Islamorada,
Village of Islands

SENT VIA UPS

May 8, 2020

Mr. Ray Eubanks, Plan Processing Administrator
Florida Department of Economic Opportunity
Caldwell Building
107 East Madison Street – MSC 160
Tallahassee, Florida 32399

RE: Compliance Review of Proposed Comprehensive Plan Amendments
Islamorada, Village of Islands, Submittal Package

Dear Mr. Eubanks:

Pursuant to Chapter 163, Part II, Florida Statutes, the Islamorada, Village of Islands Planning and Development Services Department, acting within the Florida Keys Area of Critical State Concern, hereby transmits three (3) copies of its proposed Comprehensive Plan Amendment Submittal Package of the Islamorada, Village of Islands Comprehensive Plan and hereby requests that the Florida Department of Economic Opportunity (DEO) review the amendments. **The amendments are subject to State Coordinated Review process pursuant to Section 163.3184(4), Florida Statutes.** One (1) copy of the amendment package is paper and two (2) copies are on a flash drive in PDF format.

There is one (1) ordinance in the package, summarized in the table below. The ordinance does not amend the future land use map. The amendment will update the Village's Water Supply Plan pursuant to Comprehensive Plan Policy 4-1.1.11.

The proposed amendment ordinance was approved for transmittal to the review agencies by the Village Council on May 7, 2020. One copy of the plan amendment submittal package was transmitted concurrently to each of the following agencies and governments for their review and written response:

- South Florida Regional Planning Council
- Monroe County, Florida
- Florida Department of Environmental Protection
- Florida Department of Transportation
- South Florida Water Management District
- Florida Department of State
- Florida Department of Education

Summary of the Plan Amendment Submittal Package Content: Each plan amendment listed below includes the proposed text, copies of recommendations and support documents, including any required data and analysis.

86800 Overseas Highway • Islamorada, Florida 33036-3162
Office 305-664-6400 • Fax 305-664-6467 • www.islamorada.fl.us

Ord. No.	Amendment Name	Amendment Title	LPA Hearing Date	1st VC Hearing Date	2nd VC Hearing Date
n/a	PROPOSED TEXT AMENDMENT TO ADOPT THE UPDATED WATER SUPPLY PLAN	AN ORDINANCE OF ISLAMORADA, VILLAGE OF ISLANDS, FLORIDA, AMENDING THE VILLAGE'S COMPREHENSIVE PLAN TO ADOPT THE WATER SUPPLY PLAN AS MANDATED BY FLORIDA STATUTES 163.3177(6)(C)3; PROVIDING FOR THE TRANSMITTAL OF THIS ORDINANCE TO THE STATE DEPARTMENT OF ECONOMIC OPPORTUNITY; AND PROVIDING FOR AN EFFECTIVE DATE UPON THE APPROVAL OF THIS ORDINANCE BY THE STATE DEPARTMENT OF ECONOMIC OPPORTUNITY	3/9/20	5/7/20	Tent. July 2020

- The plan amendment is related to the Florida Keys Area of Critical State Concern, pursuant to Section 380.05, Florida Statutes.
- The plan amendment is not within Orange, Lake or Seminole Counties and, therefore, the plan amendments do not apply to the Wekiva River Protection Area pursuant to Chapter 369, Part III, Florida Statutes.
- A copy of the complete amendment package including supporting data and analysis has been mailed to all of the required review agencies on the date of this letter.
- The amendment is not proposed to be adopted under a joint planning agreement pursuant to Section 163.3171, Florida Statutes.
- The amendment does not update the five-year schedule of Capital Improvements.
- There were no requests for citizen courtesy information.

The following person is familiar with the proposed amendments and is responsible for ensuring that the materials transmitted are complete:

Scarlet Hammons, AICP CTP
Planning Consultant to the Village
The Corradino Group
4055 NW 97th Avenue
Doral, FL 33178
786-510-4799
shammons@corradino.com

Thank you in advance for your timely review of these materials. Should you have any questions about the proposed amendments, please contact us.

Sincerely,

Scarlet Hammons, AICP CTP
The Corradino Group

Encl.

Cc: Isabel Moreno, Administrative Assistant, SFRPC
Mayte Santamaria, Senior Director, Monroe County Planning and Environmental Resources
Plan Reviewer, FDEP
Shereen Yee Fong, Transportation Planner, FDOT District 6
Terese Manning, Policy and Planning Analyst, SFWMD
Robin Jackson, Historic Preservation Planner, FDOS
Barbara Powell, Areas of Critical State Concern Administrator, DEO
Tracy D. Suber, Growth Management and Facilities Policy Liaison, FDOE
Village Council (no enclosures)
Seth Lawless, Village Manager (no enclosures)
Roget. V. Bryan, Village Attorney (no enclosures)

Council Communication

To: Mayor and **Village Council**

Through: **Seth Lawless, Village Manager**

From: Ty Harris, Director of Planning

Date: May 7, 2020

SUBJECT: **FIRST READING – ORDINANCE AMENDING THE VILLAGE COMPREHENSIVE PLAN TO ADOPT THE WATER SUPPLY FACILITIES WORK PLAN UPDATE**

Background:
The Village of Islamorada (the "Village") is subject to the jurisdiction of the South Florida Water Management District (SFWMD) regarding State requirements for local water supply planning. As potential limitations on the continued use of traditional water supplies became increasingly apparent, the SFWMD has concluded that traditional water supply sources will not be sufficient to meet the water needs of the growing South Florida population. As a result, the Florida Legislature enacted seven (7) bills in State Legislative Sessions between 2002 and 2016 in order to address the State's water supply needs.

Chapter 163, F.S. requires that all local municipalities update their 10-Year Water Supply Facilities Work Plan and adopt that plan into the comprehensive plan within eighteen (18) months of the SFWMD's approval of the Lower East Coast Water Supply Plan. The work plan and the comprehensive plan amendments must address the development of traditional and alternative water supplies and conservation and reuse programs that are necessary to serve existing and new development for at least a 10-year planning period. The Lower East Coast Water Supply Plan was approved on November 8, 2018. Therefore, the deadline for local governments within the Lower East Coast jurisdiction to amend their comprehensive plans to adopt a Work Plan Update is May 2020.

Analysis:
It should be noted that the Village's recent historical water user rate over the last eight (8) years is averaging 171 gallons per capita, per day. This consumption rate is higher than the adopted level of service of 149.5 gallons per capita, per day. It is likely that the higher rate is due to the greater number of resort and transient uses than other areas of the Keys. In addition, there could be inefficiencies in the aged utility infrastructure. The replacement of the transmission lines is

being addressed in the next three years by the water provider. The Florida Keys Aqueduct Authority (FKAA) has programmed almost $30,000,000 on a transmission line replacement for the Village. Therefore, it is recommended in this plan that the Village improve their conservation efforts, which could include education programs and landscape and irrigation ordinances, among other measures.

The proposed Work Plan Update and related amendments were heard by the Local Planning Agency on March 9, 2020. The LPA discussed the need to further the conservation and education efforts by the Village and requested that the water supplier, FKAA, increase leak detection efforts to the greatest extent feasible. By unanimous vote, the LPA recommended that the Village Council approve the transmittal of the Work Plan and the associated Comprehensive Plan Amendments to the Department of Economic Opportunity ("DEO")and the State Review agencies.

A copy of the proposed Work Plan Update and the related Comprehensive Plan amendments are attached.

Budget Impact:

Staff Impact:
Staff will coordinate transmittal of the Village's proposed 10-Year Water Supply Facilities Work Plan Update and related Comprehensive Plan amendments in compliance with State requirements for local water supply planning.

Recommendation:
It is recommended that the **Village Council** pass the Ordinance on First Reading, thereby approving the 10-Year Water Supply Facilities Work Plan, and that the Village Council adopt the Ordinance on Second Reading and transmit the proposed update of the Work Plan and related proposed Comprehensive Plan amendments to DEO.

ORDINANCE NO. 20-

AN ORDINANCE OF ISLAMORADA, VILLAGE OF ISLANDS, FLORIDA, AMENDING THE VILLAGE'S COMPREHENSIVE PLAN TO ADOPT THE WATER SUPPLY PLAN AS MANDATED BY FLORIDA STATUTES 163.3177(6)(C)3; PROVIDING FOR THE TRANSMITTAL OF THIS ORDINANCE TO THE STATE DEPARTMENT OF ECONOMIC OPPORTUNITY; AND PROVIDING FOR AN EFFECTIVE DATE UPON THE APPROVAL OF THIS ORDINANCE BY THE STATE DEPARTMENT OF ECONOMIC OPPORTUNITY

WHEREAS, the Florida State Legislature has mandated that all local governments draft and adopt a Water Supply Plan (the "Plan") to local Comprehensive Plans to strengthen coordination of water supply planning and local land use planning; and

WHEREAS, Section 163.3184, F.S., establishes a process for adoption of comprehensive plans and Plan Amendments, and the Village adopted its Comprehensive Plan in 2001; and

WHEREAS, pursuant to Chapter 163, Part II, Florida Statutes (F.S.), Islamorada, Village of Islands, Florida (the "Village") proposes to amend the Village Comprehensive Plan (the "Comprehensive Plan") as provided for by the Water Supply Plan (the "Plan") and associated attached as Exhibit "A;" and

WHEREAS, the Village recognizes the need for better coordination of land use planning, development and water supply; and

WHEREAS, the Village Council previously adopted Resolution 16-06-35, thereby supporting Everglades restoration projects and advocating for increased freshwater flows into Florida Bay and the recharge of the Biscayne aquifer with potable water; and

WHEREAS, on November 8, 2018, the South Florida Water Management District approved its Lower East Coast Regional Water Supply Plan update; and

WHEREAS, Section 163.3177(6)(c)3, F.S., the Village is required to update its Water Supply Plan and adopt revisions to the Village's Comprehensive Plan by addressing the water supply planning requirements within 18 months of the regional plan's approval; and

WHEREAS, Village staff has prepared the Water Supply Plan titled "Water Supply Facilities Work Plan Update"; and

WHEREAS, the Local Planning Agency (LPA) held a public hearing on March 9, 2020 to review the proposed Plan and associated Amendments; and

WHEREAS, the Village Council held public hearings on May 7, 2020 and _____, 2020 to review the proposed Plan; and

WHEREAS, the provisions of the Plan are consistent with the Village Comprehensive Plan, the Principles for Guiding Development in the Florida Keys Area of Critical State Concern, the Lower East Coast Water Supply Plan and the Florida Keys Aqueduct Authority's 20-Year Water System Capital Improvement Master Plan.

NOW, THEREFORE, BE IT ORDAINED BY THE VILLAGE COUNCIL OF ISLAMORADA, VILLAGE OF ISLANDS, FLORIDA, AS FOLLOWS:

Section 1. Recitals. The above recitals are true and correct and incorporated herein by this reference.

Section 2. Adoption of the Water Supply Facilities Work Plan. The Village Council hereby approves and adopts the proposed updates to the Water Supply Facilities Work Plan Update, as set forth herein and attached as Exhibit "A" hereto.

Section 3. Comprehensive Plan Amendment. The amendment to the Comprehensive Plan is to reflect the updated Goals, Objectives, and Policies related to the Water Supply Facilities Work Plan.

Village of Islands Comprehensive Plan is hereby amended to read as follows [1]:

Policy XX: The Village shall assist the FKAA with water conservation efforts by implementing water conservation measures which include Florida Friendly Landscape Principles.

Policy XX: The Village shall coordinate with FKAA public education programs for the implementation of water conservation measures.

Policy XX: The Village shall comply with SFWMD water use restrictions when shortages are declared by SFWMD.

Policy XX: Islamorada, Village of Islands, (Village) hereby adopts by reference the Water Supply Facilities Work Plan (Work Plan), dated xxxx, for a planning period of not less than 10 years. The Work Plan addresses issues that pertain to water supply facilities and requirements needed to serve current and future development within the Village's water service area. The Village shall review and update the Work Plan at least every five (5) years within 18 months after the governing board of the water management district approves an updated regional water supply plan. Any changes affecting the Work Plan shall be included in the annual Capital Improvements Plan update to ensure consistency between the Work Plan and the Capital Improvements Element.

OBJECTIVE 1-4.1: CONCURRENCY MANAGEMENT. Pursuant to Chapter 163, F.S~~., and Rule9J-5,F.A.C.,~~ Section 163.3180, Florida Statutes (F.S.) for concurrency requirements, the Village shall issue no development order or permit for development unless the applicant provides narrative and graphic information demonstrating to the satisfaction of the Village that public facilities required by the subject development shall be in place concurrent with the impacts of development. Furthermore, the applicant shall assure that the facilities operate at or above adopted level of service (LOS) standards. The applicant's narrative and graphic information shall also demonstrate that the subject development shall not reduce the levels of service for public facilities serving the development below adopted LOS standards.

Policy 1-4.1.1: Ensure Existing Concurrency Management System is Consistent with SFWMD's Lower East Coast Water Supply Plan. Islamorada, Village of Islands shall ensure that the existing concurrency management system is consistent with the South Florida Water Management District Lower East Coast Water Supply Plan updated ~~October 10, 2013~~ November 8, 2018 and the Florida Keys Aqueduct Authority's 20-Year Water Supply System Capital Improvements Master Plan Final, adopted December 2006.

Policy 1-4.5.5: Conserve Water Including Potable Water Supply. The water supply including the potable water supply shall be conserved by enforcing water standards as delineated in the Land Development Regulations and coordinating with the South Florida Water Management District and FKAA to implement any water restriction mandates issued, through the distribution of materials to the public and Village website.

Policy 1-4.7.2: Conserve Water Through Landscaping. The Village shall assist the FKAA with water conservation efforts by implementing water conservation measures which include Florida Friendly Landscape Principles.

Policy 1-4.7.3: Conserve Water Through Education. The Village shall coordinate with FKAA public education programs for the implementation of water conservation measures.

Policy 1-4.7.4: Conserve Water Through Restrictions. The Village shall comply with SFWMD water use restrictions when shortages are declared by SFWMD.

Policy 4-1.1.3: Adopt Potable Water Level of Service Standards. Islamorada, Village of Islands hereby adopts LOS standards for water, including potable water, as follows:

MEASURE	LOS STANDARD
Residential LOS	66.5 gal/cap/day
Non Residential LOS	0.35 gal/sq. ft./ day
Overall LOS	± ~~149~~ 171 gal/cap/day
Equivalent Residential Unit	371.7 gal/day
Minimum Pressure	20 PSI at customer
Minimum Quality	Shall be as defined by the USEPA (part 143 National Secondary Drinking Standards, 40 CFR 143, 44FR 42198)

Policy 4-1.1.6: Coordinate Between Future Land Use and Potable Water/Wastewater System Needs. The Village's Land Development Regulations shall be enforced to ensure that incremental decisions by the Village concerning water, including potable water, and wastewater system needs, plans and the location and timing of improvements shall be consistent with the objectives and policies of the Future Land Use, the Conservation Elements of this Comprehensive Plan, and the South Florida Water Management District *Lower East Coast Regional Water Supply Plan* updated ~~October 10. 2013~~November 8, 2018.

Policy 4-1.1.10: Adopt a 10-Year Water Supply Facilities Work Plan. Islamorada, Village of Islands shall adopt a 10-Year Water Supply Facilities Work Plan in coordination with the Florida Keys Aqueduct Authority that identifies existing and proposed alternative water supply projects, traditional water supply projects, conservation methods and reuse necessary to meet the water supply needs of the Village, consistent with the South Florida Water Management District *Lower East Coast Regional Water Supply Plan* updated ~~October 10. 2013~~ November 8, 2018 and the Florida Keys Aqueduct Authority *20-Year Water Supply System Capital Improvement Master Plan* Final adopted December 2006~~,. for the 2017 Islamorada Water Supply Facilities Work Plan~~

[1] Additional text is shown as underlined; deleted text is shown as ~~strikethrough~~.

Policy 4-1.1.13: Adopt the Water Supply Facilities Work Plan. Islamorada, Village of Islands, (Village) hereby adopts by reference the Water Supply Facilities Work Plan (Work Plan), dated xxxx, for a planning period of not less than 10 years. The Work Plan addresses issues that pertain to water supply facilities and requirements needed to serve current and future development within the Village's water service area. The Village shall review and update the Work Plan at least every five (5) years within 18 months after the governing board of the water management district approves an updated regional water supply plan. Any changes affecting the Work Plan shall be included in the annual Capital Improvements Plan update to ensure consistency between the Work Plan and the Capital Improvements Element.

OBJECTIVE 4-5.2: PROMOTE WATER CONSERVATION. Islamorada, Village of Islands shall assist the FKAA with water conservation and reuse efforts and assist in implementing the FKAA's Water Conservation Plan consistent with SFWMD's Water Shortage Plan, Water Conservation Program and Lower East Coast Water Supply Plan. Recognizing that the Village is located in an area that the SFWMD identifies as a "priority water resource caution area," the Village shall strive to lower its per person per day usage of water below ~~+/- 149.5~~ 171 gallons per person per day (gpcpd) and will continue to work with the Florida Keys Aqueduct Authority (FKAA) and the SFWMD to reduce demand within the Village for potable water.

Policy 4-5.2.1: Enforce Water Conservation Measures. Islamorada, Village of Islands shall continue to enforce Land Development Regulations which regulate xeriscape landscape practices, Florida Friendly Landscape Principles, and the installation of water conservation irrigation systems and water-conserving plumbing fixtures.

Policy 4-5.2.4: Leak Detection and Repair Program. The Village shall develop a leak detection and repair program for all Village-owned facilities by the end of ~~2009~~2030.

Policy 6-1.2.4: Implement Water Demand Management Policies and Programs. Islamorada, Village of Islands shall continue to cooperate with the Florida Keys Aqueduct Authority and the South Florida Water Management District to implement water demand management policies and programs consistent with the Lower East Coast Water Supply Plan Update November 8, 2018~~October 2013~~, the FKAA 20- Year Water Supply System Capital Improvement Master Plan ~~December 2006~~ 2020 and the Village's 10-Year Water Supply Facilities Work Plan ~~2017~~ 2020 Update.

Policy 8-1.1.3: Interlocal Agreement with FKAA to Identify the Availability of Water Supply to Serve Existing and New Development. By December 31, ~~2009~~2030, Islamorada, Village of Islands, shall enter into an interlocal agreement with the FKAA to formulate a mechanism that will allow the FKAA and the Village to identify the availability of water supply needed to serve existing and new development within the Village; monitor the use of potable water; and implement such alternative water supply projects, traditional water supply projects, conservation projects and reuse necessary to meet the Village's water supply needs.

Policy 9-1.2.3: Adopt and Maintain the Following Level of Service Standards. Islamorada, Village of Islands shall adopt level of service standards for public facilities, for which concurrency is required, as set forth below. Prior to issuing a development order the Village shall review all proposed development to ensure consistency with adopted LOS standards. No development shall be approved that is projected to decrease the existing LOS below the adopted standard, unless mitigation by the developer is approved by the Village Council.

SUMMARY OF LEVEL OF SERVICE STANDARDS

FACILITIES	LEVEL OF SERVICE STANDARDS
Wastewater	The Village, shall at a minimum , adopt the current level of service standards as provided in Federal and State regulations. The current LOS standards are as follows: **FLORIDA STATUTORY TREATMENT STANDARDS in MG/L - BOD/ TSS /TN/ TP** 1. Design flows less than or equal to 100,000 gpd (BAT) in MG/ L-10 / 10 / 10 / 1 2. Design flows greater than 100,000 gpd (AWT) in MG/ L- 5 / 5 / 3 / 1
Wastewater Supply LOS	70 gal/capita/day
Potable Water	Residential LOS: 66.5 gal/capita/day Non-Residential LOS: 0.35 gal/ sq.ft ./ day Overall LOS: ~~±-+ 149.5~~171 gallons/capita/day ERU: 371.7 gal/day
Solid Waste	Residential Disposal Quantity: 5.44 pounds/capita/day Non-Residential: 6.37 pounds/acre/day
Stormwater	1. Post development runoff shall not exceed the pre-development runoff rate for a 25-year storm event, up to and including an event with a 24-hour duration. 2. Stormwater treatment and disposal facilities shall be designed to meet the design and performance standards established in Rule 62-25.025, FAC, with treatment of the runoff from the first one inch of rainfall on-site to meet the surface water quality standards required by Rule 62-302.500, FAC. 3. Stormwater facilities which directly discharge into 'Outstanding Florida Waters' (OFW) shall provide an additional treatment pursuant to Rule 62-25.025(9), FAC. Stormwater facilities shall be designed so as to not degrade the receiving water body below the minimum conditions necessary to assure the suitability of water for the designated use of its classification as established in Chapter 62-302, FAC.
Recreation and Open Space	3.79 acres per 1,000 population
Roadways	U.S. 1 shall be maintained within 5% of LOS C as measured on an overall countywide basis not dependent on any single road segment, using the measured median travel speed from the annual report of public facilities capacity . All other roadways for which the Village is responsible shall have sufficient available capacity to operate at or above LOS measured by peak hour volumes at all intersections, including but not limited to all intersections with U.S. 1.

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Section 4. **Transmittal.** Pursuant to Sections 163.3184 and 163.3187(6)(a), Florida Statutes, the Village Clerk is authorized to forward a copy of this Ordinance to the State Department of Economic Opportunity (the "DEO").

