Appendix B

Roster of PDT Members

Florida Keys Water Quality Improvements Project Delivery Team (PDT) Members					
Name	**Title**	**Entity**	**Phone/ Fax**	**Email**	**Address**
Jim Roberts	County Administrator	Monroe County	305-292-4441 305-292-4544	roberts-jim@monroecounty-FL.gov	2798 Overseas Hwy., Marathon, FL 33050
David Fernandez	Utilities Director	Key West	305-293-6414 305-293-6415	dfernand@keywestcity.com	5701 W. College Rd., Key West, FL 33040
John Chromoti	Councilman	Layton			P.O. Box 778, Layton, FL 33001
John Bartus	Councilman	Marathon	305-743-0033 305-743-3667	jebartus@bellsouth.net	P.O. Box 500938. Marathon, FL 33050
Michael Tavano	Utilities Director	Islamorada	305-664-2345 305-664-2399	mike.tavano@islamorada.fl.us	81011 Overseas Hwy., Islamorada, FL 33036
Clyde Burnett	Mayor	Key Colony Beach	305-743-3571 305-289-1767	mayor@keycolonybeach.net	P.O. Box 510299 KCB, FL 33051
Rebecca Jetton	Planning Manager	Fl Dept.of Community Affairs	304-289-2402 305-289-2442	jetton@mail.state.fl.us	2796 Overseas Hwy., Ste. 212, Marathon, FL 33050
Jim Reynolds	Executive Director	Fl Keys Aqueduct Authority	305-296-2454 305-294-5683	jreynolds@fkaa.com	1100 Kennedy Drive, Key West, FL 33040
Cecelia Weaver	Keys Service Center Manager	SFWMD	305-853-3219 305-853-3221	cweaver@sfwmd.gov	10 High Point Rd., Ste. B, Plantation Key, FL 33070
Shelley Trulock	Project Manager	US ACOE	904-232-3292 904-899-5001	shelley.f.trulock@usace.army.mil	400 W. Bay St., Jacksonville, FL 32202
Bill Kruczynski	Program Scientist	US EPA	305-743-0537 305-743-3304	kruczynski.bill@epa.mail.epa.gov	P.O. Box 500368, Marathon, FL 33050
Gus Rios	Environmental Administrator	FDEP - South District	205-289-2310 305-289-2314	gus.rios@dep.state.fl.us	FDEP, Suite 221, 2796 Overseas Hwy., Marathon, FL 33050
Charles Brooks	Key Largo Wastewater Treatment District	Member of the Board	305-451-5271 305-451-6399	cbrooks442@aol.com	35 Pigeon Drive, Key Largo, Fl 33037

Appendix C

Plan Formulation Memorandum

PLAN FORMULATION MEMORANDUM

FLORIDA KEYS WATER QUALITY IMPROVEMENTS PROGRAM

Prepared by EPJV
January 22, 2003

1.0 INTRODUCTION

The Florida Keys (Keys) are a chain of islands extending from the southern tip of the Florida mainland southwest to the Dry Tortugas in portions of both Dade and Monroe counties. Among the many conservation areas designated as part of the Keys are Biscayne National Park, Everglades National Park, and the xxx Wildlife Refuge, all of which are encompassed by the larger Florida Keys National Marine Sanctuary (Sanctuary) (Figure 1). The Sanctuary includes 2,800 square nautical miles of nearshore waters that are part of a complex ecosystem that also includes seagrass meadows, mangrove islands, and the only living coral barrier reef in North America. Consequently, water quality is critical to maintaining the marine ecosystem of the Sanctuary.

Importantly, as population and tourism in the Keys have increased over the years, improvements in wastewater treatment and management practices have not kept pace with this growth. Ongoing research has suggested that this trend has resulted in a significant degradation of water quality in canals and nearshore waters surrounding the Keys and that nutrients commonly found in wastewater are one of the major contributors to the decline of water quality.

For these reasons, the U.S. Army Corp of Engineers (Corps) proposes to assist local municipalities in Monroe County with the development and implementation of wastewater and stormwater improvements as part of the Florida Keys Water Quality Improvements Program (FKWQIP or Program). The Program is designed to:

- reduce nutrient loading to the Florida Keys National Marine Sanctuary,
- subsequently improve water quality in the Sanctuary, and
- meet relevant Federal and State regulatory standards.

The implementation of several wastewater and stormwater treatment master plans prepared for municipalities in Monroe County is integral to the success of the Program. The purpose of this Plan Formulation Memorandum (Memorandum) is to document the analysis and subsequent recommendations that resulted in the development of these master plans that the Corps will use as the foundation for implementing the Program. The following sections provide information relevant to the Program and the master plans that will be used in its implementation.

1.1 Florida Keys Water Quality Improvement Program

The FKWQIP provides a means of improving the water quality of the Sanctuary. A description of the Program is presented here to provide the context in which the Plan Formulation Memorandum has been developed. The Memorandum is presented in subsequent sections.

1.1.1 Program Location

This program targets the portion of the Keys connected by U.S. Highway 1, a 110-mile stretch of roadway extending from Key Largo to Key West, and the remaining developed portion of the Keys. The entire study area is within the Sanctuary (Figure 1).

1.1.2 Program Purpose

Numerous scientific studies have documented the contribution of failing septic tanks and cesspools to the deterioration of canal and nearshore water quality in the Keys (Lapointe *et al*. 1990 and Kruczynski *et al.* 1999). In addition, research has suggested that increased nutrient loadings from wastewater and deterioration of canal and nearshore water quality are major contributors to the decline of water quality in the Sanctuary. Therefore, the primary purpose of the FKWQIP is to improve the water quality in the Sanctuary by the development and implementation of improved wastewater and stormwater treatment in the Keys.

At the Federal level, the Florida Keys National Marine Sanctuary and Protection Act of 1990 directed the U.S. Environmental Protection Agency (EPA) and the State of Florida to develop a water quality protection plan for the Sanctuary. Locally, the Monroe County 2010 comprehensive plan mandates that nutrient loadings be reduced in the marine ecosystem by the year 2010 and that wastewater systems meet more stringent Florida Statutory Treatment Standards. In light of regulatory requirements and in the interest of protecting public health and water quality, the FKWQIP was created.

The FKWQIP will be accomplished through the implementation of several wastewater and stormwater master plans prepared for Monroe County and other local municipalities in Monroe County. These plans are designed to provide cost-effective, environmentally sound, and feasible programs for managing pollutants that are now, or have the potential to, adversely impact the water quality of the Keys and the Sanctuary. The FKWQIP is intended to provide the technical and financial assistance for planning, engineering, and construction of wastewater and stormwater treatment improvement projects.

1.1.3 Program Authorization and Background

Under authority of Public Law 106-554, Departments of Labor, Health and Human Services and Education, and Related Agencies Appropriations Act of 2001, Section 109 and Conference Report H.R. 4577, the Corps is authorized to provide technical and financial assistance to carry out projects for the planning, design and construction of treatment works to improve the water quality of the Sanctuary. It should be noted that programs of this nature (i.e., wastewater treatment and stormwater management construction programs) are not in accordance with Administration Program priorities of the Corps of Engineers; however, the Corps routinely undertakes similar non-traditional Corps projects.

1.1.4 Water Quality Protection Program: *Hot Spots* and *Cold Spots*

In July 1992, the U.S. Environmental Protection Agency (USEPA) Oceans and Coastal Protection Divisions produced a report entitled *Water Quality Protection Program for the Florida Keys National Marine Sanctuary; Phase 1 Report*. The report was based on workshops and discussions and provided a list of 84 water quality *hot spots* with known or suspected water quality degradation. According to a meeting summary dated March 19, 1996, the list of 84 was

later expanded to include 88 *hot spots* based primarily water quality issues associated with wastewater influences. In July of 1999, a Monroe County document entitled *Water Quality 'Hotspots' in the Florida Keys: Evaluations for Stormwater Contributions* was released. The report assessed previously identified stormwater concerns, documented the results of field visits, and defined the areas most likely to have stormwater-associated problems. Stormwater systems in Monroe County are regulated through Monroe County Code Section 9.5-293.

In contrast with *hot spots*, *cold spots* were defined as areas where on-site systems will continue to operate. *Cold spots* fall into two categories:

- Properties with unknown systems that must replace or upgrade their systems immediately with an on-site wastewater nutrient reducing system (OWNRS). All these systems must be replaced or upgraded by July 12, 2003.
- Properties that currently have permits for their on-site systems and will not be required to upgrade or replace them until 2010, when all on-site systems must be upgraded or replaced with nutrient reduction OWNRS to meet the regulatory effluent limits described below.

1.1.5 Applicable Regulatory Requirements

As a result of concerns regarding water quality in the Keys, the *Monroe County Year 2010 Comprehensive Plan* (1997) mandated nutrient loading levels be reduced in the Keys marine ecosystem by the year 2010. In 1998, the Florida Governor issued Executive Order 98-309 which directed local and State agencies to coordinate with Monroe County to implement the *Year 2010 Comprehensive Plan* and eliminate cesspits, failing septic systems, and other substandard on-site sewage systems.

