to establish project priorities for the following annual cycle. Funds are made available for Preconstruction Loans and Construction Loans. The Loan Terms include a 20-year amortization and low-interest rates. Preconstruction loans are available to all communities and provide up-front disbursements for administrative services, project planning, project design, and the implementation of approved state nonpoint source management programs and groundwater protection strategies under section 319 of the Clean Water Act, and the development and implementation of estuary conservation and management plans under section 320 of the Clean Water Act.

14.4 FEDERAL FUNDING SOURCES

Environmental Protection Agency (EPA)

The Five Star Restoration Program brings together students, conservation corps, other youth organizations, citizen groups, corporations, landowners and government agencies to provide environmental education through projects that restore stream banks and wetlands. The program provides challenge grants, technical support, and opportunities for information exchange to enable community-based restoration projects.

The program develops knowledge and skills in young people through restoration projects that involve multiple and diverse partners, including local government agencies, elected officials, community groups, businesses, schools, youth organizations, and environmental organizations. Its objective is to engage five or more partners in each project to contribute funding, land, technical assistance, workforce support or other in-kind services that match the program's funding assistance. Consideration for funding is based upon the project's educational and training opportunities for students and at-risk youth, the ecological benefits to be derived, and the project's social and economic benefits to the community.
EPA's funding levels are modest, averaging about $10,000 per project. However, when combined with the contributions of partners, projects that make a meaningful contribution to communities become possible. This is a particularly good opportunity for groups that seek to leverage their investments.

Federal Emergency Management Agency (DHS/FEMA)

The Federal Emergency Management Agency's Hazard Mitigation Grant Program (HMGP) aims to provide States and communities with resources to invest in long-term actions that help to reduce the toll from potential natural and manmade hazards. The program also supports the implementation of mitigation measures during the immediate recovery from a disaster. The HMGP funds projects to protect either public or private property, as long as the project fits within the State's and local government's overall mitigation strategy and complies with program guidelines. In response to flood hazards, eligible projects include the elevation, relocation or acquisition and demolition of flood-prone structures, stormwater management projects, and certain types of minor flood control projects. The State is responsible for setting priorities for funding and administering the HMGP. Eligible applicants must apply for the program through the State.

United States Department of Agriculture (USDA/NRCS)

The USDA Natural Resources Conservation Service's Emergency Watershed Protection (EWP) program helps protect lives and property threatened by natural disasters such as floods, hurricanes, tornadoes, droughts, and wildfires. EWP provides funding for such work as clearing debris from clogged waterways, restoring vegetation, and stabilizing river banks. The measures that are taken must be environmentally and economically sound and generally benefit more than one property owner. EWP also provides funds to purchase floodplain easements as an emergency measure. EWP can provide up to 90 percent cost share in limited resource areas as determined by the US Census.

Charlotte Harbor National Estuary Program (CHNEP)

The Charlotte Harbor National Estuary Program (CHNEP) awards three types of grants. Micro-grant applications are accepted throughout the year but Public Outreach Grants and Research and Restoration Partner Grants are only available once a year. Florida residents, organizations, businesses, government agencies, schools, colleges and universities may apply for grants to support projects that occur within the Program study area. The Program has awarded outreach, research, and restoration projects throughout the greater Charlotte Harbor watershed since 1996.

Research and Restoration Partners Grants: The research and restoration projects, which are most often funded as research and restoration partner projects, directly benefit the natural resources in the watershed, increase technical knowledge and often include an educational aspect. Research and restoration grants provide up to $20,000 per participating partner and require a 50% match.

Public Outreach Grant Guidance: Outreach projects, which are most often funded as public outreach projects, help multiply the number of people who are aware of the importance of estuaries and the protection of watersheds. Public Outreach Grants provide up to $3,000 with no match requirements.