Section 5. **Severability.** The provisions of this Ordinance are declared to be severable and if any section, sentence, clause or phrase of this Ordinance shall for any reason be held to be invalid or unconstitutional, such decision shall not affect the validity of the remaining sections, sentences, clauses, and phrases of this Ordinance, but they shall remain in effect, it being the legislative intent that this Ordinance shall stand notwithstanding the invalidity of any part.

Section 6. Transmittal to the Florida Department of Economic Opportunity. Village Clerk is authorized to forward a copy of this Ordinance to the Florida Department of Economic Opportunity ("DEO") for approval pursuant to Sections 380.05(6) and (11), Florida Statutes.

Section 6. Effective Date. This Ordinance shall not be effective immediately upon adoption. However, the Amendment shall not take effect until the date the final order is issued by the Department of Economic Opportunity to be in compliance in accordance with Chapter 163.3184, Florida Statutes. The Department of Economic Opportunity ("DEO") notice of intent to find the Amendment in compliance shall be deemed to be the final order if no timely petition challenging the Amendment is filed.

The foregoing Ordinance was offered by _____, who moved for its adoption on first reading. This motion was seconded by _____, and upon being put to a vote, the vote was as follows:

Mayor Mike Forster ___
Vice Mayor Ken Davis ___
Councilwoman Deb Gillis ___
Councilman Jim Mooney ___
Councilman Chris Sante ___

PASSED on the first reading this __ day of _____, 2020.

The foregoing Ordinance was offered by _____, who moved for its adoption on second reading. This motion was seconded by _____, and upon being put to a vote, the vote was as follows:

Mayor Mike Forster ___
Vice Mayor Ken Davis ___
Councilwoman Deb Gillis ___
Councilman Jim Mooney ___
Councilman Chris Sante ___

PASSED AND ADOPTED on the second reading this ___ day of _____, 2020.

_____
MIKE FORSTER, MAYOR

ATTEST:

_____
KELLY TOTH, VILLAGE CLERK

APPROVED AS TO FORM AND LEGALITY
FOR THE USE AND BENEFIT OF
ISLAMORADA, VILLAGE OF ISLANDS ONLY

_____
ROGET V. BRYAN, VILLAGE ATTORNEY

Exhibit "A"

Islamorada Village of Islands, Florida

WATER SUPPLY FACILITIES WORK PLAN UPDATE

KEY WEST
THE CITIZEN
The Florida Keys Only Daily Newspaper, Est. 1876
PO Box 1800, Key West FL 33041
P: (305) 292-7777 ext. 219 F: (305) 295-8025
legals@keysnews.com

ISLAMORADA VILLAGE OF ISLANDS
86800 OVERSEAS HWY
ISLAMORADA FL 33036-3162

Account: 137900 Ticket: 341390

PUBLISHER'S AFF

STATE OF FLORIDA
COUNTY OF MONROE

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Before the undersigned authority personally appeared KEVIN HEFLIN, who on oath says that he or she is an employee of the Key West Citizen, a daily newspaper published in Key West, in Monroe County, Florida; that the attached copy of advertisment, being a legal notice in the matter of was published in said newspaper in the issues of:

Wednesday, April 22, 2020

Affiant further says that the Key West Citizen is a newspaper published in Key West, in said Monroe County, Florida and that the said newspapers has heretofore been continuously published in said Monroe County, Florida every day, and has been entered as periodicals matter at the post office in Key West, in said Monroe County, Florida, for a period of 1 year next preceding the first publication of the attached copy of advertisement; and affiant further says that he or she has neither paid nor promised any person, firm or corporation any discount, rebate, commission or refund for the purpose of securing this advertisement for publication in the said newspaper.

Kevin Heflin
(Signature of Affiant)

Affirmed and subscribed before me this 8th day of May 2020

(Notary Public Signature)

SUELYNN STAMPER
(Notary Public Printed Name) (Notary Seal)

My commission expires 6/27/22

Personally Known X Produced Identification ___

Type of Identification Produced _____

NOTARY PUBLIC STATE OF FLORIDA
Suelynn Stamper
COMMISSION # GG232802
EXPIRES: June 27, 2022
Bonded Thru Aaron Notary

ISLAMORADA, VILLAGE OF ISLANDS
NOTICE OF PUBLIC HEARING

NOTICE IS HEREBY GIVEN that on Thursday, May 7, 2020, at 5:30 P.M., the Islamorada, Village of Islands Village Council will hold a public hearing at Founders Park Community Center located at 87000 Overseas Highway, Islamorada, Florida. The purpose of the public hearing is to consider the following items:

FIRST READINGS

AN ORDINANCE OF ISLAMORADA, VILLAGE OF ISLANDS, FLORIDA, AMENDING THE VILLAGE'S COMPREHENSIVE PLAN BY ADOPTING THE WATER SUPPLY PLAN AS MANDATED BY FLORIDA STATUTES 163.3177; PROVIDING FOR THE TRANSMITTAL OF THIS ORDINANCE TO THE STATE DEPARTMENT OF ECONOMIC OPPORTUNITY; AND PROVIDING FOR AN EFFECTIVE DATE UPON THE APPROVAL OF THIS ORDINANCE BY THE STATE DEPARTMENT OF ECONOMIC OPPORTUNITY.

AN ORDINANCE OF ISLAMORADA, VILLAGE OF ISLANDS, FLORIDA, AMENDING CHAPTER 30, LAND DEVELOPMENT REGULATIONS RELATED TO TRANSFER OF DEVELOPMENT RIGHTS; AMENDING SECTION 30-506(1)(D) "TRANSFER OF DEVELOPMENT RIGHTS (TDR) FOR RESIDENTIAL DWELLING UNITS AND DENSITY"; TO SPECIFICALLY ADD VILLAGE CENTER (VC), TOURIST COMMERCIAL (TC), COMMERCIAL FISHING (CF), MARINE USE (MR), HIGHWAY COMMERCIAL (HC) AND NEIGHBORHOOD COMMERCIAL (NC) AS ELIGIBLE ZONING DISTRICTS FOR RECEIVING TRANSFERS OF RESIDENTIAL DENSITY FROM RESIDENTIAL SENDER SITES WITHIN ZONING DISTRICTS ELIGIBLE FOR TRANSFER OF RESIDENTIAL DENSITY; PROVIDING FOR THE REPEAL OF ALL CODE PROVISIONS AND ORDINANCES INCONSISTENT WITH THIS ORDINANCE; PROVIDING FOR SEVERABILITY; PROVIDING FOR INCLUSION IN THE CODE; PROVIDING FOR THE TRANSMITTAL OF THIS ORDINANCE TO THE FLORIDA DEPARTMENT OF ECONOMIC OPPORTUNITY; AND PROVIDING FOR AN EFFECTIVE DATE UPON APPROVAL OF THIS ORDINANCE BY THE FLORIDA DEPARTMENT OF ECONOMIC OPPORTUNITY.

A copy of the items may be reviewed at the Village Administrative Center and Public Safety Headquarters, 86800 Overseas Highway, Islamorada, Florida.

Affected parties may appear at the public hearing, be heard and submit evidence with respect to the applications.

Pursuant to Section 286.0105, Florida Statutes, anyone wishing to appeal any decision made by the Islamorada Village Council with respect to any matter considered at such meeting or hearing will need a record of the proceedings and, for such purpose, may need to ensure that a verbatim record of the proceeding is made, prepared by a court reporter at the appellant's expense; such record includes the testimony and evidence upon which the appeal is to be based.

ADA Assistance: In accordance with the Americans with Disabilities Act of 1990, all persons who are disabled and who need special accommodations to participate in this meeting because of that disability should contact the office of the

WATER SUPPLY FACILITIES WORK PLAN UPDATE

DRAFT

Local Planning Agency Hearing • March 9, 2020
First Reading • May 7, 2020
Adoption Hearing XXXXX

THE CORRADINO GROUP

ACKNOWLEDGMENTS

Village Council

Mike Forster, Mayor
Ken Davis, Vice Mayor
Deb Gillis
Chris Sante
Jim Mooney

Village Staff

Seth Lawless, Village Manager
Roget V. Bryan, Esq. Village Attorney
Kelly S. Toth, CMC, Village Clerk

Prepared By

The Corradino Group, Inc.
4055 NW 97th Avenue, Suite 200
Doral, FL 33178

THE CORRADINO GROUP

TABLE OF CONTENTS

1.0 | INTRODUCTION

The purpose of the Islamorada, Village of Islands, (the "Village") Water Supply Facilities Work Plan is to identify and plan for the water supply sources and facilities needed to serve existing and new development within the local government's jurisdiction. Chapter 163, Part 11, F.S., requires local governments to prepare and adopt Work Plans into their comprehensive plans within 18 months after the water management district approves a regional water supply plan or its update. The Lower East Coast Water Supply Plan Update was approved by the South Florida Water Management District (SFWMD) on November 8, 2018. Therefore, the deadline for local governments within the Lower East Coast jurisdiction to amend their comprehensive plans to adopt a Work Plan Update is May 2020.

Water users in the Village obtain their water directly from the Florida Keys Aqueduct Authority (FKAA), which is responsible for ensuring that enough capacity is available for existing and future customers.

The Village's Work Plan will reference the initiatives already identified in the FKAA 20-year Master Plan since the Village is a retail buyer. According to state guidelines, the Work Plan and the comprehensive plan amendment must address the development of traditional and alternative water supplies, bulk sales agreements, and conservation and reuse programs that are necessary to serve existing and new development for at least a 10-year planning period. The Village's Work Plan will be for a 10-year planning period and identify projects from the FKAA Master Plan consistent with this planning period.

The Village's Work Plan is divided into four sections:

Section 1- Introduction
Section 2 - Background Information
Section 3 - Data and Analysis
Section 4 - Work Plan Projects/Capital Improvements Element/Schedule
Section 5 - Goals, Objectives, and Policies

1.1 Statutory History

The Florida Legislature has enacted bills in the 2002, 2004, 2005, 2011, 2012, 2015, and 2016 sessions to address the state's water supply needs. These bills, especially Senate Bills 360 and 444 (2005 legislative session), significantly changed Chapter 163 and 373 Florida Statutes (F.S.) by strengthening the statutory links between the regional water supply plans prepared by the water management districts and the comprehensive plans prepared by local governments. In addition, these bills established the basis for improving coordination between the local land use planning and water supply planning.

In 2011, Sections 163.3177(6)(c)3 and Section 163.3177(6)(d)3, F.S. were modified to exempt water supply planning amendments to the limitation on the frequency of amendments to the comprehensive plan and to include considerations for industrial and agricultural uses when the regional water management district plans for water quantity and quality. 2015, Section 163.3177(6)(c)4, F.S. was modified to state that a local government that does not own, operate, or maintain its own water supply facilities and is served by a public water utility with a permitted allocation of greater than 300 million gallons per day is not required to amend its comprehensive plan in response to an updated regional water supply plan or maintain a work plan if the local government's usage of water is less than 1 percent of the public water utility's total permitted allocation. This exemption does not apply to the FKAA or any of the municipalities served by it.

1.2 Statutory Requirements

Each local government must comply with the following requirements:

1. Coordinate appropriate aspects of its comprehensive plan with the appropriate water management district's regional water supply plan, [163.3177(4)(a), F.S.]
2. Ensure that its Future Land Use Plan is based upon availability of adequate water supplies and public facilities and services [s.163.3177(6)(a)2d, F.S., effective July 1, 2005]. Data and analysis demonstrating that adequate water supplies and associated public facilities will be available to meet projected growth demands must accompany all proposed Future Land Use Map amendments submitted to the Department for review. The submitted package must also include an amendment to the Capital Improvements element, if necessary, to demonstrate that adequate public facilities will be available to serve the proposed Future Land Use Map modification.
3. Ensure that adequate water supplies and facilities are available no later than the date on which the local government anticipates issuing a certificate of occupancy and consult with the applicable water supplier prior to approving a building permit, to determine whether adequate water supplies will be available to serve the development by the anticipated issuance date of the certificate of occupancy [s.163.3180(2), F.S., effective July 1, 2005].
4. For local governments subject to a regional water supply plan, revise the General Sanitary Sewer, Solid Waste, Drainage, Potable Water, and Natural Groundwater Aquifer Recharge Element (the "Infrastructure Element"), within 18 months after the water management district approves an updated regional water supply plan, to:
    a. Identify and incorporate the alternative water supply projects(s) selected by the local government from projects identified in the updated regional water supply plan, or the alternative project proposed by the local government under s. 373.0361(7), F.S. [s. 163.3177(6)(c), F.S.];
    b. Identify the traditional and alternative water supply projects, bulk sales agreements, and the conservation and reuse programs necessary to meet current and future water use demands within the local government's jurisdiction [s.163.3177(6)(c), F.S.]; and
    c. Include a water supply facilities work plan for at least a 10-year planning period for constructing the public, private, and regional water supply facilities identified in the element as necessary to serve existing and new development. [s. 163.3177(6)(c), F.S.].
5. Revise the Five-Year Schedule of Capital Improvements to include any water supply, reuse, and conservation projects and programs to be implemented during the five-year period.
6. To the extent necessary to maintain internal consistency after making the changes described in Paragraphs 1 through 5 above, revise the Conservation Element to assess projected water needs and sources for at least a 10-year planning period, considering the appropriate regional water supply plan, the applicable District Water Management Plan, as well as applicable consumptive use permit(s), [s 163.3177(6)(d)2b, F.S.]
7. To the extent necessary to maintain internal consistency after making changes described in Paragraphs 1 through 5 above, revise the Intergovernmental Coordination Element to ensure coordination of the comprehensive plan with applicable regional water supply plans and regional water supply authorities' plans [s.163.3177(6)(h)l., F.S.].
8. Local governments are required to comprehensively evaluate and update the Comprehensive Plan to reflect changes in local conditions every seven years. The evaluation could address the local government's need to update their Work Plan, including the development of alternative water supplies, and determine whether the identified alternate water supply projects, traditional water supply projects, and conservation and reuse programs are meeting local water use demands [s.163.3181(3), F.S.].
9. Local governments may be exempt from updating their Work Plan if they meet certain criteria. A local government that does not own, operate, or maintain its own water supply facilities and is served by a public water supply entity with a permitted allocation of 300 million gallons per day or greater is not required to amend its Comprehensive Plan when an RWSP is updated if the local government uses less than 1 percent of the public water supply entity's total permitted allocation. However, the local government must cooperate with the public water supply entity that provides service within its jurisdiction and must keep the Sanitary Sewer, Solid Waste, Drainage, Potable Water, and Natural Groundwater Aquifer Recharge element up to date, pursuant to Section 163.3191, F.S. A local government should contact the Florida Department of Economic Opportunity (DEO) to verify its qualifications for the exemption [Section 163.3177(6)(c)4., F.S.].

2.0 | BACKGROUND INFORMATION

2.1 Overview

Islamorada, Village of Islands, was incorporated in 1997, making it the fourth municipality established in Monroe County. The Village consists of four main islands: Lower and Upper Matecumbe, Windley and Plantation Keys. The current permanent population estimate is 5,990 residents based on the most recent University of Florida Bureau of Economic and Business Research (BEBR April 1, 2018) data. The Village has a significant "seasonal population" of approximately 2,352 people. On any given day there are additional "transient residents" that may lodge in the Village for several days upward to a month. All of these population segments will utilize the Village's potable water resources. The combined amount of all population segments represents the "functional population" of the Village that will create a demand for water usage. For this Plan the functional population value is used in all per capita calculations and estimates.

The Village has a Building Permit Allocation System (BPAS) that limits new residential growth to 28 units per year and nonresidential growth to 2,500 square feet per year. The potential expansion of the Village's current boundaries through annexations is extremely unlikely.

Table 1. Population Projections 2018 - 2030: Islamorada, Village of Islands

Permanent Population	
Year	**Population**
2018	5,990
2020	6,215
2025	6,224
2030	6,232

Source: Bureau of Economics and Business Research, Florida Population Studies, Bulletin 174

2.2 Relevant Regional Issues

Relevant regional issues that affect the Village of Islamorada include minimizing pressure on the Everglades and Biscayne Bay ecosystems and Biscayne and Floridan Aquifers. Recent SFWMD priorities have focused on creating Water Reservation rules to facilitate construction on CERP project components. The Village is in support of CERP and other restoration projects.

As the state agency responsible for water supply in the Lower East Coast planning area, the SFWMD plays a pivotal role in resource protection, through criteria used for Consumptive Use Permitting. As pressure increased on the Everglades ecosystem resource, the Governing Board initiated rulemaking to limit increased allocations dependent on the Everglades system. As a result, the Regional Water Availability Rule was adopted by the Governing Board on February 15, 2007 as part of the SFWMD's Consumptive Use Permit Program. This reduced reliance on the regional system for future water supply needs, mandates the development of alternative water supplies, and increasing conservation and reuse. Additionally, the FKAA is the Village's sole water supplier and is responsible for operating and maintaining all accessory facilities such as pump stations and associated pipelines.

The Village recognizes the Everglades ecosystem as the primary source of fresh water that serves as the foundation of the nearshore estuarine environment for Florida Bay and recharge of the Biscayne aquifer with potable water. The Village, through the adoption of Resolution 16-06-35, supports expediting Everglades restoration projects to increase freshwater flows through the Everglades ecosystem and into Florida Bay.

The 2018 Lower East Coast Water Supply Plan Update water supply issues are as follows:

1. Fresh surface water and groundwater are limited; further withdrawals could have impacts on the regional system, wetlands, existing legal uses, and saltwater intrusion. As a result, additional alternative water supplies need to be developed.
2. Surface water allocations from Lake Okeechobee and the Water Conservation Areas are limited in accordance with the Lake Okeechobee Service Area RAA criteria.
3. Construction of additional storage systems (e.g., reservoirs, aquifer storage and recovery systems) to capture wet season flow volumes will be necessary to increase water availability during dry conditions and attenuate damaging peak flow events from Lake Okeechobee.
4. Expanded use of reclaimed water is necessary to meet future water supply demands and the Ocean Outfall Law.
5. Expanded use of brackish groundwater from the Floridan aquifer system requires careful planning and wellfield management to prevent undesirable changes in water quality.
6. The sole source provider of potable water to Monroe County is FKAA, whose wellfield is located in Florida City. The limited availability of SAS withdrawals presents a potential risk to the water supply for all of Monroe County. FKAA is a permitted Floridan Aquifer User, which should offset any anticipated drought-driven saltwater intrusion event. FKAA also operates reverse osmosis facilities in Marathon and Stock Island.

Other regional water issues have been identified by the Southeast Florida Regional Climate Change Compact, which includes Palm Beach, Broward, Miami-Dade and Monroe Counties. The Compact communities have agreed to use a sea level rise prediction of between 6 and 10 inches by 2030, and between 14 and 26 inches by the year 2060 for planning purposes in the Southeast Florida region until more definitive information on future sea level rise is available (the Compact's A Unified Sea Level Rise Projection for Southeast Florida, October, 2015). The potential landward movement of the saltwater intrusion line resulting from the impact of sea level rise may affect future decisions regarding the implementation of capital improvements, requiring adaptation mitigation strategies to preserve the potable water supply. Monroe County's climate change and sustainability consultants have recently summarized hydrologic modeling by the United States Geological Survey that suggests relatively low risk to the FKAA wellfields in Florida City under even the worst-case 2060 sea level rise scenarios. However, FKAA continues to monitor the most current data and analysis regarding this issue.

FKAA is a permitted Floridan Aquifer User, which should offset any anticipated drought-driven saltwater intrusion event. Further, FKAA also operates RO facilities in Marathon and Stock Island, with a combined supply capacity of 3 MGD, as an alternative water source for the county during emergencies and extreme peaks in demand.

3.0 | DATA AND ANALYSIS

The intent of the data and analysis section of the Work Plan is to describe the information that local governments need to provide to state planning and regulatory agencies as part of their proposed comprehensive plan amendments, particularly those that would change the Future Land Use Map (FLUM) to increase density and/or intensity. Additionally, population projections should be reviewed for consistency.

3.1 Population Information

The following population information is based on the FKAA as it is the provider of water for the Village. The FKAA serves three distinct populations: permanent residents, seasonal residents (those residing in the keys for 6 months or less), and day visitors. The term "functional population" is a concept that incorporates these three elements of population. Because of the unique nature of the Keys, which has an economy based on seasonal tourism, it is appropriate to use one "population" number that incorporates these three separate population components. For this Plan, the functional population value is used in all per capita calculations and estimates. Population developed by the Monroe County Planning Department (MCPD) indicate that the permanent population for the Florida Keys in 2015 was 77,600. By 2030, Monroe County is expected to have a permanent population of 75,500. In 2000, the functional population was 153,080. This increased to 155,288 in 2010 and is projected to be 157,400 in 2015; 159,051 in 2020; 160,703 in 2025; and 162,355 in 2030. The projection reflects a total increase in overall population with a predicted decrease in permanent population and increase in seasonal population. The 2040 population of the FKAA service area was estimated to be 77,101 in the Lower East Coast Water Supply Update, prepared by the South Florida Water Management District in 2018 (consistent with Monroe County Planning Department projections).

Table 2. Projected Functional Population 2015-2030: Islamorada, Village of Islands

Year	Functional Population
2015	12,574
2020	12,706
2025	12, 838
2030	12,970

Source: Fishkind & Associates, Inc.; FL Keys Aqueduct Authority; Univ. FL BEBR, PS 156 and annual estimates

Based on the population data maintained by FKAA and population data gathered from the Monroe County Planning Department, it is apparent that the Village is approximately 8% of the total water use population for the FKAA. Table 3 lists the percentage of the client population which is related to the Village.