In 1999 the Florida Legislature set statutory effluent standards and associated compliance schedules for wastewater treatment system in Monroe County. These standards address treatment for several water quality constituents and require best available technology (BAT) standards for flows less than 100,000 gallons per day and advanced wastewater treatment (AWT) standards for design flows greater than 100,000 gallons per day. Adopted water quality standards are listed below.

Water Quality Standards

Constituent	BAT (mg/L)	AWT (mg/L)
Biological Oxygen Demand (BOD5)	10	5
Total Suspended Solids (TSS)	10	5
Total Nitrogen (TN)	10	3
Total Phosphorus (TP)	1	1

Statutory compliance schedules for wastewater treatment systems in the county are listed below.

- All unknown (or unpermitted) on-site systems in *cold spots* and new installations shall be replaced or upgraded with an OWNRS by July 12, 2003.
- All existing on-site systems shall cease discharging or shall be upgraded to an OWNRS by July 1, 2010.
- All existing on-site wastewater treatment plants must be upgraded to either BAT or AWT effluent standards by July 1, 2010.

In 1998, additional legislation addressed wastewater concerns in the Keys by amending the enabling legislation of the Florida Keys Aqueduct Authority (FKAA), the principal potable water supplier for the Keys. Legislation was passed (F.L. 76-441) to strengthen FKAA involvement in wastewater management for Monroe County. A Memorandum of Understanding (MOU) between Monroe County and the FKAA was signed to "request that the FKAA exercise its authority to purchase, finance, construct, and otherwise acquire and to improve, extend, enlarge, and reconstruct a wastewater collection, transmission, treatment, and disposal system or systems in the Florida Keys." A chronological summary of these and other events relevant to wastewater management in the Keys is presented in Table 1-1.

Table 1-1. Recent Chronology of Regulatory Milestones of Wastewater Management in the Florida Keys

1993	• Initial adoption of Monroe County Year 2010 Comprehensive Plan.
1997	• Monroe County Comprehensive Plan Amended to comply with Florida Statutes. • Administration Commission adopts amendments to Monroe County Year 2010 Comprehensive Plan and established Five-year Work Program (Rule 28-20.100). • MCSWMP begins. • Monroe County established original Identification and Elimination of Cesspools Ordinance, 03-1997; this ordinance was unsuccessful and was later rescinded.
1998	• Governor's Executive Order 98-309 (State and Local Agency Participation in Carrying Out Monroe County Year 2010 Plan). • Florida Legislature amends the enabling legislation of the FKAA (F.L. 76-441) to reinforce the FKAA's involvement in wastewater for Monroe County • Monroe County enters into a Memorandum of Understanding with the FKAA requesting that the FKAA exercises its authority to finance, construct, and operate wastewater systems in the Keys
1999	• Governor Bush and his cabinet amend the 1997 Five-Year Work Program (Rule 28-20.100) to accelerate pace of program, identify *hot spots*, and initiate cesspool identification outside of *hot spot* areas. • Monroe County passes ordinance 031-1999 (Revised Identification and Elimination of Cesspools) to comply with the Governor's revised Five-Year Work Program. • F.L. 99-395 passed (New requirements for all sewage treatment, reuse and disposal facilities, and all on-site systems Monroe County; prohibits new or expanded discharges into surface waters, and require existing surface water discharges be eliminated before July 1, 2006).
Source: Modified from Monroe County, 2000	

In addition to local regulations, Section 303(d) of the Clean Water Act (CWA) requires all states to develop a list of priority surface waters that do not meet applicable water quality standards (impaired waters) after implementation of technology-based effluent limitations. States are

require to establish Total Maximum Daily Loads (TMDLs) which designate the maximum amount of a pollutant a water body can assimilate without exceeding water quality standards.

Chapter 99-223, Laws of Florida, sets forth the process by which the 303(d) list is refined through more detailed water quality assessments. It also establishes the means for adopting TMDLs, allocating pollutant loadings among contributing sources, and implementing pollution reduction strategies. Implementation of TMDLs can include any combination of regulatory, non-regulatory, or incentive-based actions necessary to reduce the pollutant loading. Non-regulatory or incentive-based actions may include development and implementation of Best Management Practices (BMPs), pollution prevention activities, and habitat preservation or restoration. Regulatory actions may include issuance or revision of wastewater, stormwater, or environmental resource permits necessary for consistency with the TMDL. Permit conditions may be quantitative effluent limitations or, for technology-based programs, a combination of structural and non-structural BMPs necessary for achieving the desired pollutant load reduction.

Florida is comprised of fifty-two major hydrologic basins, which in turn make up five TMDL groups, each of which undergoes five phases of development, beginning with basin assessment and concluding with actual implementation. The five phases of the study for each group are as follows:

- Phase I Preliminary Basin Assessment
- Phase II Strategic Monitoring
- Phase III Data Analysis and TMDL Development
- Phase IV Management Action Plan
- Phase V Implementation

The Keys are in the fifth group of water bodies to undergo TMDL implementation and are scheduled to begin Phase I in fiscal year 2004/2005 and complete it by fiscal year 2008/2009. Currently, Phase II for water bodies in Group I was completed in April of 2002. The results of the five phases for Group 5 cannot be predicted at this early data and as such, consideration to TMDLs has not been given in this Program.

1.2 Plan Formulation Memorandum

Previously developed wastewater and stormwater master plans developed by local municipalities in Monroe County provide the individual plans necessary for implementation of the FKWQIP and also alleviate the need for the Corps to develop additional planning documents. Therefore, the Memorandum is necessary to provide the documentation of the analyses and subsequent recommendations of the plans.

1.2.1 Purpose of Plan Formulation Memorandum

The purpose of this Memorandum is to document the analyses and planning processes used in developing the various master plans and other documents prepared to date for Monroe County and municipalities within Monroe County with regard to wastewater improvements and stormwater management planning. Based on the extensive work undertaken to date in the

identification of potential alternatives and recommended plans, no additional plan formulation work will be undertaken by the Corps as part of the FKWQIP. Consequently, the purpose of this memorandum is to summarize the decision-making process used in each master plan or other relevant documents, and to document the recommendations made as part of each plan.

1.2.2 Memorandum Organization

Chapter 2 of this memorandum outlines the range of alternatives considered within the previously prepared master plans and other documents listed below and summarizes the decision making process used to select the recommended action(s) within each plan. Chapter 3 provides an overview of available cost information. Chapter 4 presents concluding statements regarding the decision making process for future plans for wastewater and stormwater treatment in Monroe County and the future use of this memorandum.

1.2.3 Master Plans and Other Documents Reviewed

Several stormwater and wastewater master plans have been prepared for Monroe County and municipalities located within Monroe County. The Corps plans to use these decision making documents as the foundation for the planning component of the FKWQIP. Since 1994, several plans and documents have been produced and were reviewed for inclusion in this Memorandum. Descriptions of each plan are provided in the following sections.

1.2.3.1 Wastewater

Draft Wastewater Facilities Plan with Phased Implementation for the Marathon Area of the Florida Keys (Marathon Wastewater Facilities Plan). This document is dated April 1998, and was prepared by CH2MHill, Inc. et al. The purpose of this Plan us "to define the most cost-effective, environmentally sound, and implementable program for the management of existing and future wastewater pollutants that presently act, or will act, to deteriorate the Key's water quality in the Marathon area." The planning area encompasses the area from the Seven Mile Bridge through Conch Key (see Figure 1). The three steps that comprised the implementation of the wastewater management system were stated to be "planning, design, and construction." The scope of work for this Facilities Plan is defined in Construction Grants, 1985, a manual published by the Environmental Protection Agency (July 1984).

Design/Build/Operate Wastewater Management System (DBOWMS) for the City of Marathon, FL. This document is dated April 1998 and was prepared by the FKAA. It represents a set of specifications that accompanied a Request for Proposal (RFP) for the Design/Build/Operate Wastewater Management System for the City of Marathon, FL. The specifications establish certain minimum technical requirements and minimum level of quality for the treatment system to be constructed and operated for the City.

Monroe County Sanitary Wastewater Master Plan. This document is dated June 2000, and was prepared by CH2MHill, Inc. et al. The stated objective of this master plan was to "develop a plan that would provide an equitable, ecologically sound, and economical implementation

strategy for managing wastewater and improving the water quality in the Florida Keys." The stated goal was to "provide responsive, flexible, and cost-effective solutions that improve wastewater management throughout the keys and satisfy existing and future needs of the community." Additionally, The master plan's goal is to address affordability and equity issues, and to satisfy environmental and regulatory criteria and guidelines. The planning and study area included the entire developed area of the Florida Keys, except for the Cities of Key West and Key Colony Beach (see Figure 1).

City of Marathon Reuse Component of Central Wastewater RFP. This document was prepared in May 2001, and revised in August 2001 and again in October 2001, by Calvin, Giordano & Associates, Inc. The purpose of this study was "to determine water reuse feasibility for the City of Marathon.". The scope of this study was generally based on FDEP's *Guidelines for Preparation of Reuse Feasibility Studies for Applicants Having Responsibility for Wastewater Management.*

City of Key Colony Beach Sewer System Evaluation. This document, dated September 2002, was prepared by URS Corporation. The City has "continuously expended funds" over the last five years in rehabilitating their existing wastewater collection system. The purpose of this report is to assist the City's wastewater system operation staff in identifying additional sources of Inflow and Infiltration in their wastewater system.