15.0 NPDES
(NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM)

15.1 NPDES OVERVIEW

The U.S. Environmental Protection Agency (EPA) developed the federal National Pollutant Discharge Elimination System (NPDES) stormwater permitting program pursuant to the Clean Water Act. In October 2000, the EPA authorized the Florida Department of Environmental Protection (FDEP) to implement the NPDES stormwater permitting program in the State of Florida. FDEP's authority to administer the NPDES program is set forth in Section 403.0885, Florida Statutes (FS). The NPDES stormwater program regulates point source discharges of stormwater into surface waters of the State of Florida from certain municipal, industrial and construction activities. As the NPDES stormwater permitting authority, FDEP is responsible for promulgating rules and issuing permits, managing and reviewing permit applications, and performing compliance and enforcement activities. Importantly, the NPDES stormwater permitting program is separate from the State's storm water/environmental resource permitting programs (found under Part IV, Chapter 373, FS) and Chapter 62-25, FAC and any local stormwater programs, which may have their own regulations, permitting, and processing requirements.

The categorized sources of stormwater discharges regulated under the NPDES program fall into three separate categories: (1) municipal separate storm sewer system (MS4), (2) industrial activities, and (3) construction activities.

A municipal separate storm sewer system (MS4) is a publicly owned system of conveyances (i.e., ditches, culverts, catch basins, underground piping, detention facilities, etc.) that are designed or used for collecting or conveying storm water, and that discharge to surface waters of the State. An MS4 can be operated by a municipality, county, special drainage district (Chapter 298), or a community development district (CDD). Regulated MS4 operators must obtain an NPDES stormwater permit and implement a comprehensive stormwater management program to reduce the contamination of stormwater runoff and prohibit illicit discharges to the MS4.

The purpose of the permit is to develop, implement, and enforce a Storm Water Management Program (SWMP) to reduce the discharge of pollutants to the maximum extent practicable (MEP), protect water quality, and satisfy water quality requirements of the Clean Water Act. The requirements can be met by implementing Best Management Practices (BMPs) to meet the Minimum Control Measures prescribed by the EPA.

Additionally, annual reports must be submitted to the Department that include: (1) Status of compliance with permit conditions, an assessment of the appropriateness of identified best management practices and progress towards achieving identified measurable goals for each of the required elements of the six minimum control measures; (2) Summaries or results of information collected and analyzed. If independent monitoring is performed, provide monitoring data collected during the reporting period; (3) A summary of the stormwater activities the permittee plans to undertake during the next reporting cycle (1 year); (4) A change in any identified BMPs, measurable goals or schedules for implementation for any of the required elements of the six minimum control measures; and, (5) Notice that the permittee is relying on another governmental entity to satisfy any part of its permit obligations (if applicable).

15.2 NPDES PERMIT REPORTING STATUS

Regulatory Permit Inventory and Database

As part of the Stormwater Master Plan Update, a regulatory permit geodatabase in an ArcGIS 9.2 format was developed. The City intends to use this GIS geodatabase to help develop, implement, and manage the ongoing stormwater facility maintenance program to the desired LOS, or as may be required by SFWMD permits, and to meet the current and future requirements of the NPDES permit.

Field Collection of Water Quality Data

As part of its existing NPDES permit, the City of Fort Myers is responsible for the collection of surface water samples at twelve (12) defined stations within the City. The Lee County Environmental Laboratory (LCEL) currently collects flow and grab samples at each of these locations under contract with the City of Fort Myers. The analytical data is provided to the City where it is compiled and provided to the FDEP each year as part of its annual NPDES Report.

Public Outreach and Education Recommendations

Continue to provide and promote public outreach and educational programs targeted at issues of stormwater pollution prevention. In furtherance of this matter, the City should consider apply for cooperative grants from the CHNEP.

Operations and Maintenance Recommendations

It is recommended that the City implement a tracking system for the stormwater Operations and Maintenance (O&M) program structured to provide inspections of all facilities according to a fixed schedule and to provide maintenance on an "as-needed" basis. An annual pre-wet season inspection program would function as a routine "as-needed" maintenance program, but would cost significantly less than a simple regularly scheduled maintenance program.