Table 3. Islamorada, Village of Islands as a Percentage of FKAA Client Base

Year	% of FKAA Client Base
2015	7.98%
2020	7.98%
2025	7.98%
2030	7.98%

Source: Calculated from Monroe County Population Projections, 2010-2030

For the past 20 years, the permanent population in Monroe County has decreased while the seasonal population has increased. This has resulted in shifting water consumption patterns.

3.2 Current and Future Areas Served

The service area of the FKAA includes all of Monroe County plus that area in Miami-Dade County within one (1) mile of the transmission pipeline. The service area includes a mix of commercial, industrial, and residential zonings that typify the land uses of a suburban area. Minimal service exists in Miami-Dade County, consisting of service to only a ranger station just outside the treatment plant. The FKAA does not expect that the distribution facilities on the System will be significantly expanded in Miami-Dade County.

The Florida Keys are comprised of a chain of more than 800 individual islands located at the southern tip of Florida. The FKAA is the only potable water purveyor within the Florida Keys. There are no competing utilities. However, the FKAA is presently precluded by its rules from serving anyone in certain environmentally sensitive areas. Excluded areas are limited to national wildlife Refuges and certain hardwood hammock lands. Additionally, the FKAA is under contract with the U.S. Department of Defense (DoD) to provide up to 2.4 million gallons per day (MGD) of potable water to DoD facilities located at Key West, Boca Chica, and throughout the Keys.

3.3 Potable Water Level of Service (LOS) Standard

Pursuant to the Comprehensive Plan, the Village has an adopted Potable Water LOS of 149.5 gallons per capita, per day (gallons/capita/day). The functional population was 12,574. Therefore, .84 MGD or more of water supply capacity is required to meet the adopted concurrency standard for potable water. FKAA uses 115 gpcd for planning purposes.

3.4 Population and Potable Water Demand Projections

The population estimates and projection and the potable water demand projections for the Village are presented below along with the historical trend. The projections are through the year 2030.

Table 4. Islamorada Waster Usage Rates 2010 to 2018

Year	Average Day MGD	Water Service Population	Per Capita Use; gpd
2010	1.92694	12,424	155
2011	2.11924	12,450	170
2012	2.09350	12,476	167
2013	2.17228	12,502	173
2014	2.22114	12,528	177
2015	2.27010	12,554	180
2016	2.27228	12,580	180
2017	2.21124	12,606	175
2018	2.24696	12,632	177
			Average: 171

While the water service population has increased slightly each year, the use per capita has fluctuated, resulting in an average user rate of 171 gallons per capita, per day. Using the historical average rate, the following table projects the average MGD that will be needed to service demand through 2030. It should be noted that the average usage rate, going back to 2010 has historically exceeded the adopted LOS of 149.5 gallon/capita/day. The per capita use is high due to the higher percentage of commercial use, hotels and resorts in particular, in Islamorada.

Table 5. Islamorada Projected Demand in MGD Using a Per Capita Average

Year	Population	Per Capita Use	Average Use MGD
2019	12,632	171	2.16
2020	12,706	171	2.17
2025	12,838	171	2.20
2030	12,970	171	2.22

Table 6.

Year	Population	Per Capita Use Adopted LOS	Projected Consumption (MGD)
2019	12,632	149.5	1.89
2020	12,706	149.5	1.90
2025	12,838	149.5	1.92
2030	12,970	149.5	1.94

3.5 Water supply Provided by Local Government

The Village does not provide water. The FKAA is the area service provider.

3.6 Water Supply Provided by Other Entities

The FKAA 2020 Master Plan is attached as Appendix A. The intent of the FKAA Plan is to meet the statutory requirements mentioned in subsection 1.2 of this plan and to coordinate water supply initiatives with the SFWMD's Lower East Coast Water Supply Plan Update.

The Florida Keys Aqueduct Authority (FKAA) is the sole provider of potable water in the Florida Keys, established by Special Legislation, Chapter 76-441, L.O.F. (as amended). FKAA's primary water supply is the Biscayne Aquifer, a shallow groundwater source. The FKAA's wellfield is located within an environmentally protected pine rockland forest west of Florida City. The location of the wellfield near Everglades National Park, along with restrictions enforced by state and local regulatory agencies, contributes to the unusually high water quality. These wells contain some of the highest quality groundwater in the state, meeting all regulatory standards prior to treatment. Additionally, the FKAA is continually monitoring, assessing, and working to eliminate potential hazards to our water source, including inappropriate aquifer utilization, unsuitable land uses, and the potential for saltwater intrusion.

The service area of the FKAA includes all of Monroe County plus that area in Miami-Dade County within one (1) mile of the transmission pipeline. The service area includes a mix of commercial, industrial, and residential zonings that typify the land uses of a suburban area. Minimal service exists in Miami-Dade County, consisting of service to only a ranger station just outside of the treatment plant. The FKAA does not expect that the distribution facilities of the System will be significantly expanded in Miami-Dade County.

The Florida Keys are comprised of a chain of more than 800 individual islands located at the southern tip of Florida. The FKAA is the only potable water purveyor within the Florida Keys. There are no other competing utilities. Additionally, the FKAA is under contract with the U.S. Department of Defense (DoD) to provide up to 2.4 million gallons per day (MGD) of potable water to DoD facilities located at Key West, Boca Chica, and throughout the Keys.

The Village does not provide water. The Florida Keys Aqueduct Authority (FKAA) is their water service provider and serves about 50,000 water customers in a service area that includes all of the Florida Keys. Due to the geography of the Florida Keys, operations and maintenance crews and facilities must be located throughout the service area. In addition to operating the water system, these crews respond to line breaks and other service interruptions, perform scheduled preventative maintenance and leak surveys, and maintain facilities and structures.

The groundwater from the wellfield is treated at the FKAA's Water Treatment Facility in Florida City, which currently has a maximum water treatment design capacity of 29.8 MGD. The primary water treatment process is a conventional lime softening/filtration water treatment plant and is capable of treating up to 23.8 MGD from the Biscayne Aquifer. The secondary water treatment process is the newly constructed reverse osmosis (RO) water treatment plant which is capable of producing 6 MGD from the brackish Floridan Aquifer. The product water from these treatment processes is then disinfected and fluoridated. The FKAA treated water is pumped 130 miles from Florida City to Key West supplying water to the entire Florida Keys.

The FKAA maintains storage tank facilities which provide an overall storage capacity of 45.2 million gallons system wide. The sizes of tanks vary from 0.2 to 5.0 million gallons. These tanks are utilized during periods of peak water demand and serve as an emergency water supply. Since the existing transmission line serves the entire Florida Keys and storage capacity is an integral part of the system, the capacity of the entire system must be considered together, rather than in separate service districts.

Additionally, two saltwater RO plants, located on Stock Island and Marathon, are available to produce potable water under emergency conditions. The RO desalination plants have design capacities of 2.0 and 1.0 MGD, respectively.

At present, Key West and Ocean Reef are the only areas of the County served by a flow of potable water sufficient to fight fires. Outside of Key West, firefighters rely on a variety of water sources, including tankers, swimming pools, and saltwater either from drafting sites on the open water or from specially constructed fire wells. Although sufficient flow to fight fires is not guaranteed, new hydrants are being installed as water lines are replaced to make water available for fire-fighting purposes, and pump station/tank facilities are being upgraded to provide additional fire flow and pressure.

Three major challenges facing FKAA are replacing aging infrastructure, environmental concerns, and regulatory requirements.

The potable water level of service standard for the FKAA during the next 10 years is presented below. This table also identifies maximum day and average day finished water demands.

Table 7. Projected Water Demands 2020-2030: FKAA Service Area

Year	Functional Per Capita (gpcd)	Max Day (MGD)	Average Day (MGD)
2015 (Actual)	114	21.4	17.9
2020	115	22.9	18.3
2025	115	23.2	18.6
2030	115	23.6	18.9

Source : FKAA 2019 Water Demand with Projections

The methodology developed by CH2M Hill for the FKAA Master Plan and CUP Renewal is utilized for the demand projections.

This is based on Actual Demands through 2018.

The table below shows a comprehensive listing of the functional population served by and the potable water demand projections for the service area of FKAA, the only utility provider for the Florida Keys.

Table 8. Projected Population and Water Demands 2020-2030: FKAA Service Area

Population		Finished Water Demands		
Year	Functional	Functional Per Capita (gpcpd)	Maximum Day (MGD)	Average Day (MGD)
2015A	156803	114	21.4	17.9
2020	159252	115	22.9	18.3
2025	161604	115	23.2	18.6
2030	163956	115	23.6	18.9

Source: FKAA 2019 Water Demand with Projections

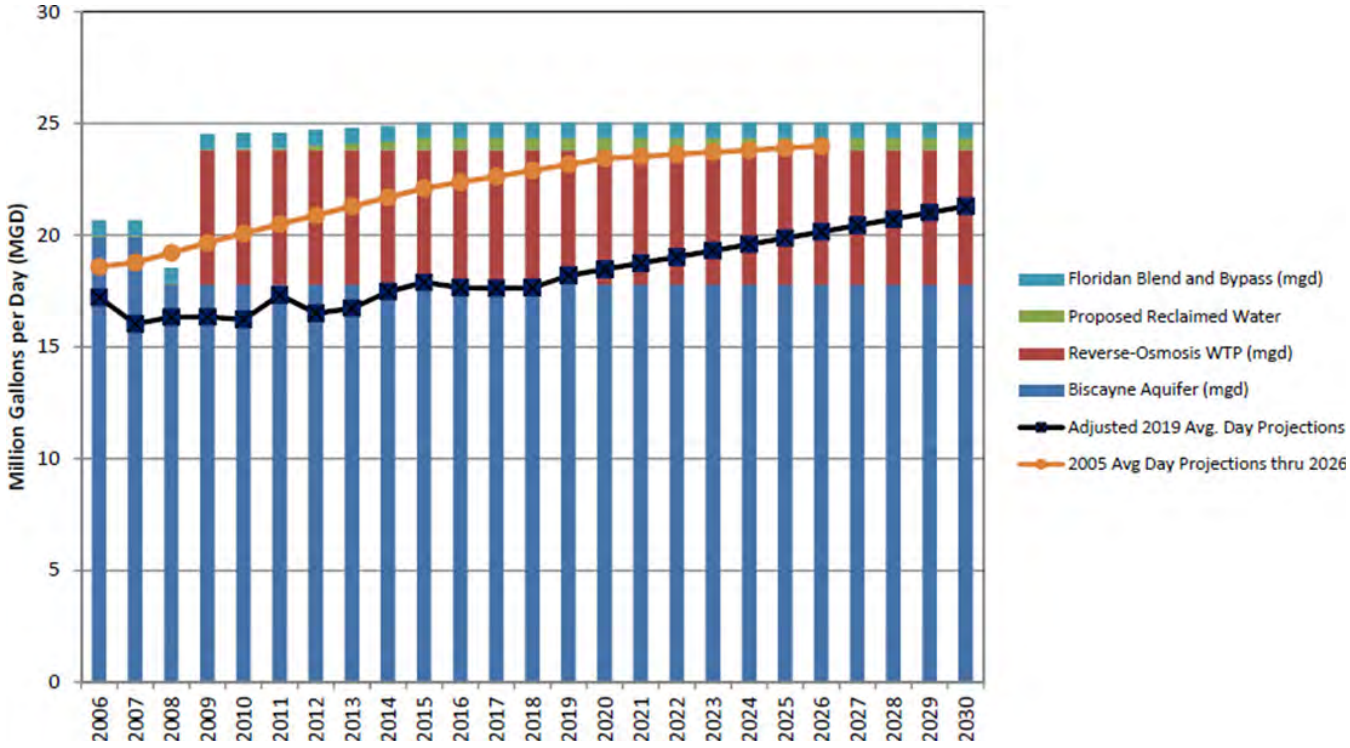
Table 9. Florida Keys Aqueduct Authority: Potable Water Demand Summary - New Water Demand, Actual Water Demand, and Expected Water Demand

	Year - 2018		Year - 2018	Year 2019
Municipality	New Water Service - Gallons/Year	Metered Water - Gallons/Year	Actual Water Demand - Gallons/Year*	Expected Water Demand - Gallons/Year
Unincorporated Monroe County	2,740,200	2,155,814,184	2,774,528,488	2,777,268,688
City of Key West	477,900	1,579,752,473	2,033,138,233	2,033,616,133
City of Marathon	587,900	510,038,439	656,418,438	657,006,338
City of Key Colony	0	109,904,011	141,446,240	141,446,240
City of Layton	0	11,493,322	14,791,882	14,791,882
Village of Islamorada	674,300	637,249,748	820,139,135	820,813,435
Entire Florida Keys	**4,480,300**	**5,004,252,177**	**6,440,462,415**	**6,444,942,715**
SFWMD WUP Annual Allocation			**8,751,000,000**	**8,751,000,000**

**metered + unmetered water demand (ie. flushing, leaks, etc.)*

The Figure below depicts FKAA Water Supply Available vs. Water Demand Projections.

Figure 1



In 2018, the FKAA distributed an annual average of 17.64 MGD from the Biscayne Aquifer plus 0.24 MGD from Floridan RO Production. This table also provides the water treatment capacities of the emergency RO plants. Since the emergency RO plants utilize seawater, a WUP is not required for these facilities.

Table 10. Projected Water Demand in 2019 (in MG)

	FKAA Permit Thresholds	2018 Water Demand	2019 Water Demand Projected
Annual Allocation			
Average Daily Demand	23.98	17.64	18.2
Maximum Monthly Demand	809.01	586.04	604.37
Annual Demand	8,751	6,440	6,641
Biscayne Aquifer Allocation/Limitations			
Average Daily Demand	17.79	17.64	17.79
Annual Demand	6,492	6,439	6,492
Floridan RO Production			
Average Daily Demand	6.00	0.24	0.41
Emergency RO WTP Facilities			
Kermit L. Lewin Design Capacity	2.00 (MGD)	0.00 (MGY)	0.00
Marathon RO Design Capacity	1.00 (MGD)	0.00 (MGY)	0.00

All figures are in millions of gallons.

Source: Florida Keys Aqueduct Authority, 2019

The 2018 figures and projections for 2019 indicate a slight increase in annual average daily demand from 17.64 to 18.2 MGD and an increase in maximum monthly demand from 586.04 MGD to 604.37 MG. Preliminary projections from FKAA for 2020 indicate no increase in annual average daily demand from the 2019 projections.

The table below provides the amount of water used on a per capita basis. Based on Functional Population and average daily demand, the average water consumption for 2018 was approximately 113 gallons per capita, which reflects the entire FKAA service area, including unincorporated Monroe County, Key West, Marathon, Islamorada, Key Colony Beach, and Layton.

Table 11. FKAA Service Area Historical Per Capita Water Use

Year	Functional Population[1]	Daily Demand (gallons)[2]	Average Per Capita Water Consumption (gallons)[2]
2000	153,080	17,016,393	111
2001	153,552	15,415,616	100
2002	154,023	16,962,082	110
2003	154,495	17,228,192	112
2004	154,924	17,652,596	114
2005	156,150	17,730,000	114
2006	155,738	17,287,671	111
2007	155,440	16,017,315	103
2008	154,728	16,285,383	105
2009	155,441	16,345,205	105
2010	155,288	16,210,959	104
2011	156,054	17,334,247	111
2012	156,391	16,508,197	106
2013	156,727	16,836,164	107
2014	157,063	17,472,362	111
2015	157,400	17,890,400	114
2016	157,730	17,704,100	112
2017	158,060	17,632,900	112
2018	158,391	17,643,800	113

Source: [1] Monroe County Population Projections - Monroe County Planning Department, 2011
[2] Florida Keys Aqueduct Authority, 2019

3.6.1 Water Supply Permitting

FKAA's groundwater withdrawals are regulated by its WUP (13-00005-W) issued by the South Florida Water Management District (SFWMD). FKAA has an annual allocation of 6,492 MG through September 2028. The FKAA draws from four different sources in the Keys. Approximately 17.79 MGD is fresh groundwater from the Biscayne Aquifer. This is supplemented with 6 MGD of groundwater from the brackish Floridan Aquifer. Additionally, seawater desalination plants contribute emergency water supply.

Per the terms of FKAA's permit with SFWMD, maximum daily withdrawals are limited to 17 MGD during the dry season (December-April) if aquifer levels fall below 1.25 NGVD29 at USGS monitoring well G-613.

Table 12. Water Supply Sources

Location	Source Water	Treatment Process	Capacity (MGD)
Location	Source Water	Treatment Process	Capacity MGD
Florida City	Biscayne Aquifer	Lime Softening	17.79
Florida City	Floridan Aquifer	Low-Pressure Reverse Osmosis	6
Marathon	Seawater	Desalination and/or R.O.	1
Stock Island	Seawater	Desalination and/or R.O.	2

Table 13. Water Withdrawal Permit Thresholds

Water Source	Permit Specification	Units	Permit Threshold
Biscayne Aquifer	Average Daily Withdrawal	MGD	17.79
	Average Dry Season Withdrawal[1]	MGD	17
	Annual Withdrawal	MG	6,492
Floridan Aquifer	LPRO Capacity	MG	6
Total Annual Allocation	Average Daily Withdrawal	MGD	23.97
	Maximum Monthly Withdrawal	MG	809.01
	Annual Withdrawal	MG	8,750.84

J. Robert Dean Water Treatment Plant

The J. Robert Dean Water Treatment Plant (WTP) has an ultimate design production capacity of 29.8 million gallons per day (mgd); however, plant production is currently limited by source water constraints. The water treatment process consists primarily of lime softening, filtration, disinfection and fluoridation. In addition to water treatment, the facility has water storage tanks, high service pumping equipment, emergency diesel generators, a communications center for the transmission telemetry monitoring and operating system, and a state-certified water quality testing laboratory.

FKAA's consumptive use permit (CUP #13-00005-W) allows the withdrawal from the Biscayne aquifer of 8,751 MG on an annual basis (equivalent to 23.97 mgd) and 809.0088 MG on a maximum-month basis (equivalent to 26.97 mgd). Pumpage may be increased up to 33.57 mgd for "special events" with proper notice to SFWMD. However, during the dry season of each year (December 1 through April 30), withdrawals from the Biscayne Aquifer are limited to an average daily quantity of 17 mgd (or 2,584 MG for the 5-month period).

In summary, the J. Robert Dean WTP has sufficient capacity to meet the annual average demand, even under drought restrictions, for the entire planning period. Additionally, during non-drought conditions, the WTP has surplus capacity to meet maximum day demands. However, during drought conditions, FKAA has an immediate need to construct 0.9 MGD of additional capacity to meet the maximum day demand. By 2040, the amount of additional capacity needed to meet the maximum day demand increases to 2.0 MGD.

Water Supply Wells

FKAA withdraws the bulk of its water from its ten Biscayne Aquifer wells at the J. Robert Dean WTP. A Floridan aquifer exploratory well at the WTP is used for blending purposes, up to a maximum of 4 percent of the Biscayne Aquifer flow.

Ten wells, with capacities ranging from 3 MGD to 3.45 MGD, provide the raw water supply from the Biscayne aquifer. The raw water is combined from the individual wells into a single 24-inch diameter pipeline, where it is later split between the three reactor clarifiers.

3.7 Conservation

3.7.1 County-Wide

Climate change and sea level rise are major issues facing Islamorada and the Florida Keys. Longer drought seasons and more frequently intense hurricanes pose a potential threat to the water supply. Hurricane Irma in 2017 destroyed many homes in the Keys and caused leaks in the system where sections of the Keys were without water for days due to shut-offs. Sea water intrusion into the Biscayne Aquifer is a major concern, causing corrosion and flooding.

Florida Keys Aqueduct Authority promotes water conservation through public outreach and educational efforts. FKAA is converting from a meter network to smart meters . This allows customers to monitor their usage electronically and includes leak status reporting shortly after probable leaks occur. FKAA now has a 14-year average per capita consumption of 109 GPCD, which is much less than the rate of 138 GPCD used for the entire region in the Lower East Coast Water Supply Update, as a result of these conservation efforts.

The water conservation program has reduced the projected water consumption rates from the previous Master Plan (2006) and historical records between 2005 and 2018. The previous Master Plan estimated that the per capita consumption would increase from 118 GPCD to 150 GPCD between 2005 and 2025. Actual data from 2005 to 2018 showed a decrease in consumption from 118 GPCD to 112 GPCD. For planning level purposes, FKAA will use a slightly more conservative consumption rate of 115 GPCD, which is still significantly less than the previous estimate of 150 GPCD.

3.7.2 Local Government Specific Actions, Programs, Regulations, or Opportunities

The Village of Islamorada will continue to conserve potable water supply by enforcing water standards as delineated in the Land Development Regulations and coordinating with the South Florida Water Management District and FKAA to implement water restriction mandates. The Village will assist the FKAA with water conservation and reuse efforts and assist in implementing the FKAA's Water Conservation Plan consistent with SFWMD's Water Shortage Plan, Water Conservation Program and Lower East Coast Water Supply Plan. Recognizing that the Village is located in an area that the SFWMD identifies as a "priority water resource caution area," the Village shall strive to lower its per person per day usage of water and will continue to work with the Florida Keys Aqueduct Authority (FKAA) and the SFWMD to reduce demand within the Village for potable water.