Federal Emergency Management Agency Draft Programmatic Environmental Assessment. The Federal Emergency Management Agency (FEMA) has received grant applications to fund the construction of several wastewater treatment systems in Monroe County. Much of the proposed project funding would be provided through FEMA 1249-DR post Disaster – Unmet Needs funds. Matching funds will be provided through the Florida Division of Emergency Management and local government applications. While the Environmental Assessment prepared in September of 2002 was programmatic in nature, it was written to address the environmental consequences of constructing four planned wastewater treatment projects.

1.2.3.2 Stormwater

Stormwater Runoff Study prepared for the City of Key West –This document dated September 1994 was prepared by Kisinger, Campo and Associates Corp (KCA). The stated purpose of the study is to identify and map the existing flooding locations and ultimately develop a Drainage Improvement Development Plan.

City of Key West Water Quality Improvement Program – This program, dated 1999, was developed by the City of Key West in order to facilitate the City's commitment to "divert stormwater runoff away from Outstanding Florida Waters," and commitment to reducing infiltration, inflow and exfiltration in their sewer system.

Islamorada, Village of Islands, Stormwater Management Master Plan. This document was prepared in September 2000 by Law Engineering and Environmental Services, Inc. The purpose of this plan is to "address water quality improvements to stormwater discharges into the

Village's canals and near shore waters of the Atlantic Ocean and Florida Bay." The planning area was the entire Village, which spans from Mile Marker 90.94 to the north to 72.66 to the south and consists of four islands: Plantation Key, Windley Key, Upper Matecumbe Key and Lower Matecumbe Key (see Figure 1).

City of Key West Long Range Stormwater Utility Plan – This plan, dated June 2001 was prepared by the City's Engineering Services Division. The purpose of the plan was to document the study's previously prepared by KCA and CH2MHill as well as information regarding flooding problems after 1994, and make recommendations as to required future projects and funding to alleviate flooding and improve water quality in and around the City of Key West.

Monroe County Stormwater Management Master Plan – This document, dated August 2001, was prepared by Camp, Dresser & McKee, Inc. The stated purposes of the Stormwater Management Master Plan are to "assess the adequacy of existing systems, prioritize stormwater management needs for each island, identify regulations and policy needs, and develop a plan to finance the construction, operation and maintenance of required facilities." The geographic area of this project consists of the islands in the County (the Keys).

2.0 ALTERNATIVES SELECTION PROCESS

This Section documents the process used by decision makers to evaluate wastewater treatment and stormwater management options contained within the various master plans and other documents that are being used to comprehensively address wastewater treatment and stormwater management needs in the Florida Keys. This discussion also provides an explanation of the methods used to evaluate alternatives within each master plan. At the conclusion of each discussion, the recommendation(s) generated from each plan or decision making document is presented.

2.1 Monroe County Sanitary Wastewater Master Plan

The Monroe County Year 2010 Comprehensive Plan mandated that a sanitary wastewater master plan be prepared to determine acceptable levels of sanitary service and treatment for all developed and undeveloped areas of Monroe County. More specifically, the development of the plan was intended to:

- Establish more stringent nutrient limits not to exceed the maximum nutrient loads that can be tolerated by the County's nutrient-sensitive waters and ecosystems without experiencing short-or-long-term adverse impacts.
- Prevent further degradation to groundwater, as well as confined, nearshore, and offshore waters.
- Ensure improvements of these waters to levels that have been demonstrated to support healthy, diverse, and productive populations of fish and other marine resources.

The Monroe County Sanitary Wastewater Master Plan is the result of a comprehensive 3-year study effort, which included extensive evaluations of existing systems in the Florida Keys and applicable technologies that would fulfill the objectives of the Monroe County's 2010

Comprehensive Plan. The master plan was prepared as an initial step towards satisfying directives of this plan

The planning area of this master plan included the entire developed area of the Florida Keys, except for the Cities of Key West and Key Colony Beach (see Figure 1). While the study was ongoing, the Village of Islamorada and the City of Marathon were incorporated. Thus, the planning area included unincorporated Monroe County in the Florida Keys, as well as the Cities of Layton and Marathon and Islamorada, Village of Islands.

2.1.1 Existing Wastewater Treatment and Collection Facilities in the Keys

Except for the Cities of Key West and Key Colony Beach where regional wastewater systems are in operation, development of wastewater facilities throughout most of Monroe County has occurred with limited forethought of regional wastewater planning. Without access to any regional wastewater utilities, each developer or homeowner has had to construct private on-site or package wastewater treatment facilities to serve their development or individual home. These conditions have resulted in the present mix of approximately 23,000 on-site systems and 246 small wastewater treatment plants.

Although the existing wastewater collection systems are not adequate for regional wastewater transmission, they could be used to provide source collection and transmission to a regional collection system.

Recommendation: The Monroe County master plan recommended existing collection systems and lift stations remain under private ownership because upgrading these facilities to standards required for a regional utility would be too costly.

2.1.2 Water Quality *Hot Spots*

A goal of the Monroe County master plan is to coordinate the Cesspool Identification and Elimination program with the master planning efforts. This 1999 Ordinance calls for the establishment of water quality *hot spots*, defining *hot spots* as areas that are anticipated to be served by central community wastewater systems within the next 10 years or by the year 2010.

Recommendation: The Monroe County master plan recommended wastewater treatment and collection system improvements be located within *hot spots* as defined by the Monroe County Ordinance governing Cesspool Identification and Elimination (1999).

2.1.3 Estimated Flow Volume During Planning Period

The planning period used for the development of the Monroe County master plan was the 20-year interval between 1998 and 2018. Wastewater flows and customer projections were developed using water use records obtained from the Florida Keys Aqueduct Authority (FKAA) for each of the 27 master plan study areas for the baseline year (1998). Wastewater flow projections were then made based on anticipated growth for the 10-year and 20-year planning

horizons (i.e. 2008 and 2018 respectively). An assumption was made that wastewater flow is equal to water use at each residential and commercial location.

Recommendation: The Monroe County master plan estimated an increase in total wastewater flow for the first 10-year planning period of 7 percent and an estimated increase in total wastewater flow in all 27 study areas for the entire 20-year planning period of approximately 14 percent.

2.1.4 Monroe County Wastewater Management Alternatives Screening Process

The decision-making (or prioritization model) approach implemented for the Monroe County master plan incorporated technical information, as well as cost and schedule data. This information was merged with the values and concerns expressed by key decision makers, stakeholders, and interested members of the public at large to reach consensus on a recommended plan. A two-step process was implemented:

1. Screen potential land areas for possible facility siting.
2. Evaluate the wastewater management alternatives.

Decision models were developed through a joint, collaborative effort between Sanitary Wastewater Master Plan Technical Advisory Committee (SWMP TAC), Monroe County Citizens Task Force on Wastewater (Task Force), and the Monroe County Board of County Commissioners (BOCC), and also through consultation with representatives of the community-at-large. This process resulted in the identification of alternatives reflecting a true combination of stakeholder concerns with technically feasible treatment solutions.

Decision model results were placed in a ranked list of sites with associated benefits and cost estimates. The process allowed sites or alternatives to be evaluated against a common framework so they could be compared more easily, while considering both budget and schedule constraints. This process also provides insight into which factors most influenced the final decision.

The siting decision model resembles an organization chart, and is broken into three levels. At the top level is the principal project objective of maximizing facility siting benefits. The second level lists a series of key issues that were identified by the stakeholder groups and the third level presents a series of performance criteria that measure how well a specific alternative will accomplish program objectives.

In evaluating wastewater management alternatives for Monroe County, decision-makers needed to consider multiple issues, including: cost, technical feasibility, performance, environmental impacts, service disruption potential, reliability, and implementation. In addition, each management alternative brings with it a host of strengths and weaknesses that had to be evaluated fairly and objectively. Finally, there were a series of policy concerns and differences

of opinion throughout the stakeholder community, and decision makers had to attempt to help resolve these as best as possible.

The evaluation model resembles a company organization chart. The first level lists the principal objective of maximizing the benefits of the wastewater management alternative. The second level lists a series of important issues identified by stakeholders. The third level lists the performance criteria that measure how well each wastewater management alternative meets the program objective.

The Wastewater Management Alternatives Screening Process involved:

- Identify Alternatives – 43 alternatives were identified.
- Preliminary Screening – Each of the 43 alternatives were scored for their ability to meet criteria in each of 7 screening areas.
- Alternative Shake-Out – Alternatives that did not meet criteria were eliminated from further evaluation.
- Next Level Screening – Alternatives that passed preliminary screening were further ranked for their ability to meet criteria within the 27 study areas.
- Feasibility Study – Ranked list of alternatives for each study area were studied for consideration in the master plan.