15.3 TMDL CONSIDERATIONS

Overview

Total Maximum Daily Loads (TMDLs) are quantitative analyses of water bodies where one or more water quality standards are not being met, and are aimed at identifying the management strategies necessary to attain those water quality standards. In essence, TMDLs describe the amount of each pollutant a water body can assimilate without violating state standards, and are characterized as the sum of the waste load allocations, load allocations, and a margin of safety to account for uncertainties. Waste load allocations are pollutant loads attributable to existing and future point sources, such as discharges from industry and sewage facilities. Load allocations are pollutant loads attributable to existing and future nonpoint sources and natural background sources. Nonpoint sources include runoff from farms, forests, urban areas, and natural sources such as decaying organic matter and nutrients in soil.

TMDLs take into account the water quality of an entire water body or watershed and assess all the pollutant loadings into that watershed, rather than simply considering whether each individual discharge meets its permit requirements. The management strategies that emerge from the TMDL process may encompass everything from traditional regulatory measures, best management practices and other pollution prevention measures, land acquisition, infrastructure funding, pollutant trading, and the like. They will also include an overall monitoring plan to test the effectiveness of the preventative or remedial measures.

For the past twenty-five years, point source discharges have been regulated under the Clean Water Act (CWA). Over time, it has become clear in many instances that every individual discharge into a water body may meet effluent discharge requirements and yet that water body may still fail to meet the standards defining good water quality. This circumstance has proved true even as the limits on point source discharges have become more and more stringent, especially in Florida. There clearly are other sources of pollution for which existing control measures are simply not adequate. These sources are associated with diffuse runoff and habitat destruction, and originate in both urban and rural areas.

The EPA requires states to set priorities for cleaning up impaired waters by establishing a TMDL for each one. Under the authority of section 303(d) of the CWA, EPA requires that TMDLs be developed where technology-based effluent limitations or other legally required pollution control mechanisms are not stringent enough to protect water quality. The development of Total Maximum Daily Loads (TMDLs) is found in the context of chapter 99-223, Laws of Florida, which details the process for listing impaired waters, determining which waters will be subjected to TMDL calculations, adopting by rule those calculations and associated allocations of pollutant loadings, implementing the management strategies designed to reduce the loadings and enable the water body to meet water quality standards.

As noted, TMDLs are established for waters that fail to meet water quality standards, and characterize how much of each pollutant the water body can assimilate without violating those standards. The FDEP considers future growth and development to the extent possible in establishing a TMDL, and accounts for the pollutant inputs from all sources, including discharges from industrial plants and sewage treatment facilities, runoff from farms, forests and urban areas, and natural sources. Using a TMDL approach for water bodies does not replace existing water quality control programs or standard treatment technologies. It provides a framework for evaluating all possible water quality control efforts and promotes closer coordination of local, state, and federal efforts to better guarantee that we collectively meet water quality goals.

Under section 303(d) of the Clean Water Act, every two years each state must identify water bodies that do not meet water quality standards. These water bodies are "water quality-limited" estuaries, lakes, and streams that fall short of surface water quality standards and that are not expected to improve within the subsequent two years. Florida's water quality standards are designed to ensure that our waters can be used for their designated purposes, such as swimming, drinking, industrial and agricultural uses, and wildlife habitat. Florida's 303(d) list identifies hundreds of "impaired" water segments, with the four most common water quality concerns being coliforms, nutrients, oxygen demanding substances, and turbidity. These water segments are candidates for more detailed assessments of water quality and, where necessary, the development and implementation of TMDLs.