The Village currently enforces Land Development Regulations which regulate Florida-friendly landscape practices, and the installation of water conservation irrigation systems and water-conserving plumbing fixtures. The Village informs residents and business owners of the regional water conservation programs. This information is available at Village Hall and will include brochures and pamphlets to educate and inform people as to the importance of water conservation. The Village has also established regulations limiting the clearing of native habitat.

The Village must work to improve their conservation efforts. An analysis of the existing levels show an increase in usage. The Village must:

- Conduct an analysis of water conservation, use, protection and the applicable policies and programs of the Village, the District, Monroe County, and the 2018 Lower East Coast Water Supply Plan Update (LEC Plan Update). The analysis should focus on how the Village is implementing, supporting or encouraging specific policies and programs.
- Through coordination with FKAA the Village needs to implement the Mandatory Year-Round Landscape Irrigation Conservation Measures, as detailed in Rule 40E-24, Florida Administrative Code.
- Identify options to conserve water, including rate structures, education programs, Florida-friendly landscape ordinances, irrigation ordinances, etc.
- Research new conservation and reuse efforts to be studied and/or implemented.

3.8 Reuse

FKAA has three small wastewater treatment plans (WWTPs) that can produce reclaimed water.

The FKAA is evaluating the feasibility of implementing wastewater reuse to offset some of the increasing potable water demands. However, the cost associated with the lack of large volume Keys irrigation users (such as golf courses), and the limited availability of other smaller Keys irrigation users who have suitable areas to irrigate make this alternative a challenge to implement in the Keys. Wastewater reuse will need to be subsidized for reuse to be a viable alternative water supply source to help offset increasing Keys potable water demands. The combined permitted capacities of Big Coppit and Duck Key WWTPs is 0.685 MGD. The Cudjoe WWTP uses reclaimed water only at the treatment facility and does not have an off-site distribution system.

The Lower East Coast Water Supply Update estimates that the average reclaimed water demand will be 0.23 MGD for the duration of the planning horizon, which appears to be a reasonable assumption. Consequently, FKAA is not anticipating an appreciable offset of potable water use with reclaimed water.

Because of recent regulatory trends, it is unlikely that FKAA will be able to rely on the Biscayne Aquifer to meet its future needs for additional water. SFWMD's Lower East Coast Regional Water Supply Plan advocated the use of the Floridan Aquifer as an alternative supply, either for aquifer storage and recovery, (ASR) or for direct withdrawals for blending or RO. Monroe County, together with FKAA and the Key Largo Sanitary Sewer District, has implemented a public infrastructure program to construct and operate central sewer collection and treatment systems. Sewage treatment facilities will have the capability to make available gray water for non-potable water applications, such as irrigation for County parks and landscaped rights-of-way. However, the lack of possible users has inhibited the necessary investment to create and maintain a viable reuse water distribution system.

4.0 | CAPITAL IMPROVEMENTS

The FKAA 2020 Master Plan contains detailed information regarding work plan projects and is attached in the Appendix. The Plan identifies many short- and long-term improvements to the water transmission, distribution, water storage, raw water supply, and the water treatment plants. Significant upgrades and proposed new facilities to the water treatment plants are planned to improve the reliability and quality of FKAA's drinking water. Major improvements to the water system include a new Floridan aquifer wellfield that will serve a new LPRO treatment facility at the J Robert Dean WTP in Florida City, multiple rehabilitation or upgrade projects at both the Kermit H. Lewin Desalination WTP and the Marathon Desalination WTP facility to increase reliability and capacity to meet emergency and peak day flows, and various transmission/distribution line replacements, distribution pump station upgrades, and improved water storage tanks to improve delivery capacity of the system.

Prior to Hurricane Irma, FKAA spent $7 million - $8 million per year to fund its Capital Improvement program. FKAA has anticipated a need to fund the CIP at an annual rate of $25.7 million per year as shown below as a result of assets reaching the end of their useful lives.

Table 14.

Category	Annual Cost ($ Million)
Supply	$0.2
Treatment	$4.1
Transmission	$10.3
Distribution	$8.1
Facilities	$3.0
Total	$25.7

Source: FKAA 2020 Master Plan

The table below shows the planned funding sources for each water project planned through Fiscal Year 2024. The 5-year estimated total cost to complete the projects identified from Fiscal Years 2020–2024 is $140.5 million, as shown.

Table 15. Five-Year Capital Improvement Funding Plan

Line No.	Description	Funding Source	Projected Fiscal Year Ending September 30					Total
CAP	ITAL COSTS - WATER SYSTEM		2020	2021	2022	2023	2024	2020-2024
Facilities and Structures								
1	Key West Administration Building Replacement	Series 2019A	$ 9,000,000	$ 9,000,000	$ 4,364,000	-	-	$ 22,364,000
2	Stock Island garage replacement	RR	-	-	-	-	$ 420,000	$ 420,000
3	**Total Water Supply**		**$ 9,000,000**	**$ 9,000,000**	**$ 4,364,000**	**-**	**$ 420,000**	**$ 22,784,000**
Water Treatment Plant								
4	SIRO Facility	RR & Series 2021	$ 3,000,000	$ 14,000,000	$ 18,000,000	$ 15,000,000	-	$ 50,000,000
5	**Total Water Treatment Plant**		**$ 3,000,000**	**$ 14,000,000**	**$ 18,000,000**	**$ 15,000,000**	**-**	**-**

Line No.	Description	Funding Source	Projected Fiscal Year Ending September 30					Total
CAP	ITAL COSTS - WATER SYSTEM		2020	2021	2022	2023	2024	2020-2024
Water Transmission System								
6	Grassy Key transmission line replacement	Series 2019A	$ 8,000,000	-	-	-	-	$ 8,000,000
7	Transmission Terminus rehabilitation	RR	-	-	-	$ 840,000	$ 3,360,000	$ 4,200,000
8	Islamorada transmission line replacement	Series 2019A & RR	$ 2,670,000	$ 13,350,000	$ 10,680,000	-	-	$ 26,700,000
9	**Total Water Transmission System**		**$ 10,670,000**	**$ 13,350,000**	**$ 10,680,000**	**$ 840,000**	**$ 3,360,000**	**$ 38,900,000**
Distribution Mains								
10	Simonton, Front and Whitehead Streets Distribution Line Replacement	RR	$ 750,000	-	-	-	$ 1,250,000	$ 2,000,000
11	Ocean Reef distribution and storage improvements	RR	-	-	-	$ 3,200,000	$ 3,900,000	$ 7,100,000
12	New distribution system at No Name Key	RR	$ 2,600,000	-	-	-	-	$ 2,600,000
13	**Total Distribution Mains**		**$ 3,350,000**	**-**	**-**	**$ 3,200,000**	**$ 5,150,000**	**$ 11,700,000**
Repairs and Upgrades								
14	Box girder bridge coating/coupling replacement	RR	-	-	-	-	$ 3,870,000	$ 3,870,000
15	Generator control panel replacement at Florida City	RR	-	-	-	-	$ 500,000	$ 500,000
16	Stock Island pump station and generator replacement	RR	$ 7,000,000	-	-	-	-	$ 7,000,000
17	Repair/upgrade subaqueous crossing	RR	$ 2,000,000	-	-	-	-	$ 2,000,000
18	Repair/upgrade cathodic protection	RR	$ 2,700,000	-	-	-	-	$ 2,700,000
19	Repair/Upgrade electrical and instrumentation	RR	$ 1,000,000	-	-	-	-	$ 1,000,000
20	**Total Distribution Pump Station & Storage**		**$ 12,700,000**	**-**	**-**	**-**	**$ 4,370,000**	**$ 17,070,000**
21	**Total**		**$ 38,720,000**	**$ 36,350,000**	**$ 33,044,000**	**$ 19,040,000**	**$ 13,300,000**	**$ 140,454,000**

Line No.	Description	Funding Source	Projected Fiscal Year Ending September 30					Total
CAP	ITAL COSTS - WATER SYSTEM		2020	2021	2022	2023	2024	2020-2024
22	Revenue and reserves	RR	$ 19,756,400	$ 17,532,000	$ 2,825,600	$ 4,040,000	$ 13,300,000	$ 57,454,000
23	Series 2019A Bonds	Series 2019A	$ 18,963,600	$ 18,818,000	$ 12,218,400	-	-	$ 50,000,000
24	Future Revenue Bonds	Series 2021	-	-	$ 18,000,000	$ 15,000,000	-	$ 33,000,000
25	**TOTAL WATER SYSTEM FUNDING SOURCES[1]**		**$ 38,720,000**	**$ 36,350,000**	**$ 33,044,000**	**$ 19,040,000**	**$ 13,300,000**	**$ 140,454,000**

The total five-year funding sources are summarized below.

Table 16. Five-Year Capital Funding Sources

Funding Source	Five-Year Amount	% of Total
Revenue and Reserves	$ 57,454,000	40.91%
Series 2019A Bonds	$ 50,000,000	35.60%
Series 2021 Bonds	$ 33,000,000	23.50%
Total	**$ 140,454,000**	**100.00%**

The preceding tables provide the financing plan needed to fund capital improvements through Fiscal Year 2024. Because financial forecasting is less reliable beyond a 5-year period, a detailed funding analysis has not been completed past Fiscal Year 2024. As future projects move within the 5-year planning horizon, specific capital strategies will be developed. Such capital funding will likely include additional borrowing as well as cash funding from rates. The underlying objective will be to continue to fund necessary capital improvements, minimize future water rate adjustments, and maintain the creditworthiness of the FKAA Water System.

5.0 | GOALS, OBJECTIVES, AND POLICIES

The following are existing and proposed Goals, Objectives, and Policies.

NEW NEEDS POLICY NUMBER

GOAL 1-4: IMPLEMENT LAND USE GOALS AND OBJECTIVES.

Islamorada, Village of Islands shall continue to monitor and evaluate development and resource conservation within the Village pursuant to goals and objectives of the Comprehensive Plan Future Land Use Element and carry out an effective implementation program as herein established.

OBJECTIVE 1-4.1: CONCURRENCY MANAGEMENT.

Pursuant to Chapter 163, F.S., ~~and Rule 9J-5, F.A.C.,~~ Section 163.3180, Florida Statutes (F.S.) for concurrency requirements, the Village shall issue no development order or permit for development unless the applicant provides narrative and graphic information demonstrating to the satisfaction of the Village that public facilities required by the subject development shall be in place concurrent with the impacts of development. Furthermore, the applicant shall assure that the facilities operate at or above adopted level of service (LOS) standards. The applicant's narrative and graphic information shall also demonstrate that the subject development shall not reduce the levels of service for public facilities serving the development below adopted LOS standards.

Policy 1-4.1.1: Ensure Existing Concurrency Management System is Consistent with SFWMD's Lower East Coast Water Supply Plan. Islamorada, Village of Islands shall ensure that the existing concurrency management system is consistent with the South Florida Water Management District Lower East Coast Water Supply Plan updated ~~October 10, 2013~~ November 8, 2018 and the Florida Keys Aqueduct Authority's 20-Year Water Supply System Capital Improvements Master Plan Final, adopted December 2006.

Policy 1-4.5.5: Conserve Water Including Potable Water Supply. The water supply including the potable water supply shall be conserved by enforcing water standards as delineated in the Land Development Regulations and coordinating with the South Florida Water Management District and FKAA to implement any water restriction mandates issued, through the distribution of materials to the public and Village website.

Policy 1-4.7.2: Conserve Water Through Landscaping. The Village shall assist the FKAA with water conservation efforts by implementing water conservation measures which include Florida Friendly Landscape Principles.

Policy 1-4.7.3: Conserve Water Through Education. The Village shall coordinate with FKAA public education programs for the implementation of water conservation measures.

Policy 1-4.7.4: Conserve Water Through Restrictions. The Village shall comply with SFWMD water use restrictions when shortages are declared by SFWMD.

GOAL 4-1: PROVIDE NEEDED PUBLIC FACILITIES.

Islamorada, Village of Islands shall ensure availability of needed public facilities associated with wastewater disposal, water, including potable water, distribution and treatment, drainage, solid waste collection and disposal, and protection of natural ground water aquifer recharge in a manner that is environmentally sound and protects marine environments (including sea grass meadows, near shore waters, mangrove islands and extensive living coral reef), while protecting investments in existing facilities and promotes orderly, compact growth.

OBJECTIVE 4-1.1: ADOPT LEVEL OF SERVICE (LOS) STANDARDS.

Islamorada, Village of Islands shall ensure that, at the time a development permit is issued, adequate wastewater treatment facilities, stormwater facilities, water, including potable water and solid waste disposal facilities are available to support the development at adopted level of service standards, concurrent with the impacts of such development, in accordance with the following policies:

Policy 4-1.1.3: Adopt Potable Water Level of Service Standards. Islamorada, Village of Islands hereby adopts LOS standards for water, including potable water, as follows:

MEASURE	LOS STANDARD
Residential LOS	66.5 gal/cap/day
Non Residential LOS	0.35 gal/sq. ft./day
Overall LOS	± ~~149~~ 171 gal/cap/day
Equivalent Residential Unit	371.7 gal/day
Minimum Pressure	20 PSI at customer
Minimum Quality	Shall be as defined by the USEPA (part 143 National Secondary Drinking Standards, 40 CFR 143, 44FR 42198)

Policy 4-1.1.5: Demand and Supply Information System. Islamorada, Village of Islands shall continue the process of updating facility demand and capacity information for water, including potable water, and shall prepare annual summaries of capacity and demand information for respective facilities and/or service areas by coordinating with the Florida Keys Aqueduct Authority.

Policy 4-1.1.6: Coordinate Between Future Land Use and Potable Water/Wastewater System Needs. The Village's Land Development Regulations shall be enforced to ensure that incremental decisions by the Village concerning water, including potable water, and wastewater system needs, plans and the location and timing of improvements shall be consistent with the objectives and policies of the Future Land Use, the Conservation Elements of this Comprehensive Plan, and the South Florida Water Management District *Lower East Coast Regional Water Supply Plan* updated ~~October 10. 2013~~ November 8, 2018.

Policy 4-1.1.7: Ensure Area Wide Planning for Potable Water. Potable water within the Village shall be coordinated with regional and county plans. Islamorada, Village of Islands shall meet annually with the Florida Keys Aqueduct Authority to review and refine area wide management strategies for the delivery of water, including potable water. Florida Keys Aqueduct Authority provides an annual update with the Portable Water Demand Summary and the Water Supply Available Vs. Water Demand Projections.

Policy 4-1.1.10: Adopt a 10-Vear Water Supply Facilities Work Plan. Islamorada, Village of Islands shall adopt a 10-Year Water Supply Facilities Work Plan in coordination with the Florida Keys Aqueduct Authority that identifies existing and proposed alternative water supply projects, traditional water supply projects, conservation methods and reuse necessary to meet the water supply needs of the Village, consistent with the South Florida Water Management District *Lower East Coast Regional Water Supply Plan* updated November 8, 2018, and the Florida Keys Aqueduct Authority *20-Year Water Supply System Capital Improvement Master Plan Final adopted December 2006*.~~, for the 2017 Islamorada Water Supply Facilities Work Plan.~~

Policy 4-1.1.11: Update 10-Vear Water Supply Facilities Work Plan. Islamorada, Village of Islands shall update the 10-Year Water Supply Facilities Work Plan every five years or within 18 months after the governing board of the South Florida Water Management District approves an updated regional water supply plan.

Policy 4-1.1.13: Adopt the Water Supply Facilities Work Plan. Islamorada, Village of Islands, (Village) hereby adopts by reference the Water Supply Facilities Work Plan (Work Plan), dated xxxx, for a planning period of not less than 10 years. The Work Plan addresses issues that pertain to water supply facilities and requirements needed to serve current and future development within the Village's water service area. The Village shall review and update the Work Plan at least every five (5) years within 18 months after the governing board of the water management district approves an updated regional water supply plan. Any changes affecting the Work Plan shall be included in the annual Capital Improvements Plan update to ensure consistency between the Work Plan and the Capital Improvements Element.

OBJECTIVE 4-5.2: PROMOTE WATER CONSERVATION.
Islamorada, Village of Islands shall assist the FKAA with water conservation and reuse efforts and assist in implementing the FKAA's Water Conservation Plan consistent with SFWMD's Water Shortage Plan, Water Conservation Program and Lower East Coast Water Supply Plan. Recognizing that the Village is located in an area that the SFWMD identifies as a "priority water resource caution area," the Village shall strive to lower its per person per day usage of water below +I-+ ~~149.5~~ 171 gallons per person per day (gpcpd) and will continue to work with the Florida Keys Aqueduct Authority (FKAA) and the SFWMD to reduce demand within the Village for potable water.

Policy 4-5.2.1: Enforce Water Conservation Measures. Islamorada, Village of Islands shall continue to enforce Land Development Regulations which regulate xeriscape landscape practices, Florida Friendly Landscape Principles, and the installation of water conservation irrigation systems and water-conserving plumbing fixtures.

Policy 4-5.2.2: Coordinate with SFWMD and FKAA on Conservation and Reuse Issues. Islamorada, Village of Islands shall continue to coordinate water conservation issues with SFWMD and FKAA policies and programs.

Policy 4-5.2.3: Provide Information on Water Conservation. The Village shall inform residents and business owners of the regional water conservation programs. This information shall be available at Village Hall and will include brochures and pamphlets to educate and inform people as to the importance of water conservation.

Policy 4-5.2.4: Leak Detection and Repair Program. The Village shall develop a leak detection and repair program for all Village-owned facilities by the end of ~~2009~~ 2030.

Policy 4-5.2.5: Ensure Adequate Water Supply for New Development. Prior to the issuance of a building permit for new development, the Village shall receive written notification from its water utility, the Florida Keys Aqueduct Authority, that adequate water to serve the new development will be available no later than the anticipated time that a certificate of occupancy is to be issued.

GOAL 4-6: PROTECT NATURAL GROUNDWATER AQUIFER RECHARGE AREAS.
Islamorada, Village of Islands shall protect the quality and quantity of water in the potable water aquifer and in the freshwater lens system to ensure public health and preserve ecosystems dependent upon fresh water.

OBJECTIVE 4-6.1: PROTECT FRESHWATER LENSES.
Islamorada, Village of Islands shall protect freshwater lenses within the Village from loss of recharge potential, ensure the preservation of the existing freshwater lens systems and from threats of groundwater contamination.

Policy 4-6.1.1: Adopt Stormwater Management Regulations. The Village shall continue to maintain Land Development Regulations for managing stormwater run-off. The regulations shall be consistent with the adopted Stormwater Management Master Plan and regulate the quality and quantity of stormwater discharges, encourage use of site specific natural drainage features to the maximum extent possible before utilizing structural stormwater control, and shall restrict the percentage of impervious areas on development and redevelopment sites.

OBJECTIVE 6-1.2: ENSURE WATER, INCLUDING POTABLE WATER, AVAILABILITY.
Islamorada,Village of Islands shall coordinate with the Florida Keys Aqueduct Authority to secure provision of water, including potable water, in sufficient quantities to meet present and projected needs, commensurate with reasonable demand through the implementation of the following policies:

Policy 6-1.2.1: Ensure Potable Water Supply. Islamorada, Village of Islands shall ensure that existing and new development shall be serviced with an adequate supply of water, including potable water, at levels of service indicated in Policy 4-1.1.3 of the Public Facilities Element, and that, at a minimum, meets State water quality standards.

Policy 6-1.2.2: Protect and Conserve Potable Water Supply. Islamorada, Village of Islands shall continue to conserve and protect the quality of current and projected future water supply. In order to assist implementation of the water conservation policies of the South Florida Water Management District (SFWMD) and the Florida Keys Aqueduct Authority (FKAA) and to achieve a reduction in the current rates of water consumption, the following standards shall be in effect:

1. Potable water shall be conserved through enforcement of conservation measures;
2. The Village shall continue to enforce the provisions of Chapter 34-34 of the Code specifically:
   - Chapter 34-34(a) requiring that irrigation with potable water on any property within the Village may occur between the hours of 5:00 p.m. and 9:00 a. m. only;
   - Chapter 34-34(b) requiring that irrigation systems installed after 2003 shall include a water sensing device that shall automatically discontinue irrigation during periods of rainfall.
3. The Village shall require the use of alternative water supplies such as treated wastewater, stormwater, cisterns and reverse osmosis systems for landscape irrigation for all new development and substantial redevelopment; and
4. The Village shall require the use of water-saving plumbing fixtures on all new development that meet the requirements of the Florida Building Code.

Policy 6-1.2.3: Coordinate Water Conservation Practices with other Jurisdictions. Islamorada, Village of Islands shall cooperate with local, regional, State and Federal agencies to maintain adequate fresh water supplies during dry periods and to conserve water where practicable. The Village shall coordinate with state, regional and county governments and other agencies having jurisdiction on water quantity and quality issues.

Policy 6-1.2.4: Implement Water Demand Management Policies and Programs. Islamorada, Village of Islands shall continue to cooperate with the Florida Keys Aqueduct Authority and the South Florida Water Management District to implement water demand management policies and programs consistent with the Lower East Coast Water Supply Plan Update November 8, 2018 ~~October 2013~~, the FKAA 20-Year Water Supply System Capital Improvement Master Plan ~~December 2006~~ 2020 and the Village's 10-Year Water Supply Facilities Work Plan ~~2017~~ 2020 Update.