Recommendation: Results of the Monroe County master plan feasibility study demonstrated that it is much more cost effective and environmentally sound to provide community wastewater collection and treatment in most areas of the keys (25 of the 27 study areas) than to upgrade or replace all existing on-site systems with shared cluster on-site wastewater nutrient reduction systems and to upgrade all existing waste water treatment plants.

2.1.5 Prioritization of Proposed Projects

Given the goal of eliminating unknown systems, and correspondingly cesspools, other parameters, such as annual cost per pound of nitrogen or phosphorous removed, while important were deemed to be secondary in importance to the goal of eliminating cesspools. Consequently the parameter of annual cost per unknown system eliminated was the principal criteria used for determining the extent of a community wastewater collection and treatment system, and for establishing and ranking *hot spot* areas.

Recommendation: The *hot spots* were ranked in order of priority with a ranking of 1 for the *hot spot* areas that the Monroe County master plan recommended be addressed first as well as for each region of the Florida Keys, regardless of political boundaries. Generally, *hot spot* areas encompass two or more subdivisions and adjacent areas. As indicated above, the Monroe County Ordinance dealing with elimination of cesspools required that each area of the Keys (Upper, Middle, Lower) establish a priority *hot spot* list and initiate planning, design, and construction of these community wastewater systems for these areas.

2.1.6 Proposed On-site Systems for *Cold Spots*

Properties within *cold spot* areas where on-site systems will continue to operate fall into two categories:

- Properties with unknown systems that must replace or upgrade their systems immediately with a nutrient reduction OWNRS. All these systems must be replaced or upgraded by July 12, 2003.
- Properties that currently have permits for their on-site systems and will not be required to upgrade or replace them until 2010, when all on-site systems must be upgraded or replaced with nutrient reduction OWNRS to meet the regulatory effluent limits of 10/10/10/1.

Recommendation: Install OWNRS as prescribed by regulatory requirements and local ordinance.

2.1.7 Wastewater Solids Management

The following discussion summarizes the solids management plan recommended by the Monroe County master plan for the 28 existing and proposed wastewater treatment facilities and the options considered. Three options were evaluated:

- ***Option 1 – Minimum Regionalization***. Operation solids handling facilities at all 14 s of 100,00 gallons per day capacity or greater.
- ***Option 2 – Maximum Regionalization.*** Operate solids handling facilities only at the largest s in the Lower, Middle, and Upper keys with solids from all other S trucked to these facilities.
- ***Option 3 – Intermediate Regionalization.*** Operate solids handling facilities at the nine s of 400,000 gpd capacity or more, with solids from the remaining plants trucked to the nearest of these facilities.

Recommendation: The Monroe County master plan recommended Option 1 that the 14 s with a capacity of 100,000 gpd or greater capacity treat and dewater their own solids.

2.1.8 Wastewater Collection Alternatives

Wastewater collection alternatives were analyzed for their suitability in each of the 27 study areas. The collection system technologies that were evaluated included:

- Conventional gravity sewers,
- Simplified gravity sewers,
- Smaller diameter gravity sewers,
- Low pressure sewer grinder pump systems, septic effluent pump systems, and
- Vacuum sewers.

Of these six collection system types, three systems were determined to be best suited for the Florida keys and were evaluated in more detail: vacuum sewers, centrifugal grinder pump systems, and progressive cavity grinder pump systems. Conceptual designs for these collection systems were prepared and construction cost estimates developed. In 22 of the 27 study areas, vacuum collection was the lowest cost alternative for serving the entire study area. This was particularly the case when the number of EDUs being collected was more than 350.

Recommendation: Besides being the most cost-effective collection system alternative, vacuum sewers offer the following advantages:

- No electrical power is required at each home or vacuum value
- Wastewater collection service is maintained during short-term or long-term utility power outages. A standby generator that will automatically generate power if there is a loss of utility power will be provided at each vacuum station
- Air drawn into the vacuum system with the sewage will help to keep the sewage fresh, and thus will help to eliminate odors

2.1.9 Selection of Effluent Disposal Methods

Requirements for wastewater effluent disposal in Monroe County were amended by the 1999-Florida Legislature. This amendment prohibited new or increased discharges into surface waters and mandating the elimination of existing discharges to surface waters by July 1, 2006. This legislation allows effluent reuse systems, but otherwise requires the use of underground injection for effluent disposal, under the following conditions:

- *Shallow Injection Wells* - If the design capacity of the facility is less than 1 mgd, the injection well must be at least 90 feet deep and cased to a minimum depth of 60 feet (this is considered a shallow injection well).
- *Deep Injection Wells* - If the design capacity of the facility is equal to or greater than 1 mgd, the injection well must be cased to a minimum depth of 2,100 feet (a deep injection well).
- *Water Reuse* – The Monroe County master plan recommended limited use or reliance on effluent reuse. Among the drawbacks sited for effluent reuse are the following:
    1. Land application requires full storage or backup disposal systems whenever treatment requirements are not achieved, or when the land application site cannot take reclaimed effluent. This includes extended periods of wet weather.
    2. Relatively large tracts of land are required to accommodate the effluent being disposed. Such tracts may be distant from the plant site, causing high transmission conveyance costs.

Recommendation: Design and construct effluent disposal systems in compliance with applicable regulatory requirements.

2.1.10 Monroe County Sanitary Wastewater Master Plan Recommendations

The recommendations presented in this master plan include:

- That existing on-site systems located in lower density areas of the Florida Keys be upgraded or replaced with on-site nutrient reduction systems (OWNRS)
- Installation of 12 community wastewater collection and treatment systems
- Installation of five regional wastewater collection and treatment systems
- That 17 existing facilities continue to operate and upgrade their treatment processes to meet BAT or AWT, as required, by July 2010

The master plan further recommended that 5 of the 12 community wastewater collection and treatment systems feature interim wastewater treatment plants that, over time, be phased into the larger regional systems. Details of the recommendation from the Monroe County master plan for each of the three regions of the Florida Keys are presented below:

Lower Keys – In the Lower Keys, four new community wastewater systems and two new regional wastewater systems were recommended for construction. The two proposed regional systems in the Lower keys are relatively small, in terms of both flow and area served, thus the first phase of these s can be constructed at the actual regional site. In addition to the discussion of new systems or extension of existing systems, the master plan recommended that seven existing facilities in the Lower Keys continue to operate and upgrade their treatment processes to meet the BAT/AWT standard by July 1, 2010.

Middle Keys – in the Middle Keys, two new community wastewater systems and one new regional systems are recommended. The proposed Middle Keys service areas are shown on Figure 1. Other than Duck Key, Conch Key, and Long Key/Layton, all study areas of the Middle Keys continue to operate and upgrade their treatment process to meet the BAT/AWT standard by July 1, 2010. These systems include:

- Hawk's Cay (Hawk's Cay portion of AWT upgrade)
- West End Long key (three facilities)
- East end Long Key (two facilities)

Upper Keys – In the Upper Keys, one new community wastewater system is recommended in lower Matecumbe, and two new regional systems are recommended: the 1.5 million gallon per day (mgd) system to serve Islamorada Regional Wastewater Management District, and the 2.25-mgd system to serve the Tavernier/Key Largo Regional Wastewater Management District.

2.2 Marathon Wastewater Facilities Plan

2.2.1 Wastewater Treatment Plant Siting Alternatives

This preliminary screening process resulted in identification of 19 potential wastewater treatment plant () sites. These sites were applied to a selection criteria matrix to narrow the potential site list to six sites, including at least three regional sites (greater than 10 acres). The six sites with the highest scores in the site selection criteria matrix were selected for further evaluation,

including field environmental assessments. Assessed values of the sites were obtained from records of the Monroe County Property Appraiser.

Environmental assessments of the six selected sites consisted of the following activities:

- Review existing Monroe County Land Use Classification Maps.
- Review U.S. EPA Florida Keys Wetlands Advanced Identification Project Land Cover Maps.
- Review any site-specific development and proposed development plans available through Monroe County.
- Review the most recent available color infrared and tax assessor aerial imagery.
- Review threatened and endangered species data relative to each selected site.
- Site inspection by a qualified environmental scientist.

Recommendation: This master plan recommended Site No. 4 (West of 48th Street) as the first priority site for a regional . An analysis of collection system alternatives indicated that use of this site will not incur significantly higher collection/transmission system costs than use of the more centrally located Site No. 6. This site has the added advantages of being partially cleared, absent of environmentally sensitive lands, and in proximity to a reclaimed water application site (Sombrero Country Club Golf Course).

2.2.2 Collection System Alternatives

The three wastewater collection technologies identified as best suited for use in the study area were centrifugal grinder pump systems, progressive cavity grinder pump systems and vacuum sewers. All three technologies are capable of providing reliable wastewater service, if properly installed and maintained. Gravity sewers would also provide reliable service, but at a significantly higher cost than the alternative collection systems. Based on cost estimates prepared for the four collection system options, vacuum sewers were identified as the lowest cost alternative.

Of the three preferred alternative wastewater collection systems, it was reported that vacuum systems have a clear advantage with respect to system reliability. Vacuum sewers do not require a power source at individual connection points and the system can remain in service during a power outage if auxiliary power is provided at the vacuum stations. Maintenance costs for the four wastewater collection system options are similar. Owners and operators of existing systems reported similar frequencies of maintenance calls for the two types of grinder pump stations and the vacuum valves. On the average, repairs to vacuum valves were reported to be less costly than repairs to grinder pump station.