The 303(d) list is developed based on the Florida Water Quality Assessment [305(b) report]. Section 305(b) of the CWA requires states to report biennially to the EPA on their water quality. The 305(b) report describes the existing programs to protect the quality of Florida's surface waters, ground water, and wetlands. In the 305(b) report, water quality is evaluated using biological data, chemistry data from the federal water quality database (STORET), violations of Florida's water quality standards, mercury fish consumption advisories, qualitative nonpoint source assessments, and other information solicited through public workshops. The information in the report is reviewed and water bodies are placed on the 303(d) list of impaired waters based on specific criteria designed to identify the highest priority water bodies in need of restoration based on the best available data.

Surface Water Quality Classifications

The Clean Water Act requires that the surface waters of each state be classified according to designated uses. Florida has five (5) classes with associated designated uses, which are arranged in order of degree of protection required. For a more detailed description of classes and specific waterbody designations, see 62-302.400 F.A.C.

Class I - Potable Water Supplies

Fourteen general areas throughout the state including: impoundments and associated tributaries, certain lakes, rivers, or portions of rivers, used as a drinking water supply.

Class II - Shellfish Propagation or Harvesting

Generally coastal waters where shellfish harvesting occurs.

Class III - Recreation, Propagation and Maintenance of a Healthy, Well-Balanced Population of Fish and Wildlife

The surface waters of the state are Class III unless described in rule 62-302.400 F.A.C.

Class IV - Agricultural Water Supplies

Generally located in agriculture areas around Lake Okeechobee.

Class V - Navigation, Utility and Industrial Use

Currently, there are not any designated Class V bodies of water.

Criteria for Surface Water Quality Classifications

To protect present and future most beneficial uses of the waters, water quality criteria have been established for each classification. While some criteria are intended to protect aquatic life, others are designed to protect human health. The criteria are located in rules 62-302.500 and 62-302.530 F.A.C. Water quality standards also include narrative criteria for pollutants and other conditions not specifically listed.

Anti-degradation Policy

The anti-degradation policy (found in 62-302.300 and 62-4.242 F.A.C.) allows for protection of water quality above the minimum required for a classification.

15.4 2007 LEGISLATIVE AMENDMENTS

Currently in the Legislature, House Bill 7157 and Senate Bill 392 changes the “Lake Okeechobee Protection Program” to the “Northern Everglades and Estuaries Protection Program”. FDEP is directed to expedite development and adoption of TMDLs for the Caloosahatchee River and estuary. No later than December 31, 2008, DEP must propose for final agency action TMDL limit for nutrients in the tidal portions of the Caloosahatchee River and estuary. The bill took effect July 1, 2007.

The bill provides for the development of a phased implementation plan to address the reduction of pollutant loadings, restoration of natural hydrology, and compliance with applicable state water quality standards within the Caloosahatchee and St. Lucie River watersheds. The plan must also include a goal for salinity envelopes and freshwater inflow targets for the estuaries based upon existing research and documentation.

No later than January 1, 2009, the SFWMD, in cooperation with the other coordinating agencies, Lee County, and affected counties and municipalities, shall complete a River Watershed Protection Plan. The plan will identify the geographic extent of the watershed and contain an implementation schedule for pollutant load reductions that is consistent with any adopted total maximum daily loads and is compliant with any state water quality standards. Specifically the plan:

(1) Creates the Caloosahatchee River Watershed Construction Project to improve the hydrology, water quality, and aquatic habitats within the watershed. An initial phase must be designed and constructed by the SFWMD no later than January 1, 2012. The District shall:

- Develop and designate facilities to achieve stated goals and objectives
- Conduct scientific studies
- Identify the size and location of all facilities
- Provide a construction schedule for all such facilities
- Provide a schedule for the acquisition of lands to achieve the construction schedule
- Provide a schedule of costs and benefits associated with each construction project and identify funding sources
- To ensure timely implementation, coordinate with coordinating agencies, Lee County, and other affected counties and municipalities.