Policy 6-1.2.5: Conserve Water during Emergencies. Islamorada, Village of Islands shall cooperate with FKAA and SFWMD to conserve water resources during emergencies.

Policy 6-1.2.6: Coordinate with Florida Keys Aqueduct Authority. Islamorada, Village of Islands shall update the administrative procedures, which mandates technical review of public facility plans during site plan review to be consistent with the Village's 10-Year Water Supply Facilities Work Plan. The procedures shall continue to mandate coordination among the developer, the Village and FKAA in order to efficiently manage potable water service system issues. Islamorada, Village of Islands shall not approve any development order unless the FKAA has reviewed and approved that project's water, including potable water service system, demand needs and ensures the availability of water at adopted LOS for the proposed development.

Policy 6-1.4.14: Monitor FKAA Compliance with Federal Regulations Prohibiting Potable Water Hookups in Schaus' Swallowtail Butterfly Habitat. Islamorada, Village of Islands shall monitor FKAA compliance with Federal regulations prohibiting potable water hookups to designated habitat areas of the Schaus, swallowtail butterfly (pursuant to FKAA Rules Chapter 48-7).

Policy 6-1.9.8: Ensure FKAA Compliance with Federal Regulations Prohibiting Potable Water Hookups Designated Eastern Indigo Snake Habitat. Islamorada, Village of Islands shall monitor FKAA compliance with Federal regulations prohibiting water including potable water, hookups to designated habitat areas of the Eastern Indigo Snake (pursuant to FKAA Rules Chapter 48-7).

Policy 8-1.1.3: Interlocal Agreement with FKAA to Identify the Availability of Water Supply to Serve Existing and New Development. By December 31, ~~2009~~ 2030, Islamorada, Village of Islands, shall enter into an interlocal agreement with the FKAA to formulate a mechanism that will allow the FKAA and the Village to identify the availability of water supply needed to serve existing and new development within the Village; monitor the use of potable water; and implement such alternative water supply projects, traditional water supply projects, conservation projects and reuse necessary to meet the Village's water supply needs.

Policy 9-1.2.3: Adopt and Maintain the Following Level of Service Standards. Islamorada, Village of Islands shall adopt level of service standards for public facilities, for which concurrency is required, as set forth below. Prior to issuing a development order the Village shall review all proposed development to ensure consistency with adopted LOS standards. No development shall be approved that is projected to decrease the existing LOS below the adopted standard, unless mitigation by the developer is approved by the Village Council.

SUMMARY OF LEVEL OF SERVICE STANDARDS

FACILITIES	LEVEL OF SERVICE STANDARDS
Wastewater	The Village, shall at a minimum , adopt the current level of service standards as provided in Federal and State regulations. The current LOS standards are as follows: **FLORIDA STATUTORY TREATMENT STANDARDS in MG/L - BOD/TSS/TN/TP** 1. Design flows less than or equal to 100,000 gpd (BAT) in MG/L-10/10/10/1 2. Design flows greater than 100,000 gpd (AWT) in MG/L- 5/5/3/1
Wastewater Supply LOS	• 70 gal/capita/day
Potable Water	• Residential LOS: 66.5 gal/capita/day • Non-Residential LOS: 0.35 gal/ sq.ft ./ day • Overall LOS:±-+ ~~149.5~~ 171 gallons/capita/day • ERU:371.7 gal/day
Solid Waste	• Residential Disposal Quantity: 5.44 pounds/capita/day • Non-Residential: 6.37 pounds/acre/day
Stormwater	1. Post development runoff shall not exceed the pre-development runoff rate for a 25-year storm event, up to and including an event with a 24-hour duration. 2. Stormwater treatment and disposal facilities shall be designed to meet the design and performance standards established in Rule 62-25.025, FAC, with treatment of the runoff from the first one inch of rainfall on-site to meet the surface water quality standards required by Rule 62-302.500, FAC. 3. Stormwater facilities which directly discharge into 'Outstanding Florida Waters' (OFW) shall provide an additional treatment pursuant to Rule 62-25.025(9), FAC. Stormwater facilities shall be designed so as to not degrade the receiving water body below the minimum conditions necessary to assure the suitability of water for the designated use of its classification as established in Chapter 62-302, FAC.
Recreation and Open Space	• 3.79 acres per 1,000 population
Roadways	• U.S. 1 shall be maintained within 5% of LOS C as measured on an overall countywide basis not dependent on any single road segment, using the measured median travel speed from the annual report of public facilities capacity. • All other roadways for which the Village is responsible shall have sufficient available capacity to operate at pr above LOS Das measured by peak hour volumes at all intersections, including but not limited to all intersections with U.S. 1.

Appendix A:

Florida Keys Aqueduct Authority Master Plan 2020

MASTER PLAN 2020

FLORIDA KEYS AQUEDUCT AUTHORITY

Table of Contents

List of Appendices

List of Acronyms

CCI	Construction Cost Index
CCL	Contaminant Candidate List
CCS	Cooling Canal System
CIP	Capital Improvement Plan
CIP	Cast Iron Pipe
DIP	Ductile Iron Pipe
EPA	Environmental Protection Agency
FDEP	Florida Department of Environmental Protection
FPL	Florida Power and Light
GPCD	Gallons per Capita per Day
GLV	Galvanized Steel
GMP	Good Manufacturing Practices
GWR	Ground Water RUle
HDPE	High-density Polyethylene
LPRO	Low Pressure Reverse Osmosis
MCL	Maximum Contaminant Level
MG	Million Gallons
MGD	Million Gallons per Day
NGVD	National Geodetic Vertical Datum
NRW	Non-Revenue Water
PERA	Permitting, Environmental & Regulatory Affairs
PFAS	Per – polyfluoroalkyl substances
PPCP	Pharmaceuticals & personal care products
PSI	Pounds per Square Inch
PSIG	Pounds per Square Inch Gauge
PVC	Polyvinyl Chloride
RO	Reverse Osmosis
SDWA	Safe Drinking Water Act
SFWMD	South Florida Water Management District
SIRO	Stock Island Reverse Osmosis
SWIM	Saline Water Intrusion Monitoring
TDS	Total Dissolved Solids
UIC	Underground Injection Control
USGS	United States Geological Survey
WQPM	Water Quality Program Manual
WUP	Water Use Permit

EXECUTIVE SUMMARY

FLORIDA KEYS AQUEDUCT AUTHORITY

Executive Summary

The Florida Keys Aqueduct Authority (FKAA) has been the sole water purveyor to Monroe County for over 80 years. During its early years, FKAA faced the challenge of meeting the water demands of a rapidly growing population. Between 1940 and 2000, the population in Monroe County grew from 14,000 to 80,000, which required large investments in its water treatment, transmission and distribution facilities. However, over the past ten years, the population has remained relatively constant, with a seasonal population replacing the permanent population. During the next twenty years, FKAA will face different challenges, including replacement of its aging infrastructure and defending against the impacts of climate change.

In order to plan for these new challenges, FKAA has developed this 20-Year Water System Master Plan, which will provide the investment strategy and funding requirements for its on-going Capital Improvement Program (CIP). This strategy will be implemented project by project through FKAA's annual CIP. While the CIP prioritizes individual projects based on FKAA's most pressing needs and asset conditions, this Master Plan provides the long-term funding requirements and coordination between projects. The Master Plan is divided into eight sections, as follows:

Section	Title	Highlight
1	Introduction	FKAA's current challenges include aging infrastructure, growing environmental concerns and future regulatory requirements.
2	Population and Water Demand Forecast	Over the next twenty years, FKAA will see an increase in its average day demand increase from 17.7 MGD to 19.1 MGD and maximum day demand increase from 20.8 MGD to 23.8 MGD.
3	Water Supply System	FKAA should construct a new wellfield to protect its source water from seawater intrusion and provide a 4-MGD interconnect with Miami-Dade water.
4	Water Treatment and Standards	During drought conditions, FKAA will need to provide up to 2 MGD of water supply from the new Stock Island Reverse Osmosis Facility to meet future maximum day demands.
5	Water Transmission System	FKAA will need to implement a long-term program to replace its transmission system pipeline.
6	Water Distribution System	FKAA will need to implement a long-term program to replace its distribution system pipe, beginning with galvanized pipe and 2-inch diameter pipe.
7	Financial Plan	FKAA will evaluate the Capital Improvement Plan (CIP) and operating budget on an annual basis to determine appropriate funding needs.
8	Findings and Recommendations	The Master Plan recommends an annual budget of $25.7 million to meet FKAA's long term capital improvement needs. Individual projects will be scoped, estimated and prioritized annually.

The challenge of replacing aging infrastructure is not unique to FKAA. In 2017, the American Society of Civil Engineers published their annual report card evaluating the condition of the infrastructure in the United States. On a national level, drinking water received a grade of D. However, Florida received a slightly higher grade of C+ with a recommendation that the State spend $16.5 billion in water infrastructure over the next 20 years. As a result, utilities across the country will need to make the necessary changes to their rate structure to fund these infrastructure improvements.

As part of this planning effort, FKAA developed cost estimates to replace the existing infrastructure. As shown in **Figure ES-1**, approximately 80 percent of FKAA's assets consist of pipelines. While vertical assets – such as treatment plants and pump stations – often receive greater attention because they are seen daily, the pipelines are equally essential. Pipeline failures not only disrupt water service to FKAA customers, but they also have a financial impact associated with pipeline repair and lost water. In recent years, FKAA has recognized the need to begin an aggressive program to replace these assets. The Engineering and Operations divisions have recently implemented an asset management program to track maintenance histories, which will then be analyzed along with other factors; such as operating pressure, material, and age – to prioritize replacement and repair projects. This program will also be used for a similar analysis of FKAA's vertical assets.

FIGURE ES - 1
FKAA's Asset Allocation

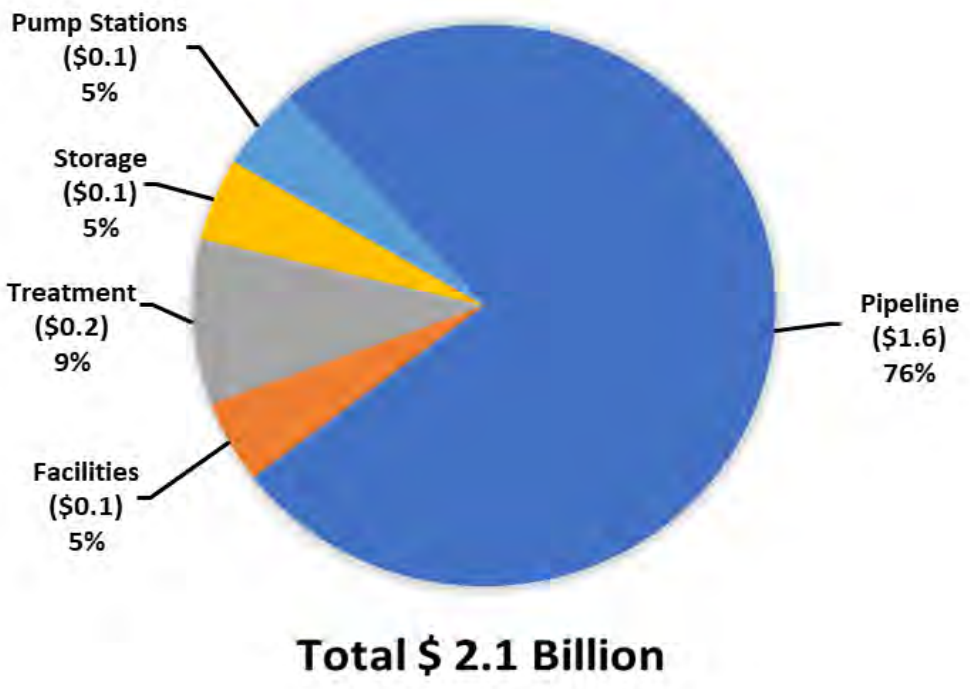
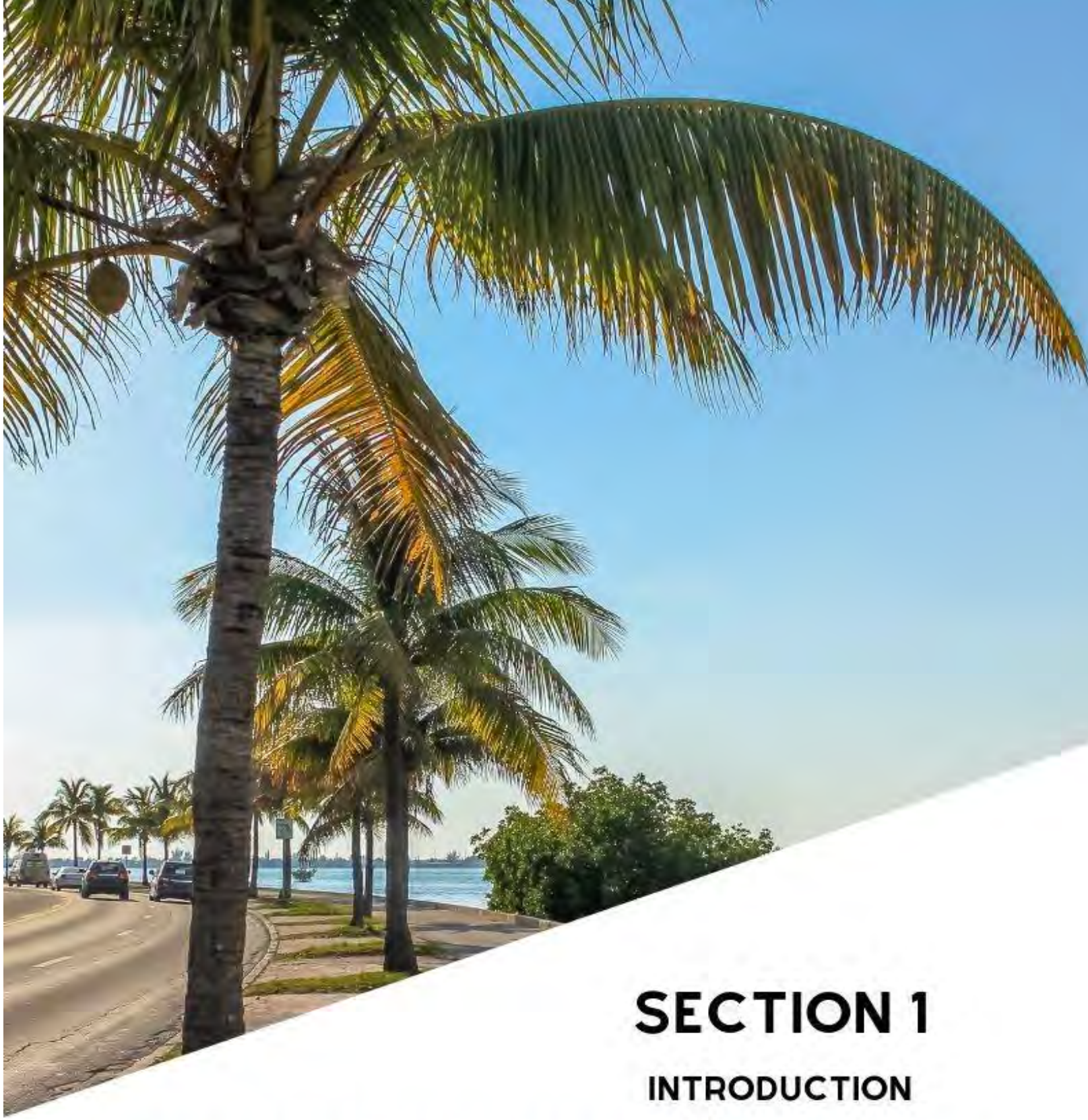


TABLE ES – 1
Capital Improvement Projects

Category	Annual Cost ($ Mil)
Supply	$ 0.2
Treatment	$ 4.1
Transmission	$ 10.3
Distribution	$ 8.1
Facilities	$ 3.0
Total	**$ 25.7**

Prior to Hurricane Irma, FKAA typically spent between $7 and $8 million per year to fund its Capital Improvement Program. However, as many of FKAA's assets reach the end of their useful lives, the funding level for the CIP will need to increase significantly. By dividing the asset replacement cost by the estimated design life, FKAA has anticipated a need to fund the CIP at an annual rate of $25.7 million per year, as shown in **Table ES-1**. This level of spending is consistent with the project needs identified in the current 5-year CIP and will likely continue at this rate for the remainder of the planning horizon.



SECTION 1

INTRODUCTION

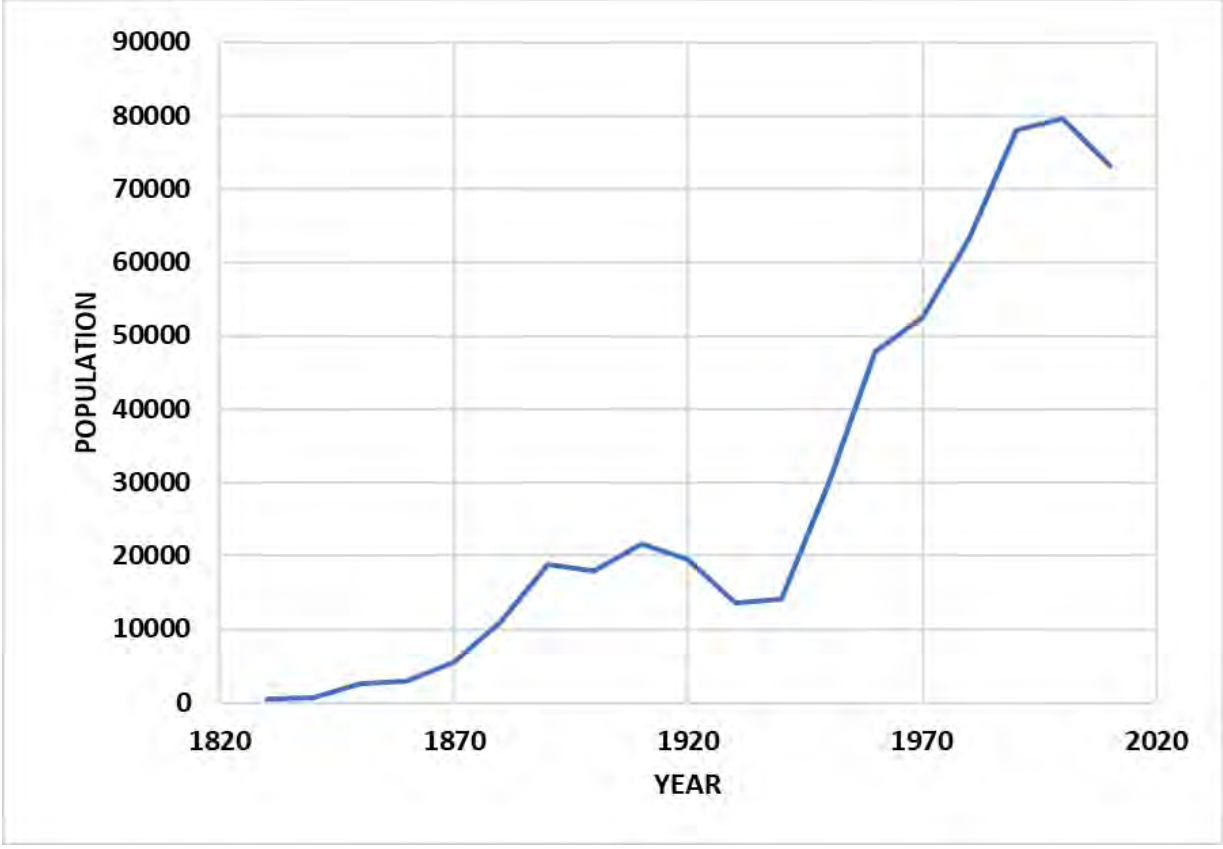
FLORIDA KEYS AQUEDUCT AUTHORITY

SECTION 1
Introduction

1.1 Historical Perspective

The challenges being faced today by the Florida Keys Aqueduct Authority differ from those in previous master planning efforts. In the past, FKAA was tasked with providing water to a rapidly growing population. As shown in **Figure 1-1**, the population grew from approximately 14,000 residents in 1940 to 80,000 residents in 2000. This population boom can be attributed largely to the introduction of a reliable supply of potable water to an otherwise remote area. In 1942, a water pipeline was constructed to convey fresh water from the Biscayne Aquifer beneath Florida City to U.S. Navy facilities in Key West. This project was jointly funded by the Navy and FKAA's predecessor, the Florida Keys Aqueduct Commission.

FIGURE 1-1
Monroe County Permanent Population



Over the past 20 years, the permanent population in Monroe County has decreased while the seasonal population has increased, resulting in changes to water consumption patterns. While annual average water production remained relatively constant during this period, water use during peak tourist season (from approximately January to April) has increased and water use during the off season (from approximately May to December) has trended downward. As a result of these changing demographics, FKAA and Monroe County planners created a new metric – "functional population" – to account for the shift from permanent residents to seasonal residents. The term "functional population" is a concept that incorporates three elements of population: permanent residents, seasonal visitors, and day visitors. Because of the unique nature of the Keys, which has an economy based on seasonal tourism, it is appropriate to use one "population" number that incorporates these three separate population components. This is discussed in more detail in Section 2.

1.2 Current Challenges

As FKAA enters this next 20-year planning horizon, the three greatest challenges it faces are replacing its aging infrastructure, adapting to growing environmental concerns, and future regulatory requirements. FKAA believes it can maintain its finished water production rates within its current capacity by promoting water conservation and reducing water loss in the system. However, if water demands were to increase beyond the current projections, FKAA has identified measures within this Master Plan that will allow for expansion and adaptation to meet that demand.