Recommendation: The entity responsible for the wastewater utility should participate in the decision process for selection of the type of collection system to be used. Final selection should be based on cost and on preference of the wastewater utility, provided the difference in cost is not large enough to adversely impact users of the system.

2.2.3 Wastewater Treatment Alternatives

The overall approach evaluated a wide range of wastewater treatment alternatives producing varying degrees of effluent quality over a wide range of capacities. The intent was to screen all reasonably promising processes that potentially could be applied in the study area, although the emphasis was on fundamental processes and not on the diversity of proprietary process variations that are available in the marketplace. Such process variations were left for further evaluation once the fundamental process train has been established.

The study area included some 70 FDEP permitted s. Consideration was given to upgrading one or more of these existing plants for use as a regional or subregional . The cost estimates developed were based primarily on information provided by a number of equipment vendors. Cost information from prior CH2M HILL projects was also utilized. Unit sizing criteria were developed in accordance with Ten States Standards. The estimates were prepared to emphasize relative cost differences between the alternatives rather than the absolute magnitude of the costs.

Recommendation: Capital and O&M costs were estimated for each alternative at treatment capacities of 0.02 mgd, 0.10 mgd, 1.0 mgd, and 2.0 mgd. Pre-engineered, field-erected treatment units were assumed for the cost estimates, however, the entity ultimately responsible for wastewater treatment may wish to consider cast-in-place construction. The initial construction cost would be somewhat higher, however, a cast-in-place plant would offer advantages in reduced maintenance and increased operational flexibility.

2.2.4 Effluent Management Alternatives

Potentially feasible effluent management alternatives were identified and subjected to a preliminary screening. Those alternatives that contained major obstacles to implementation were eliminated from further consideration. The alternatives that passed the preliminary screening were evaluated further. Upon completion of the in-depth evaluation, the remaining effluent management alternatives were either eliminated from further consideration or incorporated into the Facilities Plan. Reuse by land application, underground injection through deep wells, underground injection through shallow wells, and surface water disposal were identified as potentially feasible methods for effluent management in the Marathon area.

Recommendation: A total of four scenarios were considered:

Scenario No. 1 – Capacity of 0.02 mgd. FDEP does not allow reuse for systems this small. A shallow injection well system is the only remaining feasible alternative for effluent management. The order-of-magnitude construction cost estimate for this system is $33,000 for two wells, wellfield piping, and polishing tank only.

Scenario No. 2 – Capacity of 0.1 mgd. It was recommended that the primary effluent management system be a shallow injection wellfield system. The order-of-magnitude construction cost estimate for the shallow injection wellfield, including four wells, piping effluent, and polishing, is $100,000.

Reuse should be pursued as the secondary effluent management method. 0.1 mgd is the minimum allowable size for a reuse system. The order-of-magnitude cost estimate for the reuse system is approximately $1 million for filters, disinfection, effluent storage tank, continuous on-line turbidity and chlorine residual monitoring equipment, and high service pumping. This cost does not include transmission and distribution piping and connection to the existing irrigation systems. These offsite costs will be determined when site-specific areas for reuse are defined and can be expected to add substantially to the cost of the reuse alternative.

Scenario No. 3 – Capacity of 1.0 mgd. As with Scenario No. 2 above, a shallow injection wellfield system is recommended for the primary effluent management system. The order-of-magnitude construction cost for the shallow injection well system, including 14 wells is $750,000.

Reuse should be pursued as the secondary method of effluent management, depending on economic feasibility. The order-of-magnitude construction cost estimated for the filters, disinfection, effluent storage tank, continuous on-line turbidity and chlorine residual monitoring equipment, and high service pump station is approximately $2.5 million. Again, offsite facilities, to be evaluated later in the Facilities Plan, will add substantially to the cost of the entire reuse system.

Scenario No. 4 – Capacity of 2.0 mgd. A deep injection well system was recommended as the primary effluent management system. Two injection zones exist that are suitable for wastewater disposal were identified. These constitute the upper part of the Floridian Aquifer System (FAS); these are an intermediate-depth zone, extending from 650 to 1,200 feet below the surface (bls) and the deeper Boulder zone, extending from 2,100 to 2,500 bls.

If the proposed injection zone is the intermediate-depth zone, preliminary design indicates that a 12-inch diameter steel casing set to a depth of approximately 650 feet bls will convey effluent to the injection horizon. The well will be completed with open-hole construction from 650 to 1,200 feet bls.

Typical surface facilities will include a pump station, surge control system, yard piping, and instrumentation. A second, redundant intermediate depth injection well would provide a back-up system for periods in which the primary injection well is off-line for testing. An order-of-magnitude construction cost for two intermediate-depth injection wells and surface facilities is approximately $1.52 million, with an annual O&M cost of approximately $90,000.

If the intermediate-depth deep well described above could not be permitted, another potential injection zone exists is the deeper Boulder Zone. This injection horizon is most likely confined by dense limestone from 1,200 to 2,100 feet bls. This option would include a 22-inch casing set to 650 feet bls, and a 12-inch-diameter casing set to 2,100 feet bls, with open-hole construction to 2,500 feet bls. The estimated order-of-magnitude construction costs for two deep wells and surface facilities is $2.82 million, with an annual O&M cost estimated to be $90,000.

The master plan recommended that reuse should be pursued as the secondary effluent management method, if economically feasible. The order-of-magnitude estimate of the construction cost for reuse facilities at the WWTP site is approximately $3.5 million.

2.2.5 Solids Management Alternatives

Alternatives for processing and disposing of residual wastewater solids (treatment plant sludge and septage) that would be generated in the study area upon implementation of regional or subregional wastewater collection and treatment systems were evaluated. The alternatives evaluated included various processes for stabilizing, dewatering, transporting, and disposing of solids produced by two s serving the primary and secondary service areas. Alternative means of handling treatment plant solids and septage from the remaining areas of the planning area were evaluated.

Proven solids handling processes in general use in the United States today were first screened with respect to their applicability at a new regional WWTP serving the primary service area. For the wastewater collection/treatment option utilizing subregionals, it was assumed that a single centralized solids handling facility would be constructed at one site, and solids from the other s would be transferred to that site for processing. The most feasible processes were then formulated into alternative systems, which were compared on the basis of both capital and O&M costs.

***Recommendation*:** A solids handling system consisting of aerobic digestion, dewatering, and contract hauling to remote agricultural land is the recommended alternative for a new regional WWTP. The regional WWTP or central subregional solids management facility should also be equipped to receive and co-process residual solids from the Key Colony Beach WWTP and the Hawks Cay WWTP serving the secondary service area. Continuing disposal of septage through contract haul to the Miami-Dade Water and Sewer Department (MDWASD) system is the recommended method of septage disposal.

2.2.6 Wastewater Management Alternatives

The wastewater management alternatives were evaluated to identify the most cost-effective and environmentally favorable plan for wastewater management in the Marathon Study Area. The alternatives consisted of the following.

- Upgrade individual on-site systems with Best Available Technology (BAT) and upgrade existing package plants to Advanced Wastewater Treatment (AWT) standards.
- Serve the primary service area with subregional WWTPs.
- Serve the primary service area with a regional WWTP.

All regional management alternatives were evaluated on the basis of providing AWT where treatment plant flows were greater than 100,000 gpd in accordance with the Monroe County BCC's selection of AWT as the most environmentally sound treatment level. Alternatives were evaluated on the basis of cost and environmental and implementation factors.

***Recommendation*:** Before any reuse facilities are incorporated into the design and construction of the project, a firm, legally binding commitment to use reuse waster at a guaranteed demand should be obtained from reuse customers. Based on these commitments, the initial reuse demand can be determined, and the size and extent of the initial reuse facility can thus be determined and incorporated into the project. Depending on the size of the initial reuse capacity at the regional plant, additional capital costs could vary from approximately $2,050,000 to $10,500,000. Total project costs could vary from approximately $2,600,000 to $13,400,000; these costs would have to be included and financed in the total project cost of the regional facility. Annual O&M costs would increase between $18,000 and $50,000.

2.3 Islamorada, Village of Islands, Stormwater Management Master Plan

In order to evaluate potential reduction on pollutant load generated by storm events within the Village, an alternatives analysis was conducted for each of the Village's drainage basins including review of a No Action alternative. The ranking methodology evaluated the qualitative aspects of various attributes for each alternative treatment technology with regard to program priorities and future land use projections. When present, environmental impacts for each alternative were evaluated on the basis of their potential effects on natural resources including: effects on flora and fauna, water and sediment water quality standards; habitat communities and unique physical features of the environment within each basin as they relate to future land use activities.

Ten alternative scenarios to reduce pollutant load evaluated include:

1 Installation of sediment removal mechanisms,
2 Installation of drainage wells and associated sediment removal mechanisms,
3 Construction of swales,
4 Installation and maintenance of native vegetative buffers,
5 Construction of retention/detention facilities,
6 Wetland hydrologic enhancement,
7 Creation of wetland habitats,
8 Infrastructure / system maintenance,
9 Public education, and
10 No Action.