(2) Creates the Caloosahatchee River Watershed Pollutant Control Program to reduce pollutant loads by improving the management of pollutant sources within the Caloosahatchee River watershed through implementation of regulations and BMPs,

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development and implementation of improved BMPs, improvement and restoration of the hydrologic function of natural and managed systems, and utilization of alternative technologies such as cost-effective biologically based, hybrid wetland/chemical and other innovative nutrient control technologies. Coordinating agencies must utilize federal programs that offer opportunities for water treatment. The program includes:

- Nonpoint source BMPs must be implemented on an expedited basis.
- Neither DEP nor the SFWMD are precluded from complying with water quality standards, adopted total maximum daily loads, or current BMP requirements set forth in any regulatory program authorized by law for the purpose of protecting water quality.
- Projects using private lands or lands held in trust for Indian tribes that restore the natural hydrology of the basin, restore wildlife habitat or impacted wetlands, reduce peak flows after storm events, or increase aquifer recharge, are eligible for grants.
- An assessment of current water management practices within the watershed is required as are recommendations for structural, nonstructural, and operational improvements.
- After December 31, 2007, DEP may not authorize the disposal of domestic wastewater residuals within the watershed unless the applicant can affirmatively demonstrate that the nutrients in the residuals will not add to nutrient loadings in the watershed. This prohibition does not apply to Class AA residuals that are marketed and distributed as fertilizer products in accordance with department rule.
- All entities disposing of septage within the watershed are to develop and submit to the Department of Health, an agricultural use plan that limits applications based upon nutrient loading. By July 1, 2008, nutrient concentrations may not exceed the limits established in the SFWMD’s Works of the District program.
- DACS must initiate rulemaking requiring entities within the Caloosahatchee River watershed which land apply animal manure to develop a resource management system level conservation plan, according to United States Department of Agriculture criteria, that limits such application.

(3) Creates the Caloosahatchee River Watershed Research and Water Quality Monitoring Program to evaluate the program and conduct an assessment of the water volumes and timing from the Lake Okeechobee and Caloosahatchee River watersheds and their relative contributions to the timing and volume of water delivered to the watershed.

Implementation schedules and priorities are to be established for the achievement of TMDLs, the requirements of 403.067, F.S., and compliance with water quality standards within the waters and watersheds. Annual funding priorities shall be established and the highest priority shall be assigned to programs and projects that have the greatest potential for achieving the goals and objectives of the plans. By March 1, 2012, and every three years thereafter, the SFWMD shall conduct an evaluation of any pollutant load reduction goals. Moreover, the SFWMD shall identify modifications to facilities of the watershed projects and the evaluation shall be included in the annual progress report.

In view of the above, ECT recommends that the City designate a staff person (or representative) as a single point of contact for tracking and coordinating these programs in furtherance of the City's interests.

16.0 SUMMARY of RECOMMENDATIONS

Below is a listing of selected areas of discussion as a summary of the most pertinent recommendations from the representative section(s) of the report.

16.1 WATERSHED MONITORING

As was stated in sections 5 and 7, the gaging and monitoring of the watershed parameters for rainfall, stream flow, and water quality data are of paramount importance. These data support the computations of annual runoff volumes for NPDES reporting and any subsequent remedial actions, as well as the calibration of the numerical models used for such evaluations.

Water Quality Monitoring Stations: Relocations and Modifications

Relocate or modify the location of the following from their current location as described in table 7-2 of the report: Billy Creek - (BILLGR60) upstream of the Billy Creek Filter Marsh Weir; Billy Creek - (CFMBILLY4) upstream of the Marsh Avenue; Billy Creek - (BILLGR20) upstream of the Michigan Avenue (Shoemaker Canal); Manuel's Branch - (CFMMANUEL) upstream of Cortez Weir; Winkler Canal - (CFMWINKLER) upstream of Rogers Weir; North Colonial - (CFMCOLONIAL) upstream of Seaboard Weir; and Downtown - (CFMBROADWAY) modify inlet w/ low level weir at 2.0

Stage Recorder: Equipment and Locations

Install nine (9) continuous stage recorders at the following locations: Billy Creek @ Billy Creek Filter Marsh Weir; Ford Street Canal @ Cemetery control structure; Shoemaker Canal @ Michigan Avenue; Zapato Canal @ Zapato Weir; Manuel's Branch @ Cortez Weir; Carrell Canal @ FMCC Weir; Winkler Canal @ Rogers Weir; Galloway Canal @ Galloway Weir; and North Colonial Waterway @ Seaboard Weir.