Aging Infrastructure

The original wellfield in Florida City and 18-inch diameter steel transmission pipeline were installed in 1942. Since that time, FKAA has expanded its system to include a water softening plant, low-pressure reverse osmosis (LPRO) plant, two emergency seawater reverse osmosis plants, 21 pump stations, 33 storage tanks, and approximately 790 miles of pipeline, as shown in **Figure 1-2**. While FKAA staff have done an excellent job maintaining these assets, the harsh natural conditions in the Florida Keys regularly expose most infrastructure to salt, heat, and storm damage; therefore, many of these assets will require replacement over the next 20 years. This Master Plan will provide a recommended level of funding based on the replacement costs of the assets and their remaining useful life. Each year, as part of the annual Capital Improvement Planning (CIP) process, individual projects will be prioritized based on current asset management data.

Growing Environmental Concerns

The Florida Keys are very vulnerable to the impacts of climate change and sea level rise. Climate change impacts include periods of extended drought and the potential for more frequent and powerful hurricanes. Based on recent experience, FKAA is not only impacted by hurricane damage done to its facilities, but FKAA is also impacted by the damage done to its customers.

For example, during Hurricane Irma in September 2017, many homes were destroyed causing massive leaks to our system which resulted in sections of the Lower Keys to be intermittently left without water for ten days until crews were able to shut off water to those homes and isolate areas with massive leaks. Additionally, sea level rise poses multiple threats to the entire FKAA water system, including seawater intrusion into the Biscayne Aquifer, accelerated corrosion of its steel pipelines, and flooding of its pump stations and storage tanks. It is also anticipated that climate change will affect the population projections in the Keys. Following Hurricane Irma, approximately four percent of permanent residents left and were unable or chose not to return.

Future Regulatory Requirements

Like many other industries, the field of potable water treatment is continuously improving as technology evolves. Advancements in analytical equipment has enabled the water industry to detect various contaminants at trace concentrations. When it is determined that a contaminant has a potential to adversely impact public health, the U.S. Environmental Protection Agency (EPA) will promulgate a Maximum Contaminant Level (MCL) for that constituent. In recent years, scientific studies have shown that exposure to per- and polyfluoroalkyl substances (PFAS) may result in changes in liver, immune, and thyroid function as well as increased risk of some cancers. While the EPA has yet to adopt new MCLs, the EPA Acting Administrator Andrew Wheeler stated the following in February 2019: **"*For the first time in Agency history, we utilized all of our program offices to construct an all-encompassing plan to help states and local communities address PFAS and protect our nation's drinking water. We are moving forward with several important actions, including the maximum contaminant level process, that will help affected communities better monitor, detect, and address PFAS.*"**

The FKAA has been following this issue for a couple years. Initial sampling detected PFAS compounds in its Biscayne Aquifer at concentrations lower than the EPA's current Life Health Advisory level of 70 parts per trillion (ppt), but slightly higher than the levels that other states are considering to adopt. In response to this concern, FKAA has recently installed a pilot plant at the Florida City water treatment plant to evaluate the removal of PFAS compounds using granular activated carbon. Although the pilot results are very promising, full implementation of a PFAS removal system would have significant capital and operational costs.

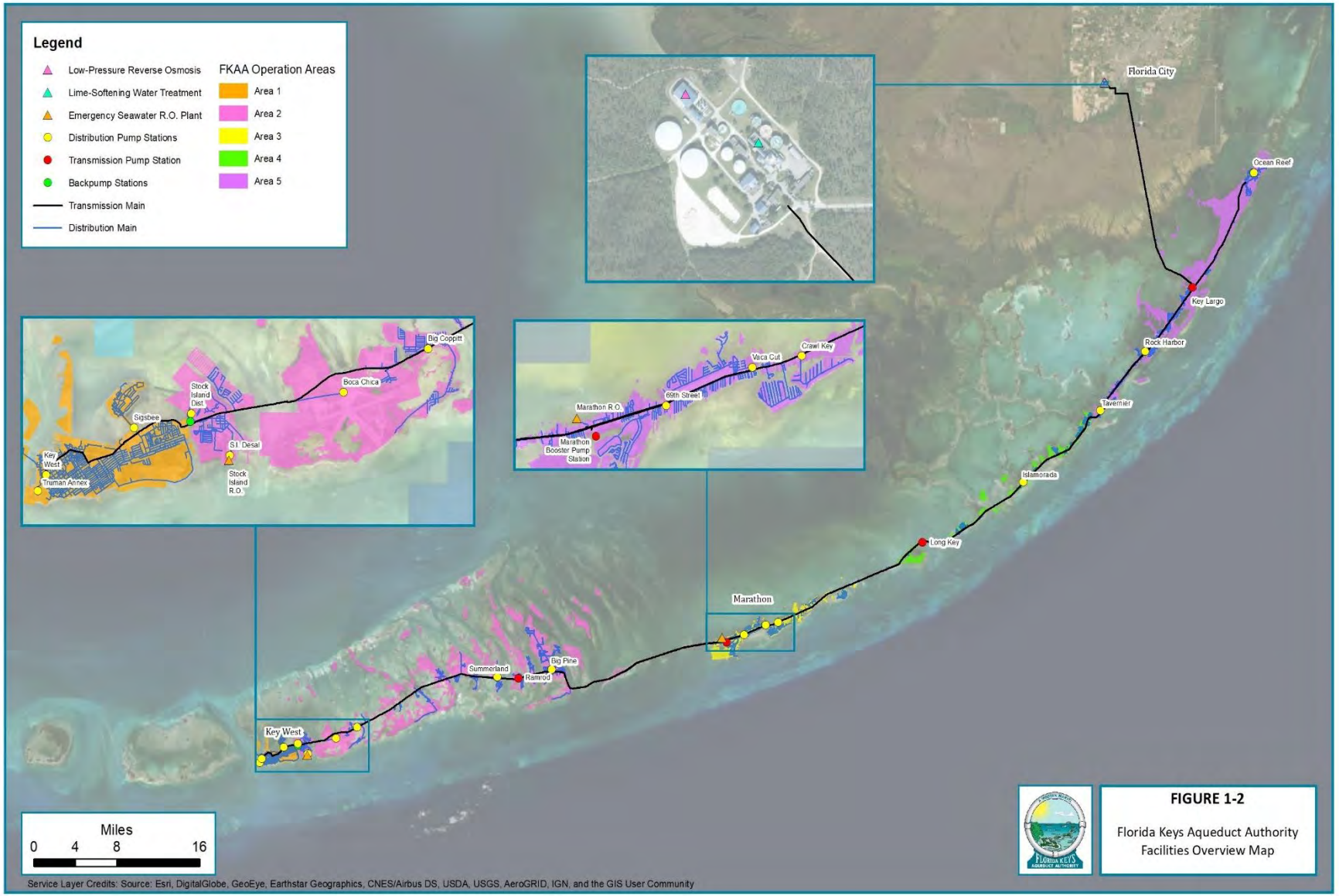


FIGURE 1-2

Florida Keys Aqueduct Authority
Facilities Overview Map

1.3 Master Plan Objectives

This Master Plan provides FKAA with a long-range strategy for developing an annual Capital Improvement Plan (CIP) to accomplish the following objectives:

- Improve system reliability
- Identify, evaluate and mitigate risk
- Reduce non-revenue water
- Evaluate potential future water supply needs by using alternative water supplies (e.g. Biscayne Aquifer, Floridan Aquifer, seawater, and connection to Miami-Dade water system
- Adapt to climate change
- Promote conservation of potable water
- Develop a long-term financing plan to match the CIP

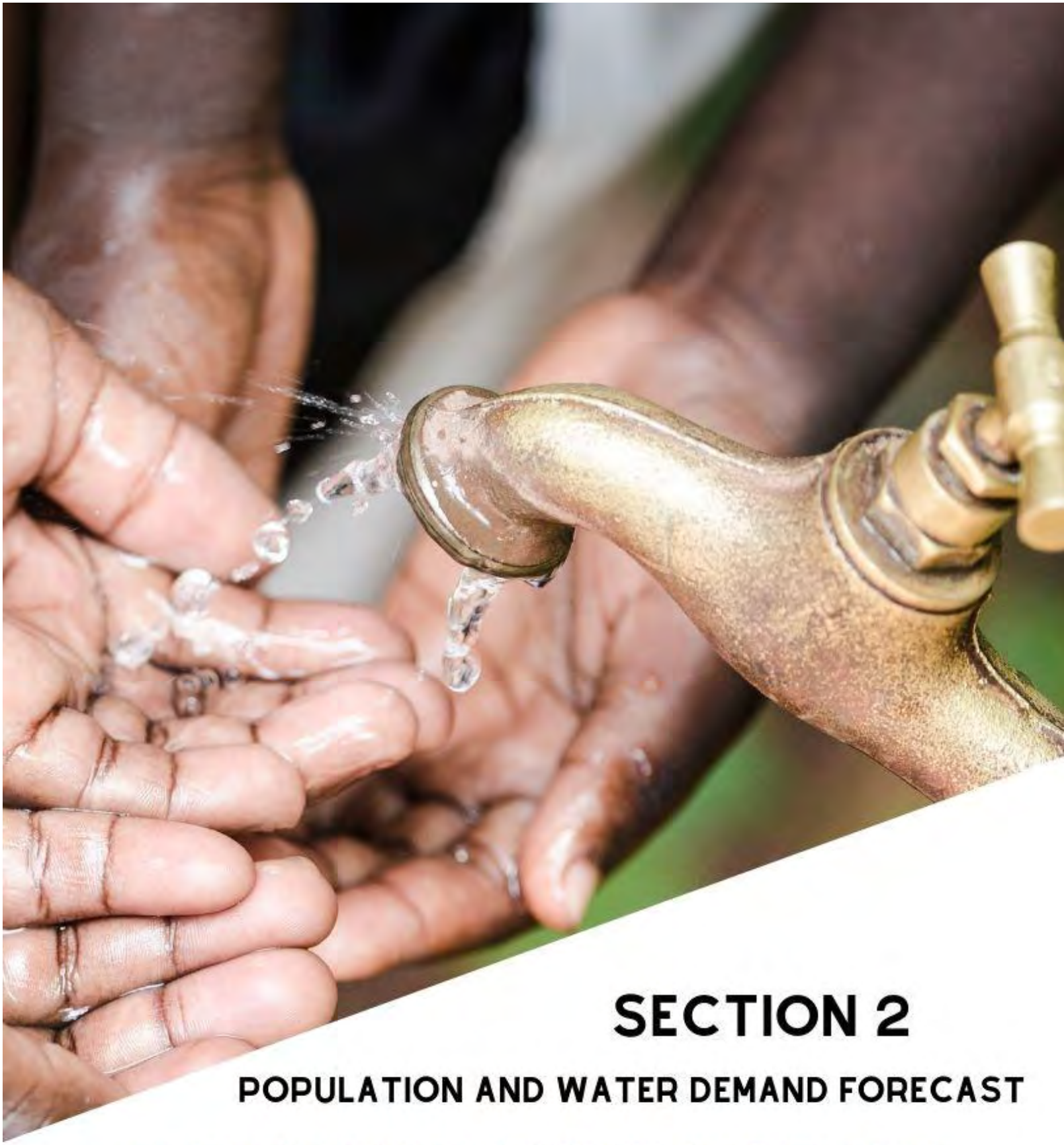
This Master Plan will provide FKAA with guidance and recommendations on strategic water system capital improvements through 2040. The plan includes recommendations for new facilities as well as upgrades to existing facilities in water treatment, supply, transmission, storage, pumping stations, and distribution. In addition, the Master Plan includes the most recent capital improvement program and a financial analysis to prioritize and sequence the improvements, minimizing the impact on water rates as much as possible.

1.4 Report Organization

This Master Plan is organized as follows:

- **Executive Summary:** Presents key issues and final capital improvement recommendations, including a 20-year financial strategy (2020–2040).
- **Section 1 - Introduction:** Presents a brief purpose of the Master Plan and a summary of existing water infrastructure.
- **Section 2 - Population and Water Demand Forecast:** Presents population and water demand forecasts for the planning period (2020–2040).
- **Section 3 - Water Supply System**: Describes FKAA's water supply system and presents recommendations for water supply improvement options to meet projected demands.
- **Section 4 - Water Treatment and Standards:** Discusses the current facilities for water treatment and the impact of current or anticipated drinking water standards and presents recommendations for water treatment options to meet projected demands.
- **Section 5 - Water Transmission System:** Describes FKAA's current transmission main and booster pump station facilities and recommended improvements.

- **Section 6 - Water Distribution System:** Presents a discussion of the FKAA distribution mains, ground storage, and pumping system network and proposed improvements.
- **Section 7 - Financial Plan:** Presents a 20-year financial strategic model.
- **Section 8 - Findings and Recommendations**: Recommends an annual budget of $25.5 million to meet FKAA's long term capital improvement needs.
- **Appendix A:** South Florida Water Management District East Coast Water Supply Update
- **Appendix B:** Water Loss Report
- **Appendix C:** Water Quality Program Manual
- **Appendix D:** Capital Improvement Plan Projects and Cost Estimates
- **Appendix E:** Water Treatment Plant Facilities



SECTION 2

POPULATION AND WATER DEMAND FORECAST

FLORIDA KEYS AQUEDUCT AUTHORITY

SECTION 2
Population and Water Demand Forecast

2.1 Projected Population

The Florida Keys are a world-renowned tourist destination, resulting in a large population of visitors and seasonal residents. Due to the unique composition of permanent and seasonal residents, the Monroe County Planning Department (MCPD) adopted the concept of a functional population, which incorporates three elements of population: permanent residents, seasonal visitors, and day visitors. FKAA uses the functional population as a basis for projected future water demands.

2.1.1 Permanent Population

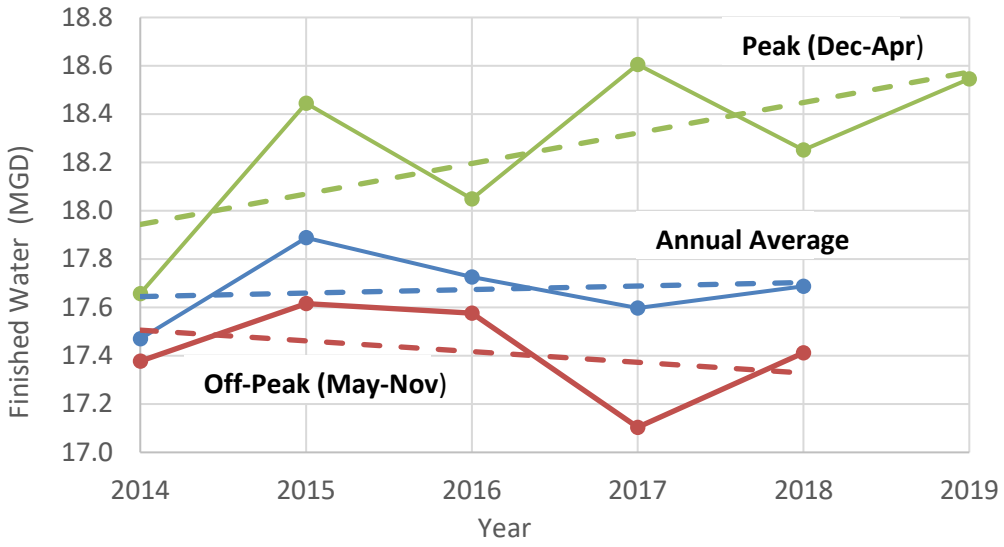
According to the U.S. Census Bureau, the permanent population of Monroe County peaked at 82,180 in 1993. Since that time, the population has decreased to approximately 77,000 permanent residents in 2017. The State of Florida has designated the Keys as an "Area of Critical Concern" and beginning in 2023, will no longer allow issuance of new building permits for the municipalities in the Keys. Development within the Keys is highly regulated to ensure timely evacuation of its visitors and residents prior to severe hurricanes.

The 2040 population of the FKAA service area was estimated to be 77,101 in the *Lower East Coast Water Supply Update,* prepared by the South Florida Water Management District in 2018, as shown in **Appendix A**. This value is essentially equivalent to the current population and consistent with the expectation that the permanent population will remain constant over the next 20 years.

2.1.2 Seasonal Population

The MCPD developed population projections for seasonal population through 2030. In the absence of MCPD data beyond 2030, this Master Plan uses a conservative assumption that the seasonal population will continue to grow at an annual rate of 0.2 percent. The shift from permanent residents to seasonal residents is evident when comparing the average water demand during peak and non-peak seasons, as shown in **Figure 2-1.** Over the past five years, the water demand during the peak season has increased and the water demand during the off-peak season decreased.

FIGURE 2-1
Seasonal Water Demand



2.2 Conservation Measures

Florida Keys Aqueduct Authority has a long history of promoting water conservation through public outreach and a variety of educational materials. Currently, FKAA is transitioning its meter network to smart meters that allow customers to monitor their usage electronically and includes leak status reporting shortly after probable leaks occur. As a result of these measures, FKAA has a 14-year average per capita consumption of 109 GPCD, which is much less than the rate of 138 GPCD used for the entire region in the *Lower East Coast Water Supply Update*.

The success of the water conservation program is also seen in the difference between the projected water consumption rates from the previous Master Plan (2006) and historical records between 2005 and 2018. The previous Master Plan estimated that the per capita consumption would increase from 118 GPCD to 150 GPCD between 2005 and 2025. However, actual data from 2005 to 2018 showed a decrease in consumption from 118 GPCD to 112 GPCD. Therefore, for planning level purposes, FKAA will use a slightly more conservative consumption rate of 115 GPCD, which is still significantly less than the previous estimate of 150 GPCD .[1]

2.3 Reclaimed Wastewater

FKAA operates three small wastewater treatment plants (WWTPs) that have the capability to produce reclaimed water. Only the Big Coppitt and Duck Key WWTPs have distribution systems that can convey reclaimed water to their customers. The combined permitted capacities of these two plants is 0.685 MGD, and the plants are currently operating at less than half of this value.

1 The 150 GPCD included the Navy's full allocation of 2.4 MGD, the Navy's current consumption is 0.72 MGD and not expected to increase.

The Cudjoe WWTP uses reclaimed water only at the treatment facility and does not have an off-site distribution system.

The *Lower East Coast Water Supply Update* estimates that the average reclaimed water demand will be 0.23 MGD for the duration of the planning horizon, which appears to be a reasonable assumption. Consequently, FKAA is not anticipating an appreciable offset of potable water use with reclaimed water.

2.4 Climate Change and Sea Level Rise

At the time of writing this Master Plan, official census data following Hurricane Irma (September 2017) has not been released. However, the Bureau of Economic and Business Research at the University of Florida has estimated that approximately 3,000 permanent residents never returned to the Keys after the storm[1]. If future climate predictions hold true, powerful hurricanes will become more frequent, resulting in a greater potential for future declines in the permanent population. Also, newly revised flood maps for Monroe County will likely increase insurance rates, making the Keys even more costly to its residents. Furthermore, sea level rise will slowly increase the areas affected by tidal flooding and storm surge, thus reducing the amount of habitable land over time.[2]

While this Master Plan considers the impacts of climate change and sea level rise, no adjustments were made to reduce the population projections; using the current population projections will provide a conservative estimate of future water demands. However, over the course of this planning horizon, FKAA will continually update the population data and evaluate future trends in population growth.

2.5 Finished Water Production

The actual and projected finished water production rates for the period between 2005 and 2040 are shown in **Table 2-1**. During the period between 2005 and 2018, the finished water average daily demand (ADD) remained fairly constant within a range of 16.0 - 17.7 MGD. The decrease in annual consumption between 2007 to 2010 is likely due to the Great Recession following the global financial crisis.

The projected finished water demands during the current planning horizon (2020–2040) are also shown in **Table 2-1.** As previously discussed, Monroe County has only provided population projections through 2030. For the period between 2030 and 2040, this Master Plan assumes that the seasonal population will continue to grow at a rate of 0.2 percent per year. The permanent population is expected to remain constant at 77,101. Additionally, this Plan will continue to use a max day to average day ratio a 1.25 even though ratio has been trending downward in recent years.