A ranking system was developed to assess the relative degree of potential adverse environmental impacted and reduction of pollutant loadings associated with each of the ten alternatives listed above. The alternatives were ranked on a scale of one to five, with five being the most desired ranking or representing negligible adverse environmental impacts, and one where significant ecosystem impacts were anticipated, or estimated costs were disproportionate to benefits.

Each alternative was ranked with regard to categories of:

- Water quality (e.g. nutrient loading; suspended solids; oil and grease and heavy metals),
- Physical parameters (e.g. maintenance; public safety and erosion and sedimentation),

- Sediment storage capacity,
- Flora and fauna (e.g. avifauna; fish; benthos; and threatened/endangered plant and animal species),
- Alternation of costal habitats,
- Land use,
- Level of Service provided (water quality and quality discharge requirements of the Village Comprehensive Plan), and
- Relative cost.

The categories were then averaged to determine the final ranking of each ten alternatives for each of the Village's 13 proposed future land use categories. The result was a recommended strategy for reduction of pollutant loads for each land use type.

Each drainage basin may contain one or more land use types. As stated above, for each land use type a preferred methodology for pollutant reduction was developed. Each drainage basin was then ranked with regard to priority for implementation of pollution reduction measures based on the improvements ability to meet Program Priorities developed by the Village and the potential benefits of the improvements.

Recommendation: The master plan provides a prioritized list of 63 projects recommended for implementation over 30 years with an associated cost in current dollars of $48,916,882.

2.4 Monroe County Stormwater Management Master Plan

Goals and Objectives of the Study
Based on public input and the 2010 Comp Plan, the following is a list of recommended goals and objectives for the Monroe County Stormwater Management Master Plan:

Goal 1. The stormwater master plan will identify, prioritize and recommend remedial improvements for the significant water quality related problem areas within the unincorporated areas of the County.

Goal 2. The stormwater master plan will recommend actions that will reduce the sediment and nutrient loading of near shore waters resulting from runoff.

Goal 3. The stormwater master plan will review existing regulatory requirements for the control of new development related to flooding and water quality and will recommend improvements as needed. As a related issue, the SMMP will review existing enforcement activities and recommend changes necessary to improve the compliance of existing or new regulations.

Goal 4. The stormwater master plan will recommend activities related to the stormwater management of future growth that will be expected to result in no increase in sediment or nutrient loads to near shore waters.

Goal 5. The stormwater master plan will strive to use nonstructural and source controls to achieve a reduction in existing sediment and nutrient loads. When necessary, the SMMP will recommend structural controls associated with the publicly owned infrastructure.

Alternatives Considered

As part of this plan, various alternative strategies for stormwater management with particular emphasis on those to be used in the Monroe County Stormwater Management Master Plan were considered:

On-site Approach. In the case of future urban development or retrofit of existing development, the on-site approach (also known as piecemeal approach to stormwater control) involves the delegation of responsibilities for BMP deployment to local land developers or the use by the County of BMPs serving small areas due to site constraints. Each developer is responsible for constructing a structural BMP at the development site to control nonpoint pollution loadings from the site. On-site detention ponds typically have contributing areas of 20-50 acres. The local government is responsible for reviewing each structural BMP design to ensure conformance with specified design criteria, for inspecting the constructed facility to ensure conformance with the design, and for ensuring that a maintenance plan is implemented for the facility. The treatment facility usually consumes 15 percent of developable site based on research done in the State of Florida by CDM and others.

Regional Approach. The regional approach to stormwater control involves strategically locating regional structural BMPs to control nonpoint pollution loadings from multiple development projects. For ponds serving new development, the front-end costs for constructing the structural BMP are assumed by the developer and/or the local government that administers the regional BMP plan. BMP capital costs can then be recovered from upstream developers on a "pro-rata" basis as development occurs. Individual regional BMPs are phased in as development occurs rather than constructing all regional facilities at one time. Maintenance responsibility for regional structural BMPs can be assumed by the developer (or designee with certified maintenance bonds) or by the local government. For retrofit of existing development, regional BMPs may also be used to cost-effectively treat areas near the areas that cannot be cost-effectively treated. The regional approach can address concurrence for the entire watershed.

BMP Alternatives. The study listed 19 structural BMPs and 16 nonstructural source controls considered in for the Florida Keys.

Structural BMPs

- Shallow grassed swales
- Retention basins
- Buffer strips
- Porous pavement
- Water quality inlets and baffle boxes
- Hydrodynamic separators
- Underdrains and stormwater filter systems
- Infiltration drainfield
- Dry wells
- Modular treatment systems
- Stormwater wetlands
- Alum injection systems
- Aeration
- Level spreaders
- Oil/grease separators
- Recharge wells and bore holes with pretreatment

Nonstructural Stormwater Controls

- Land use planning
- Public information programs
- Stormwater management ordinance requirements
- Fertilizer application controls
- Pesticide use controls
- Control of gray water (cisterns and rain barrels)
- Solid waste management
- Hazardous materials management
- Street sweeping
- Vehicle use reduction
- Directly connected impervious area (DCIA) minimization
- Low impact development
- Illicit connections (non-stormwater discharges) identification and removal
- Erosion and sediment control on construction sites
- Source control on construction sites
- Operation and maintenance

Bridges. The study lists the islands along US 1 within the Monroe County study area with the approximate lengths and bridges connecting them (lengths given to the nearest 0.1 mile). It can be seen that, of the 107 miles indicated, 18.9 miles (about 18 percent) of US 1 are bridges of various lengths. As part of the stormwater master plan, recommendations will be made (see below) on suggested retrofit and rehabilitation projects for US 1, excluding along most of Key

Largo, for approximately 17.5 miles. In order to address all of the potential sources of stormwater runoff, the contribution of the bridges was also considered.

Related to stormwater runoff, a bridge is 100 percent impervious and rain that falls on the bridge either runs off directly to the near shore waters under the bridge or flows down the bridge to the entrance or exit. The question, therefore, is whether or not runoff directly from the bridge can be treated efficiently and at a reasonable cost. From 1993 to 1995, the U.S. Geological Survey conducted a study of the Bayside Bridge in Clearwater, Florida (Stoker, Y.E., "*Effectiveness of a stormwater collection and detention system for reducing constituent loads from bridge runoff in Pinellas County, Florida*", USGS Open File Report 96-484). For the Bayside Bridge, stormwater runoff was collected along the bridge through inlets, and carried to a land-based detention facility near the bridge entrance. This study concluded that, after monitoring 33 storm events, runoff quality varied with total runoff volume, antecedent dry period, and season. Many parameters, including sediments and nutrients, were inversely related to runoff volume. For treatment efficiency, suspended solid loads were reduced by 30 to 45 percent, inorganic nitrogen by 60 to 90 percent and most metals by 40 to 99 percent. However, TKN, alkalinity, pH and specific conductance, among others, had negative efficiencies (i.e., the outflow values were greater that the inflow). This article points out the experience related to bridge BMPs: 1) runoff needs to be carried to the shore where it is treated, 2) regular maintenance is necessary, and 3) treatment efficiencies are highly variable, with some parameters actually increasing. While these results may not be encountered in the Florida Keys, bridge runoff control is not recommended on a large scale. However, it is suggested that bridge runoff treatment should be tried at one or more sites for a few years, with monitoring to confirm treatment efficiencies. Depending on the outcome, bridge runoff control could be implemented on selective bridges.

Recommendations: The stormwater master plan provides a number of benefits related to the goals and objectives of the plan. First, the master plan provides retrofit and rehabilitation projects for all of the identified public problem areas within the Keys. These projects will address both flooding and water quality improvements. Second, the implementation of the master plan will also improve maintenance activities for existing and future stormwater management facilities. Third, the master plan recommends a number of programs that will minimize the runoff pollutant loading to the near shore waters from future developments and eventually will reduce the loads from existing sources.

The following actions were recommended.

- *Monroe County should adopt a 95 percent treatment requirement and strictly enforce its application on new development and significant redevelopment.* The 95 percent treatment requirement means that new developments must remove 95 percent of the annual average load of pollutants from developed property. For the purposes of this plan, the 95 percent standard means 95 percent capture of the mean annual rainfall volume. Through modeling of stormwater pollutant loading for future growth, it has been shown that this requirement will achieve Goal 4 (no increase in future loads). The consequences of this requirement are two-fold. First, the County should review each new development to confirm that the 95 percent requirement is met and through construction inspection, confirm that the stormwater systems are being built according to the approved design.

Second, the County should work with existing residential and commercial developments that plan to redevelop. Once reasonable stormwater retrofits are defined that meet the 95 percent rule, the County should allow redevelopment, as the redeveloped property will provide water quality benefits.

- *Monroe County should implement an operation and maintenance (O&M) program for public stormwater management systems and inspection of private systems*. The O&M program adopted by the County should include routine maintenance for critical stormwater systems as well as routine inspection of others. Furthermore, private stormwater systems should receive proper maintenance with annual certification by owners.