Rain Gage: Equipment and Locations

Install four (4) continuous tipping bucket rainfall gages at each of the existing locations.

16.2 RECOMMENDED CAPITAL IMPROVEMENTS

Projects and Schedule

Construct the capital improvement projects as outlined in section 13. The proposed schedule may be adjusted according to budget and other funding availabilities or constraints. As outlined, these projects have a total estimated budget of $3,750,000 which has an average annual expenditure of $750,000 for five (5) years.

As of the date of this report, a number of the recommended projects are in various stages of implementation as outlined below. As cooperative funding was being made available, City staff acted expeditiously to secure or apply for the available funding.

<u>Pending Construction:</u>

Billy Creek Filter Marsh Park (50% Cost Sharing with the SFWMD)

Manuel's Branch East and West Weirs (100% Funded by the SFWMD)

<u>Under Design:</u>

Manuel's Branch Siltation Structure (Design - 100% Funded by the SFWMD)

Ford Street Canal Filter Marsh Park (Design - 100% Funded by the SFWMD)

North Ten Mile Canal Stormwater Treatment System

<u>Pending Funding:</u>

Carrell Canal (FMCC) Water Quality Improvements (CBIR and SFWMD)

Ford Street Canal Filter Marsh Park (CBIR and SFWMD)

North Ten Mile Canal Stormwater Treatment System (CBIR and SFWMD)

16.3 FUNDING MECHANISMS

ECT recommends that the City designate a staff person (or representative) as a single point of contact for tracking and coordinating funding programs in furtherance of the City's interests.

Cooperative Cost Sharing

Prepare and submit applications for cooperative funding through the Community Budget Issue Request (CBIR), the Florida Department of Environmental Protection (FDEP) Section 319 grant program, and the South Florida Water Management District (SFWMD) for the recommended capital improvement projects.

Stormwater Utility

Implement a Stormwater Utility for the construction and maintenance of the proposed capital improvement projects. It is essential in the scoring of grant applications, such as the FDEP 319 program, that a community demonstrates a perpetual dedicated funding source for the implementation, operation, and maintenance for such facilities.

16.4 NPDES ANNUAL REPORTING

Annual Reporting

Implement a GIS software program as it relates to the public works functions for facilities documentation, work order tracking, and related reporting items required by the permit.

Operations and Maintenance

It is recommended that the City implement a tracking system for the stormwater Operations and Maintenance (O&M) program structured to provide inspections of all facilities according to a defined schedule and to provide maintenance on an "as-needed" basis. An annual pre-wet season inspection program would function as a routine "as-needed" maintenance program, but would cost significantly less than a simple regularly scheduled maintenance program. Such considerations as limiting the degree of mowing along canals and channels to a minimum 4" to 6" stand of vegetation would limit the amount bank erosion. Similarly, planting of low maintenance ground cover along canal banks could significantly reduce the maintenance cost thereof. Further it is recommended that regular removal of sediments for existing and proposed sediment traps be based upon the depth of accumulation, and not by a calendar schedule. Routine inspection of culverts would likely reduce the extent of nuisance flooding in the areas defined in section 11.

Outreach and Education

Continue the public outreach and education programs through current City activities, as well as applying for available grant funding from the Charlotte Harbor Nation Estuary Program (CHNEP) for these and related activities.

Code of Ordinances

The City should review its stormwater management ordinance to include provisions allowing for the funding of the Storm Water Utility, as well as mandating compliance with existing and pending TMDL requirements.