[1] The Bureau of Economic and Business Research at the University of Florida Survey, September 2018

[2] Union of Concerned Scientists, "The US Military on the Front Lines of Rising Seas", July 2016

TABLE 2-1
Finished Water Production

Year		Population			Finished Water Production			
		Permanent [1]	Seasonal [2]	Functional	Per capita (MGD)	Avg. Day (MGD)	Max. Day (MGD)	Max. Day /Avg. Day
Actual	2005	76230	73737	149967	118	17.7	22.4	1.26
	2006	74252	75228	149480	111	17.2	22.4	1.30
	2007	73499	76453	149952	103	16.0	19.9	1.24
	2008	73333	78647	151980	106	16.3	21.6	1.33
	2009	73299	77516	150815	105	16.4	21.3	1.30
	2010	73219	78401	151620	107	16.2	20.0	1.23
	2011	73981	77974	151955	114	17.3	21.7	1.25
	2012	74627	78431	153058	108	16.5	20.5	1.24
	2013	75914	78887	154801	108	16.7	20.5	1.22
	2014	76492	79343	155835	112	17.5	20.1	1.15
	2015	77003	79800	156803	114	17.9	21.4	1.20
	2016	77304	80270	157574	112	17.7	21.9	1.24
	2017	77013	80740	157753	112	17.6	20.7	1.17
	2018	77101	81211	158312	112	17.7	20.8	1.17
Projected	2019	77101	81681	158782	115	18.2	22.8	1.25
	2020	77101	82151	159252	115	18.3	22.9	1.25
	2021	77101	82622	159723	115	18.4	23.0	1.25
	2022	77101	83092	160193	115	18.4	23.0	1.25
	2023	77101	83562	160663	115	18.5	23.1	1.25
	2024	77101	84033	161134	115	18.5	23.2	1.25
	2025	77101	84503	161604	115	18.6	23.2	1.25
	2026	77101	84973	162074	115	18.6	23.3	1.25
	2027	77101	85444	162545	115	18.7	23.4	1.25
	2028	77101	85914	163015	115	18.8	23.4	1.25
	2029	77101	86384	163485	115	18.8	23.5	1.25
	2030	77101	86855	163956	115	18.9	23.6	1.25
	2031	77101	87037	164138	115	18.9	23.6	1.25
	2032	77101	87220	164321	115	18.9	23.6	1.25
	2033	77101	87403	164504	115	18.9	23.7	1.25
	2034	77101	87587	164688	115	18.9	23.7	1.25
	2035	77101	87771	164872	115	19.0	23.7	1.25
	2036	77101	87955	165056	115	19.0	23.7	1.25
	2037	77101	88140	165241	115	19.0	23.8	1.25
	2038	77101	88325	165426	115	19.0	23.8	1.25
	2039	77101	88510	165611	115	19.1	23.8	1.25
	2040	77101	88696	165797	115	19.1	23.8	1.25

[1] Permanent population from 2010 - 2017 obtained from US Census. Population projection for 2040 obtained from SFWMD Lower East Coast Water Supply Plan Update (2018). Population between 2018 to 2040 assumed to be constant

[2] Seasonal population from 2010 - 2030 obtained from USACE Carrying Capacity Study (2003). Seasonal population between 2030 and 2040 assumes continued growth at 0.2%

Even with the conservative assumptions presented herein, the future average day demand is only anticipated to increase from 17.7 MGD (in 2005 and 2006) to 19.1 MGD and the maximum day demand is projected to increase from 22.4 MGD to 23.8 MGD.

2.5.1 Demand by Service Type

FKAA records water usage in the following categories: residential, commercial, Navy, irrigation, cruise ships, fire service, and hydrant (for construction), as shown in **Table 2-2**. Prior to 2008, FKAA used a different customer service software system that did not include categories for irrigation, cruise ships, fire service, and construction hydrants. As a result, these values are included in the commercial column. Also, for the purposes of this report, the water demand for cruise ships, fire service, and hydrant are grouped as "other" since their total is less than one percent of the water demand.

TABLE 2-2
Water Use by Service Type

Year	Annual Average Demand (MGD)					
	Residential	Commercial	Navy	Irrigation	Other	Total
2005	8.18	5.33	0.88	NA	NA	14.39
2006	8.69	5.20	0.89	NA	NA	14.78
2007	7.95	4.89	0.83	NA	NA	13.67
2008	7.96	4.56	0.76	0.00	0.03	13.31
2009	7.71	4.51	0.64	0.00	0.02	12.88
2010	7.39	4.41	0.70	0.00	0.01	12.51
2011	7.88	4.63	0.76	0.02	0.02	13.31
2012	7.68	4.45	0.77	0.11	0.09	13.10
2013	7.57	4.58	0.75	0.24	0.08	13.22
2014	7.54	4.62	0.75	0.35	0.06	13.32
2015	7.98	4.81	0.73	0.50	0.04	14.06
2016	7.61	4.85	0.73	0.62	0.04	13.85
2017	7.25	4.71	0.75	0.78	0.05	13.54
2018	7.29	4.62	0.72	1.01	0.06	13.70

More than half (58 percent) of the water produced by the FKAA is used by residential customers. Commercial customers are the next-largest consumer category, with an average use of 35 percent. No large commercial customers (that is, those using 40 percent or more of the water sold in the commercial category) have been identified.

The U.S. Navy is FKAA's largest single customer, accounting for approximately five percent of its annual consumption. During the period between 2000 and 2004, the average annual demand was 1.05 MGD. This consumption decreased significantly by 2008, where it has remained relatively constant at 0.73 MGD. At the present time, the Navy has indicated that the current consumption level will remain relatively constant. However, FKAA's contract with the Department of Defense calls for supplying the U.S. Navy with up to 2.4 MGD of water. Therefore, in order to meet the Navy's water supply needs, FKAA maintains frequent contact with Navy personnel. If any future increase is required, FKAA will update this Master Plan and construct any necessary facilities to meet the Navy's contracted water supply requirements.

With the exception of irrigation flows, the water demand by service type has been relatively constant over the past 11 years. Residential demand has decreased slightly and irrigation demand increased slightly. The increase in irrigation demand is attributed to both a change in accounting methods and actual increased irrigation flows. When FKAA began billing for sewer service, irrigation flows were recorded separately so the customers were not charged a sewerage fee for water used to irrigate.

2.5.2 Future Demand Allocation

Vacant parcel maps were analyzed to determine where the potential future water demand would be allocated within Monroe County. As shown in **Table 2-3**, most of the potential for growth exists in Areas 2 and 5.

TABLE 2-3
Future Demand Allocation Based on Vacant Parcels[1]

Parcel Type	Area 1	Area 2	Area 3	Area 4	Area 5
Condominiums	2286	0	0	0	0
Miscellaneous Res.	137	9	0	0	1
Mixed Use - Residential/Commercial	257	62	88	50	62
Mobile Home	6	2025	563	394	2492
Multi Family	1017	224	371	138	243
Single Family	5060	8176	4457	3808	6022
Total	**8763**	**10496**	**5479**	**4390**	**8820**
Vacant Residential	191	3101	1442	860	2688
Percent Vacant	2%	37%	17%	10%	32%
Max. Day Demand (MGD) Allocation	0.1	1.1	0.5	0.3	1.0

1 Refer to Figure 1-2 for locations of service areas.

2.5.3 Non-Revenue Water

Non-revenue water (NRW) is the volume difference between the water that is metered leaving the treatment facility and the sum of the water billed to customers. Non-revenue water includes the following components:

- Unbilled metered consumption
- Unbilled un-metered consumption (including fire-flow and distribution system flushing)
- Unauthorized consumption
- Customer metering inaccuracies
- Data handling errors
- Leakage in storage tanks or overflows
- Leakage in transmission or distribution lines
- Leakage in service connections prior to customer meter

In 2013, FKAA retained a consultant to conduct a water and revenue loss assessment and develop a Water and Revenue Loss Management Plan. The analysis followed the AWWA M36 standard methodology and was based on system data from 2013 to 2014. Since then, FKAA has had a team dedicated to improving meter accuracy and locating leaks in the distribution system. While the leak detection staff are constantly finding leaks in the system, the new leaks are developing at the same pace as old leaks are repaired, resulting in little change to the overall water loss, as shown in **Appendix B**. On average, non-revenue water accounts for approximately 23 percent of the total production.

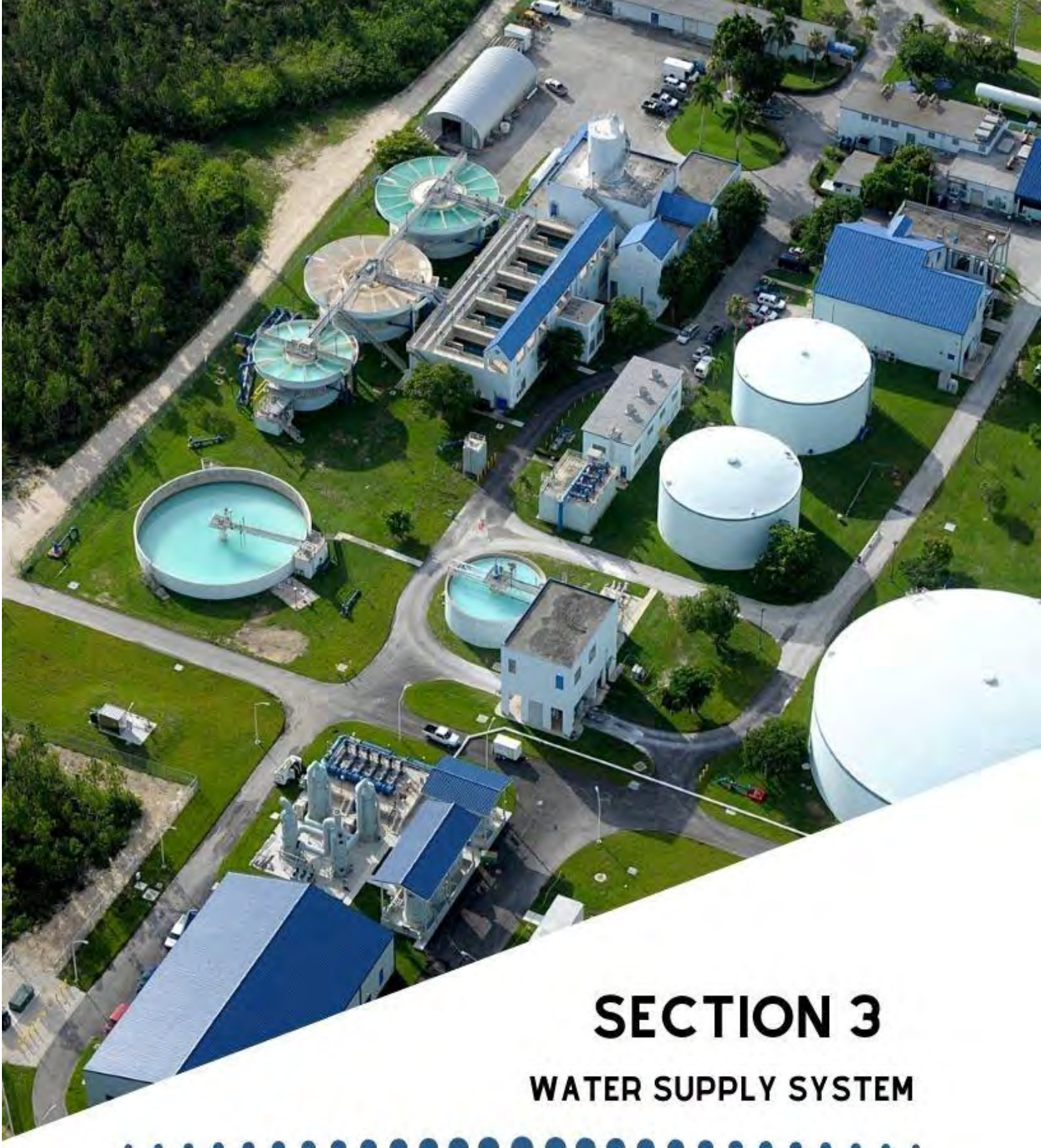
TABLE 2-4
Non-Revenue Water

Year	Annual Average Water Use				
	Billed	Non-Revenue Water			Total
	(MGD)	(MGD)	(%)	(GPCD)	(MGD)
2013	13.2	3.6	21%	71	16.7
2014	13.3	4.2	24%	71	17.5
2015	14.1	3.8	21%	74	17.9
2016	13.8	3.9	22%	76	17.8
2017*	13.5	4.0	23%	78	17.6
2018*	13.7	4.0	23%	77	17.7

*Impacted by Hurricane Irma

2.6 Conclusions

Over the course of this planning horizon, FKAA's average daily finished water demand is expected to increase from 17.7 MGD in 2018 to 19.1 MGD in 2040. The maximum day demands are calculated using a peaking factor of 1.25. The projected maximum day demand for 2040 is 23.8 MGD. While FKAA is working to promote water conservation and reduce non-revenue water, this plan has adopted a conservative assumption that these values will remain constant over the next 20 years.



SECTION 3

WATER SUPPLY SYSTEM

FLORIDA KEYS AQUEDUCT AUTHORITY

SECTION 3
Water Supply System

The Florida Keys Aqueduct Authority draws from four different supply sources in the Keys. Most of the supply (approximately 17.79 MGD) is fresh groundwater from the Biscayne Aquifer, which is treated through a lime softening process. This is supplemented with approximately 6 MGD of groundwater from the brackish Floridan Aquifer, which is treated at FKAA's Low-Pressure Reverse Osmosis facility; both the lime softening plant and the LPRO facility are located at the J. Robert Dean Water Treatment Plant in Florida City. Additionally, two seawater desalination plants located in Marathon and Stock Island contribute emergency water supply; the Marathon plant has a capacity of 1 MGD and the Stock Island plant has a capacity of 2 MGD. A summary of these sources is included in **Table 3-1** below.

Per the terms of FKAA's water use permit with South Florida Water Management District, the water supply is limited to a maximum daily withdrawal of 17 MGD during the dry season (December-April) if aquifer levels fall below 1.25 NGVD29 at USGS monitoring well G-613.

TABLE 3-1
Water Supply Sources

Location	Source Water	Treatment Process	Capacity (MGD)
Florida City	Biscayne Aquifer	Lime Softening	17.79[1]
Florida City	Floridan Aquifer	Low-Pressure Reverse Osmosis	6
Marathon	Seawater	Desalination and/or R.O.	1
Stock Island	Seawater	Desalination and/or R.O.	2

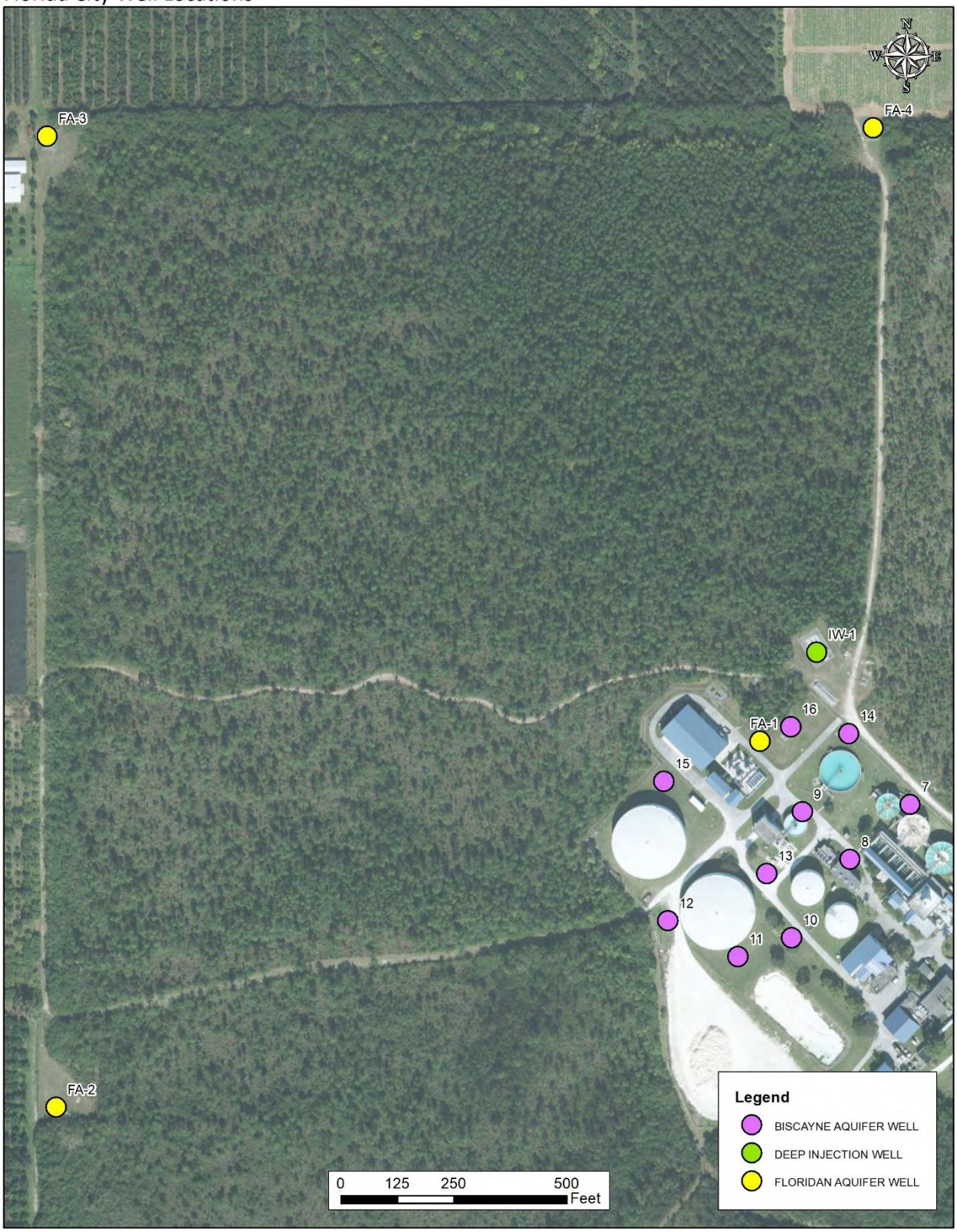
1 Max day withdrawal limited to 17 MGD during dry season if aquifer level falls below 1.25 NGVD29 at USGS monitoring well G-613 between December 1 and April 30.

3.1 Florida City

The WTP in Florida City has the capability to supply water from either the Biscayne Aquifer or Floridan Aquifer. Since the cost to operate the lime softening plant is significantly less than the cost to operate the LPRO, most of the water is supplied from the Biscayne Aquifer.

The WTP also has an injection well that is used for brine disposal from the LPRO Facility. **Figure 3-1** shows the locations of supply and deep injection wells at the treatment plant.

FIGURE 3-1
Florida City Well Locations



3.1.1 Biscayne Aquifer

In southeastern Miami-Dade County, the Biscayne Aquifer is composed of three geologic formations: Miami Limestone, the Fort Thompson Formation, and the Tamiami Formation. Although these are three distinct geologic formations, they essentially act as one hydrogeologic unit.

Miami Limestone outcrops at ground surface at the FKAA WTP and is found to a depth of approximately 25 feet below land surface (bls). Beneath the Miami Limestone, the Fort Thompson Formation is found to a depth of approximately 100 feet bls; this is the principal water-bearing unit of the Biscayne Aquifer.

The Biscayne Aquifer wells are relatively shallow, having an average depth of 58 feet. The current operating wells were installed between 1981 and 2000. The six original wells have since been abandoned and capped. A summary of the wellfield information is shown in **Table 3-2.**

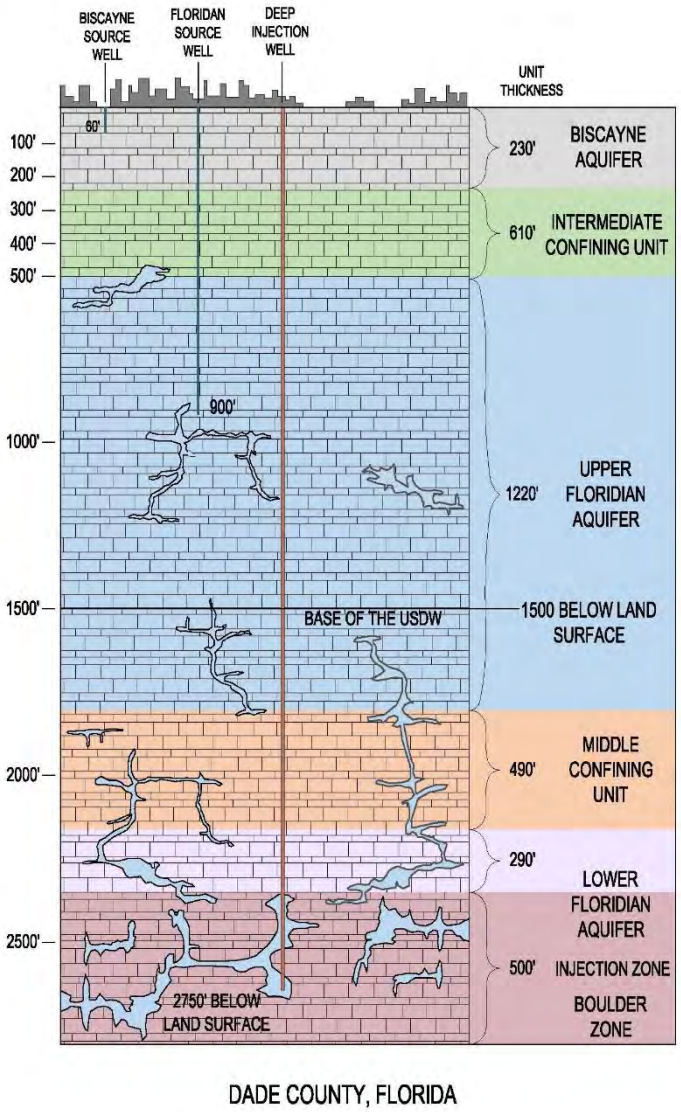
TABLE 3-2
Aquifer Supply Wells

Well		Planar Coordinates [1]		Well Construction Information				Pump Information	
		Easting	Northing	Well Diameter (in)	Well Depth Below Land Surface (ft)	Casing Depth Below Land Surface (ft)	Year Drilled	Pump Depth Below Land Surface (ft)	Pump Capacity (GPM)
Biscayne Aquifer	7	818625	402390	24	60	20	1981	20	2,100
	8	818530	402282	24	60	20	1981	35	2,100
	9	818387	402406	24	60	20	1981	35	2,100
	10	818340	402095	24	57	37	1986	20	2,100
	11	818250	402030	24	57	37	1986	20	2,100
	12	818075	402145	24	56	36	1987	20	2,100
	13	818295	402210	24	56	36	1987	20	2,100
	14	818484	402530	24	56	36	1987	20	2,100
	15	818124	402407	24	60	35	2000	20	2,400
	16	818329	402609	24	60	35	2000	20	2,400
Floridan Aquifer	1	818336	402531	24	1,300	880	2007	83	1,500
	2	816738	402695	15	1,262	908	2008	83	1,500
	3	816712	403866	15	1,266	880	2008	83	1,500
	4	818526	403887	15	1,266	880	2008	83	1,500

[1] Planar coordinates are Florida State Plane East

3.1.2 Floridan Aquifer

FIGURE 3-2
Floridan Aquifer Cross Section



The Floridan Aquifer System (FAS) is a regional aquifer that is present throughout Florida and extends into southern Georgia and Alabama. The FAS is recharged by rainfall and seepage in the north-central Florida area, where it outcrops at land surface. Regionally, the FAS is divided into the Upper Floridan Aquifer (UFA) and the Lower Floridan Aquifer (LFA). The UFA is separated from the LFA by a low-permeability unit called the middle confining unit. The LFA includes the Boulder Zone, a highly-permeable interval used for the disposal of municipal effluent and industrial waste, which includes RO brine concentrate. **Figure 3-2** depicts a conceptual cross-section of the FAS in Miami-Dade County, with an injection well and associated monitoring wells.