- *Monroe County or South Florida Water Management District (SFWMD) should develop a stormwater well inventory*. Runoff from both public and private properties is discharged into drainage wells. Unfortunately, very little is known about the location, tributary area and land use draining to each well. While drainage wells provide significant stormwater flood relief, the benefits and impacts on water quality are not well documented because of the lack of information.

- *Monroe County and SFWMD should enforce existing regulations through inspection and asbuilt drawings*. The review of existing federal, state, regional and local stormwater regulations confirmed that there are sufficient regulatory controls defined today. However, field inspections confirmed that many of the permitted systems were not built according to the permit and/or are not being maintained. County and water management district inspectors should also be trained in sediment and erosion control.

- *Monroe County should pay special attention to marinas with respect to stormwater runoff*. Many of the stormwater quality problem areas identified in the Florida Keys were related to private marinas. Field inspections identified major problems that were related to runoff from material storage areas, unpaved areas, and lack of stormwater controls prior to discharge. The County should encourage the state to continue the Clean Marina Program, and marina retrofits should be reviewed on a case-by-case basis to meet the 95 percent rule.

- *Monroe County should encourage redevelopment and retrofit with reductions in impervious area*. Many of the existing stormwater problems occur because development has increased the imperviousness of the area. Increased imperviousness changes the volume, timing, peak flow, and pollutant content of stormwater runoff. The County should offer incentives for the reduction of impervious areas using vegetated and landscaped swales, rain gardens, bio-filters, and pervious pavement.

- *Monroe County should encourage the use of vegetated buffers and conservation measures*. As noted previously, the major problems encountered in the Florida Keys are due to the lack of stormwater controls prior to discharge. Simple, yet powerful, controls consist of vegetated buffers such as swales, rain gardens, bio-filters and bio-retention. Also, by conserving water through the use of runoff for residential irrigation reduces the

volume of runoff and limits the pollutant loading discharged. Conservation measures such as cisterns, rain barrels and xeriscape are particularly effective.

- *Monroe County should require all vegetated systems such as swales, medians, etc., to be planted with native vegetation to minimize maintenance*. Planting of vegetated systems with native plants will maintain the beauty of the Florida Keys' natural environment as well as minimize special maintenance. Public and private construction and development should be encouraged to use salt-tolerant plants near shoreline spray areas and other native plants away from the coast line.

- *With the support of federal, state, and regional governments, Monroe County should implement the recommended retrofit and rehabilitation projects to address existing problem areas*. Twenty-two retrofit and rehabilitation projects have been identified to address problem areas within Monroe County. The projects include improvements to be implemented by the Florida Department of Environmental Regulation (Heritage Bike Trail), Florida Department of Transportation (along US 1), Monroe County and Marathon. Three additional projects on private property have been considered as well: K-Mart in Marathon, Key Largo Trailer Village, and the Safe Harbor area on Stock Island. These represent example projects to illustrate the possible retrofit or rehabilitation of private property.

- *Where possible, FDOT should include stormwater controls as part of all Florida Keys projects, including bridge entrances and exits.* A review of existing designs and a field survey of FDOT systems showed that many areas have limited stormwater quality controls. Many of the bridge entrances and exits, especially in the Upper Keys discharge uncontrolled stormwater that contain significant sediment loads. Since the FDOT stormwater system is the major (and in some study areas, the only) stormwater controls available, stormwater quality improvements will also result in improvements to near shore waters.

2.5 Stormwater Runoff Study Prepared for the City of Key West

2.5.1 Goals of the Study

The stated purpose of the study is to identify and map the existing flooding locations and ultimately develop a Drainage Improvement Development Plan by prioritizing the documented flooding areas and analyzing alternative solutions for each area.

2.5.2 Alternatives Considered

The study considered six alternatives to address flooding.

1. Roadside ditches
2. Urban storm drain systems
3. French drains
4. Storage chambers

5. Retention/detention ponds
6. Gravity wells

Recommendations: Recommendations made for the program includes the following:

- Implement a City wide maintenance program that would provide scheduled cleaning of the existing and/or proposed storm drain systems.
- Implement a street sweeping program to keep the streets clean of yard debris and trash which would eventually block inlets and pipes.
- Install flap gates or similar devices on outfalls that discharge into the Atlantic Ocean or the Gulf or of Mexico. This would help prevent tidal waters from entering the storm drain systems and flooding the roadways.
- The existing storm drain systems should be inventoried and mapped. This would include documenting the type, size, location, elevation, and condition of all inlets, manholes, pipes and outfalls. To accomplish this task, all structures that are filled with dirt and debris would need to be cleaned. This could be completed on each flooding location as they are chosen for improvements.
- Model the existing storm drain system associated with each flooding location and determine which improvements are necessary to alleviate the flooding problems and provide as much stormwater treatment as possible.

2.6 City of Key West Water Quality Improvement Program

Goals of the Program

The stated goal of this program was to facilitate the City's commitment to "divert stormwater runoff away from Outstanding Florida Waters," and commitment to reducing infiltration, inflow and exfiltration in their sewer system.

Recommendations: Recommendations made for the program includes the following:

- Installation of five Pump-Assist Injection Well Systems built to BMP standards to prevent flooding, divert stormwater flow from outfalls and Outstanding Florida Waters and avoid near-shore water contamination.
- Elimination and/or Retrofit of 63 outfalls to reduce or eliminate discharge of pollutants to near-shore waters.
- Installation of 239 injection wells to prevent flooding and divert stormwater flow from outfalls and sheet flow to Outstanding Florida Waters.
- Retrofit existing injection wells to provide additional treatment for oils and hydrocarbons.

2.7 City of Key West Long Range Stormwater Utility Plan

Purpose of the Plan

The purpose of the plan was to document the study's previously prepared by KCA and CH2MHill as well as information regarding flooding problems after 1994, and make

recommendations as to required future projects and funding to alleviate flooding and improve water quality in and around the City of Key West.

Alternatives Considered

Alternatives considered in the Plan included:

- To control storm surge
  - Increasing the height of seawalls, beach berms and roadways around the perimeter of the Island
  - Place tide-valves on every outfall.
- To control flooding due to intense rain events
  - Install French Drain systems in higher elevation areas
  - Install Outfalls and wells in lower elevation areas
- To control standing water
  - Install French drain
  - Regrade areas to drain onto existing drainage inlets or retention areas
  - Install infrastructure to tie into existing drainage systems

Recommendations: The plan presents the list of recommended improvements for various drainage areas within the City as wells as a recommended maintenance program. The recommended projects include:

- Limited road reconstruction
- Numerous drainage wells
- Outfall treatment structures
- Additional infrastructure (inlets and piping) to convey stormwater to existing systems or outfalls.

2.8 City of Key West Wastewater Enterprise Fund Capital Improvements Program

Based on information provided by the City, there are eight projects included in this program which extends until the year 2013. The projects consist of the following:

- Deep injection well
- Miscellaneous sewer system repairs
- Installation of manhole liners
- Installation of manhole rain guards
- S. Duval Street sewer rehabilitation
- Wastewater reuse WWTP improvements
- Wastewater reuse distribution system
- Truman Annex Sewer

2.9 City of Key Colony Beach Sewer System Evaluation

This document, dated September 2002, was prepared by URS Corporation. The City has "continuously expended funds" over the last five years in rehabilitating their existing wastewater collection system. The purpose of this report was to assist the City's wastewater system operation staff in identifying additional sources of inflow and infiltration in their wastewater system.

Recommendation: Based on the investigation, the recommended rehabilitation work included sliplining, point repairs and grouting.

2.10 City of Marathon Reuse Component for Central Wastewater Request For Proposal (RFP)

Three alternatives for public access reuse systems were evaluated for a design year of twenty years from the current date:

- A maximum reuse system where 100 percent of the average annual daily flow of domestic wastewater is reused in the design year,
- A medium reuse system where 33 percent of the average annual daily flow of domestic wastewater is reused in the design year, and
- A minimum reuse system where 31 percent of the average annual daily flow of domestic wastewater is reused in the design year.

For the maximum distribution of reuse water, nearly 1.6 million gallons per day (mgd) of treated effluent will have to be stored and pumped to all potential current and future reuse water users. The reuse water will be continuously monitored for total suspended solids (TSS) and chlorine residual to determine if it passes the water quality requirements. Unsuccessfully treated water will be stored and diverted to the head of the plant to be retreated. Regulatory criteria requires that reject storage and wet weather storage provide volumes equal to one day flow and three days flow, respectively, at the average daily design flow. A water balance was performed using the FDEP's LANDAP98 computer model to confirm the quantity of wet weather storage needed.

For the medium reuse system and minimum reuse system, approximately 0.52 mgd and 0.49 mgd of effluent, respectively would be stored and pumped to a portion of reuse water users.

Recommendation: Inclusion of a reuse component was deemed to be technically feasible and the required equipment and facilities were identified. The land for the reuse facilities would be located at the future WWTF site at Crawl Key.

It does not appear that the project will harm the biological environment nor have a major adverse impact on the physical or socioeconomic environment as long as the construction work follows the design and specification requirements.

Present value analyses showed that the Minimum and Medium Reuse Systems are possible choices. The maximum reuse system, due to its high capital costs, was deemed economically infeasible.

The Marathon area and the Florida Keys, in general, currently practice water conservation, mainly due to the high cost of potable water. Therefore, relatively few sites, including residences have irrigation systems. The report identified potential reuse sites which contained green areas that could be irrigated. Prior to implementing a reuse program, a survey must be taken to determine which sites would participate and then there must be a firm legally binding commitment to use reuse water at a guaranteed demand from reuse customers.

2.11 DBOWMS for the City of Marathon, FL

The DBOWMS is a RFP, which is generally in compliance with the Monroe County Sanitary Wastewater Master Plan and Marathon Wastewater Facilities Plan. As such, it does not appear that alternatives were considered, and that recommendations from the master plans were used to develop this RFP.

Recommendation: The recommendations of this document are essentially the requirements of the Request for Proposal, which are detailed below.

- Collect wastewater via a vacuum sewer system and transmit wastewater to a treatment facility with a design capacity of 1.52 mgd Annual Average Daily Flow (AADF), expandable to 2.0 mgd AADF.

- Provide for a treatment facility that must produce effluent that meets AWT standards.

- Additional treatment processes required as part of the RFP include:
  - Influent flow metering and screening,
  - High-level disinfection,
  - Effluent disposal,
  - Sludge digestions, dewatering and storage, and
  - Odor control.

- Provide effluent disposal through deep injection wells and a reclaimed water system.

2.12 FEMA Draft Programmatic Environmental Assessment

In the EA, FEMA is considering the provision of funding assistance related to several proposed alternatives, which are designed to improve wastewater treatment, and ultimately water quality in the Florida Keys. Alternatives presented in the EA parallel alternatives studied and approved for consideration by Monroe County in its master plan. This plan served as the base document in the description of wastewater treatment options. The EA addressed three alternatives:

Alternative 1 – No Action Alternative: Under this alternative FEMA would not provide funds to the project applicants for wastewater improvements. Communities currently utilizing on-site systems, such as cesspools and septic systems, to manage wastes would have to construct either community or regional WWTFs or on-site wastewater nutrient reduction systems, to effectively manage waste nutrient to levels that meet the Florida Statutory Treatment Standards of 2010.

Alternative 2 – Centralized Wastewater Treatment Plant Alternative: project applicants with FEMA grant funds would construct a new community or regional WWTF or perform facility upgrades to existing systems at selected locations in the Florida Keys. New construction of community and regional WWTFs would be targeted in densely populated areas, where the installation of central sewers would eliminate a high number of declining and inadequate on-site wastewater treatment methods such as septic tanks and cesspools.

Alternative 3 – On Site Treatment Upgrades: project applicants would use FEMA funds to convert OWTSs, such as cesspools and septic tanks with drainfields, to OWNRS to improve wastewater management in the Florida Keys. A biological nitrogen removal system coupled with physical/chemical phosphorous removal system, disinfection (through chlorination or other means), and disposal through either subsurface drip irrigation systems or shallow injection wells are proposed under this alternative. Under this alternative, a "cluster system" would be designed such that multiple homes would use one OWNRS system.

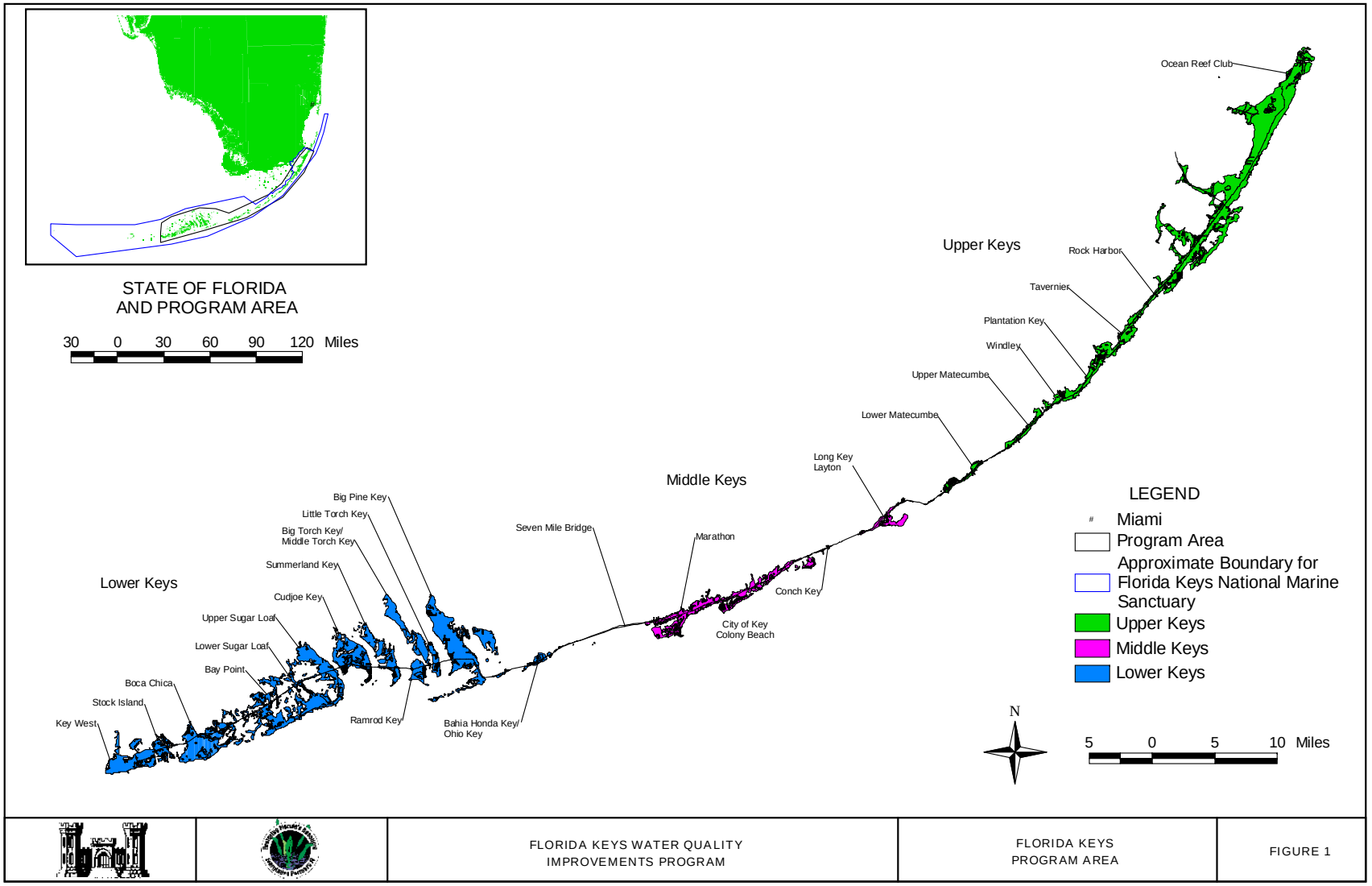
***Recommendation*:** The FEMA EA supports implementation of the Monroe County master plan and proposes that projects with the Florida Keys Aqueduct Authority and the Village of Islamorada be implemented to reduce wastewater nutrient loading at selected County *hot spots*. FEMA monies through the Unmet Needs program would be used to establish their wastewater treatment objectives.

3.0 COST ESTIMATES

The estimated cost to implement all projects listed in the master plan is $529,624,949. The costs for each project were compiled from each respective plan and the accuracy of these cost estimates has not been scrutinized during the preparation of this document. It is assumed that these are "order-of-magnitude" estimates as defined by the American Association of Cost Engineers. These estimates are subject to change based on market conditions. As the FWQIP moves forward, recent bid prices should be considered for refining estimated future costs.

4.0 CONCLUSIONS

The recommendations that have been documented herein will serve as the basis for development of the Program Management Plan (PMP) and proposed action in the Programmatic Environmental Impact Statement. The recommendations from the various planning documents discussed above served as the basis for development of the overall program project list which the municipalities will be asked to update for inclusion in the PMP.


STATE OF FLORIDA
AND PROGRAM AREA
30 0 30 60 90 120 Miles
Upper Keys
Ocean Reef Club
Rock Harbor
Tavernier
Plantation Key
Windley
Upper Matecumbe
Lower Matecumbe
Long Key
Layton
Middle Keys
Marathon
Seven Mile Bridge
Conch Key
City of Key
Colony Beach
Lower Keys
Big Pine Key
Little Torch Key
Big Torch Key/
Middle Torch Key
Summerland Key
Cudjoe Key
Upper Sugar Loaf
Lower Sugar Loaf
Bay Point
Boca Chica
Stock Island
Key West
Ramrod Key
Bahia Honda Key/
Ohio Key
LEGEND
Miami
Program Area
Approximate Boundary for
Florida Keys National Marine
Sanctuary
Upper Keys
Middle Keys
Lower Keys
N
5 0 5 10 Miles
FLORIDA KEYS WATER QUALITY
IMPROVEMENTS PROGRAM
FLORIDA KEYS
PROGRAM AREA
FIGURE 1