3.2 Raw Water Quality

3.2.1 Biscayne Aquifer

The raw water drawn from the Biscayne Aquifer meets drinking water standards in all regulated water quality parameters prior to any treatment**.** A summary of the average Biscayne Aquifer raw water quality parameters recorded at the J. Robert Dean WTP between 2014 and 2018 can be found in the Water Quality Program Manual, **Appendix C**. While most water quality parameters have remained constant, there has been a gradual increase in chloride concentration and color. However, these parameters remain significantly below the regulatory limits and warrant no immediate action.

3.2.2 Floridan Aquifer

A summary of the average Floridan Aquifer raw water quality parameters recorded at the J. Robert Dean WTP can be found in the Water Quality Program Manual, **Appendix C**. An inverse relationship between chloride concentration and pumpage has been observed, indicating that the pumping of the Floridan Aquifer well at the rates indicated do not appear to induce any upconing of poorer-quality water from depths below the base of the well. This probably results from the apparent layer of confining material located just below the bottom of the well, which would inhibit the upward movement of the poorer-water quality.

3.3 Water Supply Permitting

FKAA's groundwater withdrawals are regulated by its Water Use Permit (WUP) (13-00005-W) issued by the South Florida Water Management District (SFWMD).

3.3.1 SFWMD Allocation

FKAA has an annual allocation of 6,492 MG through September 2028. This represents a 20-year allocation for FKAA's current use. **Table 3-3** summarizes FKAA's permit thresholds.

TABLE 3-3
Water Withdrawal Permit Thresholds

Water Source	Permit Specification	Units	Permit Threshold
Biscayne Aquifer	Average Daily Withdrawal	MGD	17.79
	Average Dry Season Withdrawal[1]	MGD	17
	Annual Withdrawal	MG	6,492
Floridan Aquifer	LPRO Capacity	MG	6
Total Annual Allocation	Average Daily Withdrawal	MGD	23.97
	Maximum Monthly Withdrawal	MG	809.01
	Annual Withdrawal	MG	8,750.84

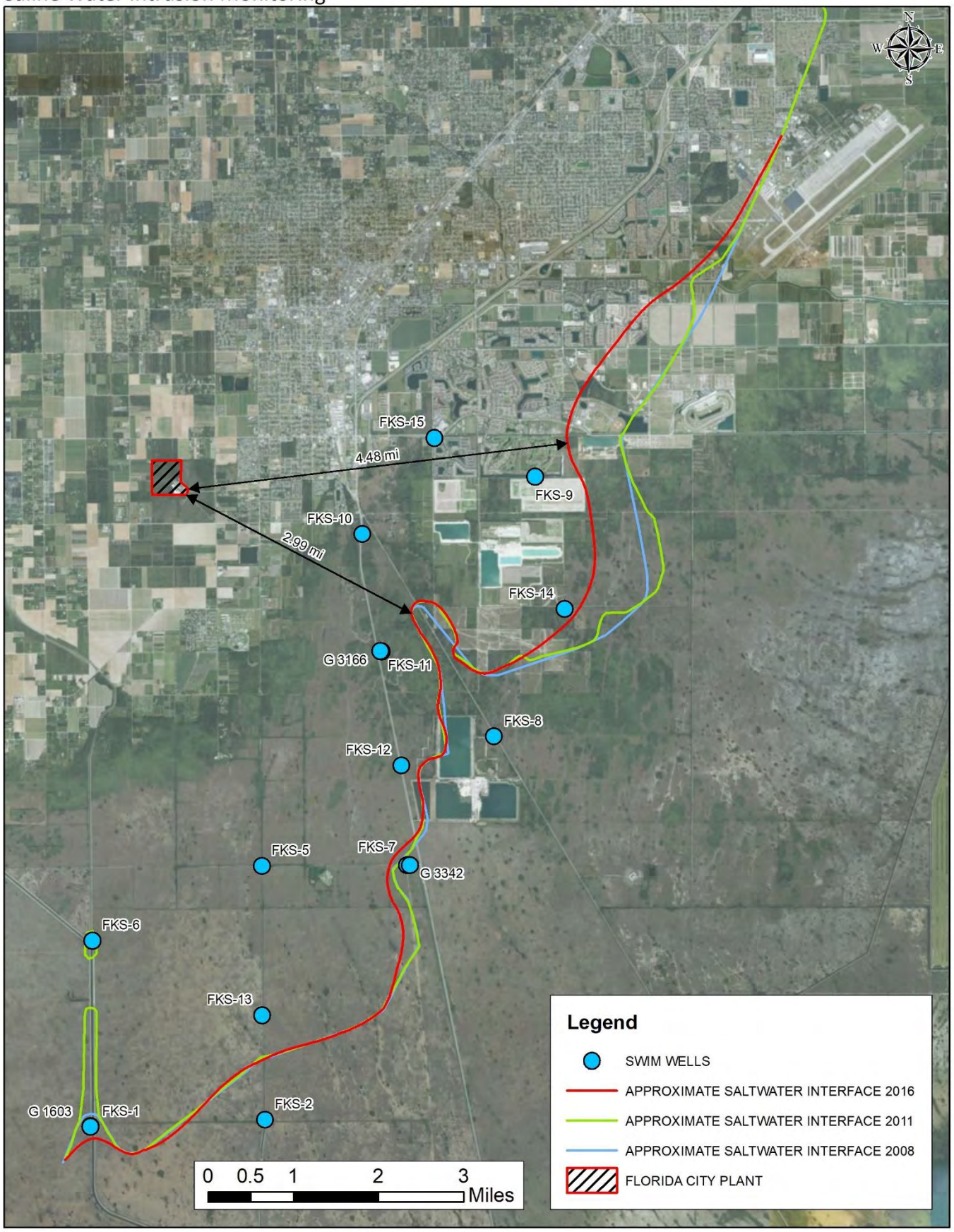
[1] Dry Season is defined as December through April

3.3.2 Wellfield Protection

The FKAA is proactive in its wellfield protection practices and programs. Much of the program is driven by the wellfield's location and proximal land uses. Predominant land uses in the immediate vicinity of the wellfield include extensive agriculture and the presence of a primate breeding facility, the Mannheimer Foundation, which houses approximately 2000 monkeys. Additionally, the wellfield's proximity to Biscayne Bay, the South Biscayne Aquifer 1000-ppm Isochlor Line, and the Turkey Point Nuclear Power Plant also plays a significant role in developing and refining the program. Key aspects of the wellfield protection program include:

- Cooperative wellfield protection agreement with Miami-Dade's Department of Permitting, Environmental and Regulatory Affairs (PERA)
- Saline water intrusion monitoring well program (SWIM)
- Biscayne Aquifer monitoring well program
- Chemical contamination monitoring (point and non-point sources)
- Emerging and unregulated contaminant monitoring
- Radiological monitoring

FIGURE 3-3
Saline Water Intrusion Monitoring



Saline Water Intrusion Monitoring

Limiting Condition #23 of FKAA's Water Use Permit (WUP) requires the implementation of a Saline Water Intrusion Monitoring (SWIM) program to protect the Biscayne Aquifer from saltwater intrusion. FKAA has collected data since 1991 and has been required to install additional monitoring wells occasionally, as appropriate. To date, data has not demonstrated that FKAA's withdrawals cause increased saline water intrusion. The growing population of users in south Miami-Dade County, along with climatic changes and regional water supply management decisions made by SFWMD, appear to play a more significant role in the movement of the saltwater interface, which is inherently dynamic in nature.

The withdrawal of additional Biscayne Aquifer water during the wet season is unlikely to contribute to saline water intrusion due to the high-water levels and precipitation that occurs during this time of the year. **Figure 3-3** shows the saltwater intrusion map developed by the United States Geological Survey (USGS) and the location of existing SWIM monitoring wells. Also shown are the monitoring wells maintained by FKAA and sampled monthly.

In addition, the FKAA worked with CDM Smith on the Water Supply Protection Program Phase I and II. Through the Phase I and II Reports, a significant amount of data was compiled and analyzed, revealing some statistically significant relationships and trends. To the extent that data was available, the results of this effort provided a robust evaluation of influences and relationships. Key conclusions generated from the analysis are as follows:

- Canal stage levels have direct cause-effect relationships with observed water levels in the wells.
- The data indicate that canal operations control groundwater fluctuations in the wells.
- Operation of the control structures appears to be directly related to chloride levels in the wells.
- Neither FKAA pumpage nor total pumpage appears to cause the observed chloride concentrations in the wells; the data support canal operations as a more probable explanation.

The C-111 Spreader Canal Western Project is anticipated to have positive effects on saltwater intrusion management within the study area. The statistical analysis conducted for this study concluded that operation of the surface water management system had more influence on salinity in the sentry wells than withdrawals from the aquifer by FKAA or surrounding agricultural users.

Based on the results of this analysis, the following recommendations are being made:

- Continued monitoring of key sentry wells for changes in salinity with ongoing operations and structural changes in the canal control systems.
- Presentation of the findings of this study to key operations and regulatory staff at SFWMD for information transfer and to begin discussions on how the information provided may impact SFWMD's future direction of FKAA's operations in the Biscayne Aquifer.

- Identify which current agricultural operations are creating the most critical demands on the canal system operations that most influence migration of the saline water front; develop possible adjustments to system operations under specific timeframes or circumstances, such as drought conditions.

Florida Power and Light Hypersaline Plume

Florida Power and Light (FPL) maintains a Cooling Canal System (CCS) for operation of power generation units at their Turkey Point Power Generation Facility in southeast Miami-Dade County. The western boundary of the CCS is located about 9.5 miles east of the FKAA wellfield and about 5.5 miles east of FKAA's SWIM well (FKS-9). The CCS consists of some 6,000 acres of canals through which water is circulated for dissipation of heat created by the power generation units. The CCS is characterized as a "closed-loop" cooling system in that the same water is circulated through the extensive canal network without direct input of new water to the system. However, the CCS does not function as a closed loop system hydrologically in that as the warmed water is circulated, evaporation losses to the atmosphere remove freshwater from the canal system causing a concentration of salinity that exceeds typical ocean salinities by a factor of two or more. This increased salinity is accompanied by a corresponding increase in water density that causes hypersaline water to migrate downward into the underlying groundwater system and radially outward beneath the CCS.

Tritium and TDS concentrations in groundwater samples show that hypersaline water emanating from the CCS has moved more than two miles westward and is influencing movement of the saline water interface within the Biscayne Aquifer more than four miles inland. Currently, FPL is under a consent order to remove the hypersaline plume and has begun operation of a recovery and injection system designed to remove hypersaline water from the Biscayne Aquifer and inject it into the Boulder Zone via a deep injection well. SFWMD has permitted FPL to capture 5.475 billion gallons per year (15 MGD) of hypersaline water from the Biscayne Aquifer and FDEP has granted FPL an Underground Injection Control (UIC) permit to inject up to 15.59 MGD of water into a deep injection well.

Miami-Dade Cooperative Wellfield Protection Agreement

FKAA maintains a cooperative agreement with the Miami-Dade County Department of Permitting, Environmental and Regulatory Affairs to regulate and manage issues relating to the protection of FKAA's wellfield. Programs managed by PERA include:

- A ground and surface water monitoring program to detect water quality trends
- A surveillance and enforcement program to eliminate illegal discharges
- A wetlands program to protect important aquifer recharge areas

- A hazardous materials management program that includes regulation of underground storage tanks and liquid waste haulers
- A planning program to analyze data and refine the programs as needed

Biscayne Aquifer Monitoring Program

As part of the cooperative agreement for wellfield protection between FKAA and Miami-Dade, a series of Biscayne Aquifer monitoring wells were installed in eight locations surrounding FKAA's wellfield. Three wells were installed in each location for a total of 24 wells. Each location has a shallow (±20-foot), an intermediate (±40-foot), and a deep (±60-foot) well.

Water Quality Monitoring Wells

Chemical contamination can occur from point and nonpoint sources. Monitoring for these sources occurs at FKAA's raw water supply and at the Biscayne Aquifer monitoring wells as shown in **Figure 3-4.** Examples of contamination sources include underground fuel storage, sewage septic systems, and fertilizer or pesticides sprayed onto agricultural fields. Observations of elevated nitrate concentrations prompted further investigation via nitrogen and oxygen stable isotope water quality sampling; these results identified wastewater contamination as the potential nitrate source. Monitoring and further investigation of nitrate concentrations of these wells is ongoing, with a specific focus on the monitoring well nearest the Mannheimer Foundation primate facility. This facility treats wastewater via 12 septic tanks and drainfields; FKAA continues to encourage the Mannheimer Foundation to connect to Miami-Dade's Central Sewer Collection System.

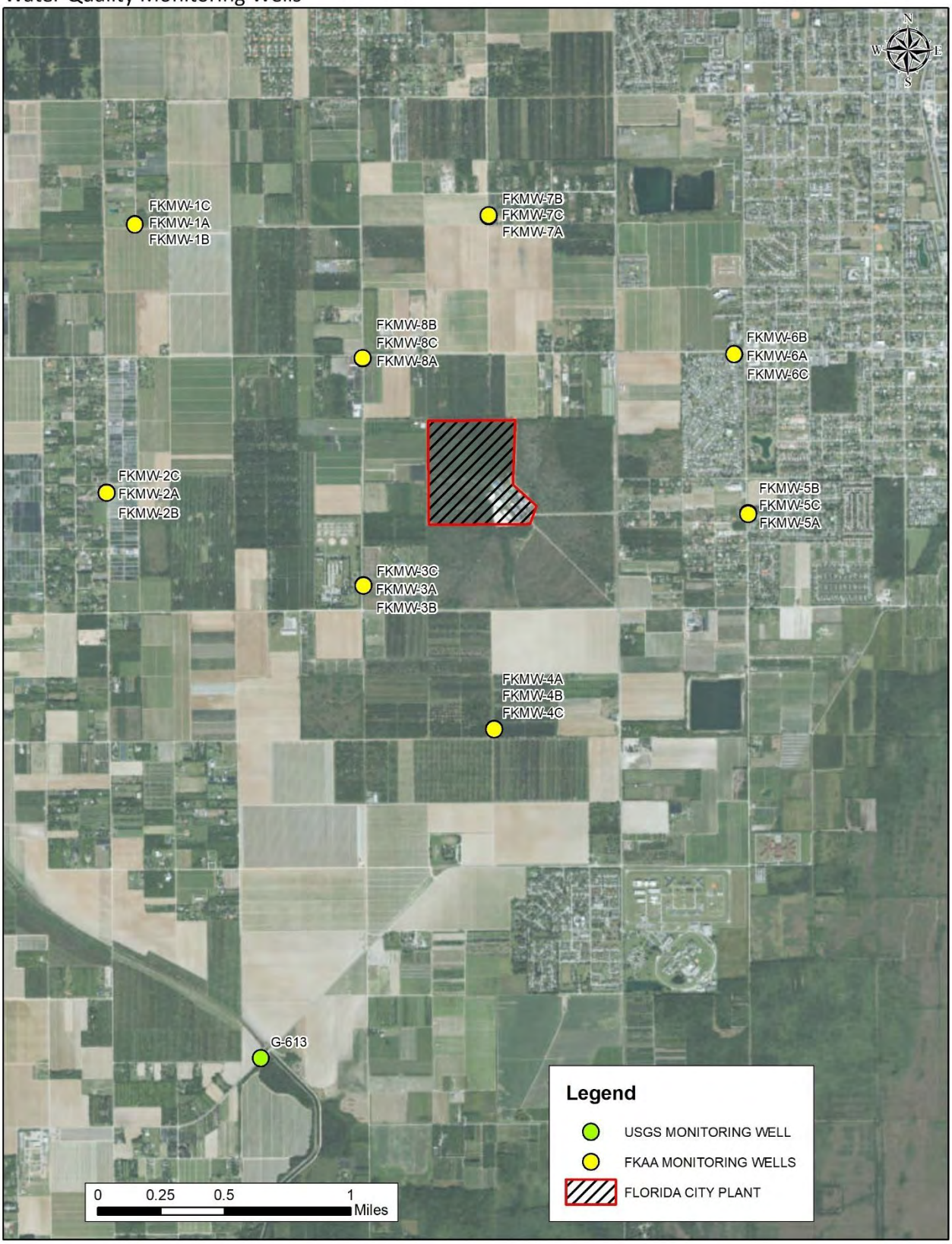
Emerging and Unregulated Contaminants

Emerging contaminants such as pharmaceuticals and personal care products (PPCPs) have recently been identified as potential threats to public water supplies. Sampling events for these contaminants were conducted in 2008 and 2009; the analytic results for each parameter were below the detectable limits. Per- and polyfluoroalkyl substances (PFAS) are also of recent concern; FKAA's pilot study surrounding treatment of PFAS in the drinking water supply is detailed further in Section 4.4.2.

Pesticides and Herbicides

Reports of specific pesticides and herbicides in nearby canals and adjacent to extensive agricultural uses led FKAA to perform additional pesticide and herbicide monitoring in 2008. Atrazine, an herbicide used in agriculture for weed control, was detected in three wells at levels significantly below regulatory limits. Annual testing is performed by FKAA on the finished water; PERA also monitors for these constituents from the surrounding monitoring wells at least annually.

FIGURE 3-4
Water Quality Monitoring Wells



Radiological Monitoring

Due to FKAA's proximity to the Turkey Point Nuclear Power Plant, as well as nuclear events like Japan's Fukushima disaster, radiological monitoring was conducted in select FKAA wells. Results indicated that there were no exceedances of the maximum contaminant levels for drinking water. In the event of a nuclear disaster, FKAA has the necessary facilities to treat water without exposure to the atmosphere.

Wellfield Protection Recommendations

Based on extensive monitoring and research, recent wellfield protection recommendations for chemical contamination prevention include:

- Increase accountability in rule enforcement and corrective action to identify and remove potential sources of contamination
- Install a new monitoring well cluster between Mannheimer's "Well Cluster 3" and FKAAs's wellfield
- Sample monitoring and supply wells to definitively identify the source of nitrate contamination. Recommended methods include sampling for chloride and bromide, stable isotopes of ^{11}B and ^{10}B, and optical brighteners, all indicators of wastewater contamination.
- Additional monitoring for microbial source tracking to differentiate between human and non-human fecal material when positive bacteriological results occur in a monitoring well

3.4 Climate and Sea Level Impact

The FKAA's groundwater supply from the Biscayne Aquifer is threatened by climate change and sea level rise. Climate change has the potential to cause severe droughts, reducing the amount of water available to recharge the aquifer. As previously discussed, the current SFWMD Water Use Permit (13-00005-W) contains a provision that limits the maximum day withdrawals from the Biscayne Aquifer if the groundwater elevation falls below 1.25 feet NGVD 29 at USGS monitor well G-613 between December 1 and April 30.

Rising sea level causes the saline water interface to migrate inland toward FKAA's water supply wells, as shown in **Figure 3-3**. However, the rate of change is relatively gradual, and FKAA does not anticipate any impacts to its water supply during this 20-year planning horizon.

3.5 Water Supply Recommendations

FKAA's projected 2040 average day finished water demand is 19.1 MGD and the projected 2040 maximum day finished water demand is 23.8 MGD. Assuming that Biscayne Aquifer withdrawals are limited to 17.0 MGD during the dry season and 4.5 MGD is available from the Floridan Aquifer on average, FKAA will have sufficient capacity to meets its future average day demands.

However, there will be a shortage in meeting the maximum day demand. Some recommended alternatives to close this gap include installing an interconnect with Miami-Dade Water and operating the Stock Island RO (SIRO) facility during maximum day demands, as described in Section 4.

Table 3-4 lists the projects that are recommended to improve resiliency and provide additional supply capacity. A list of all the Capital Improvement Projects is contained in **Appendix D**.

TABLE 3-4
Recommended Water Supply Projects

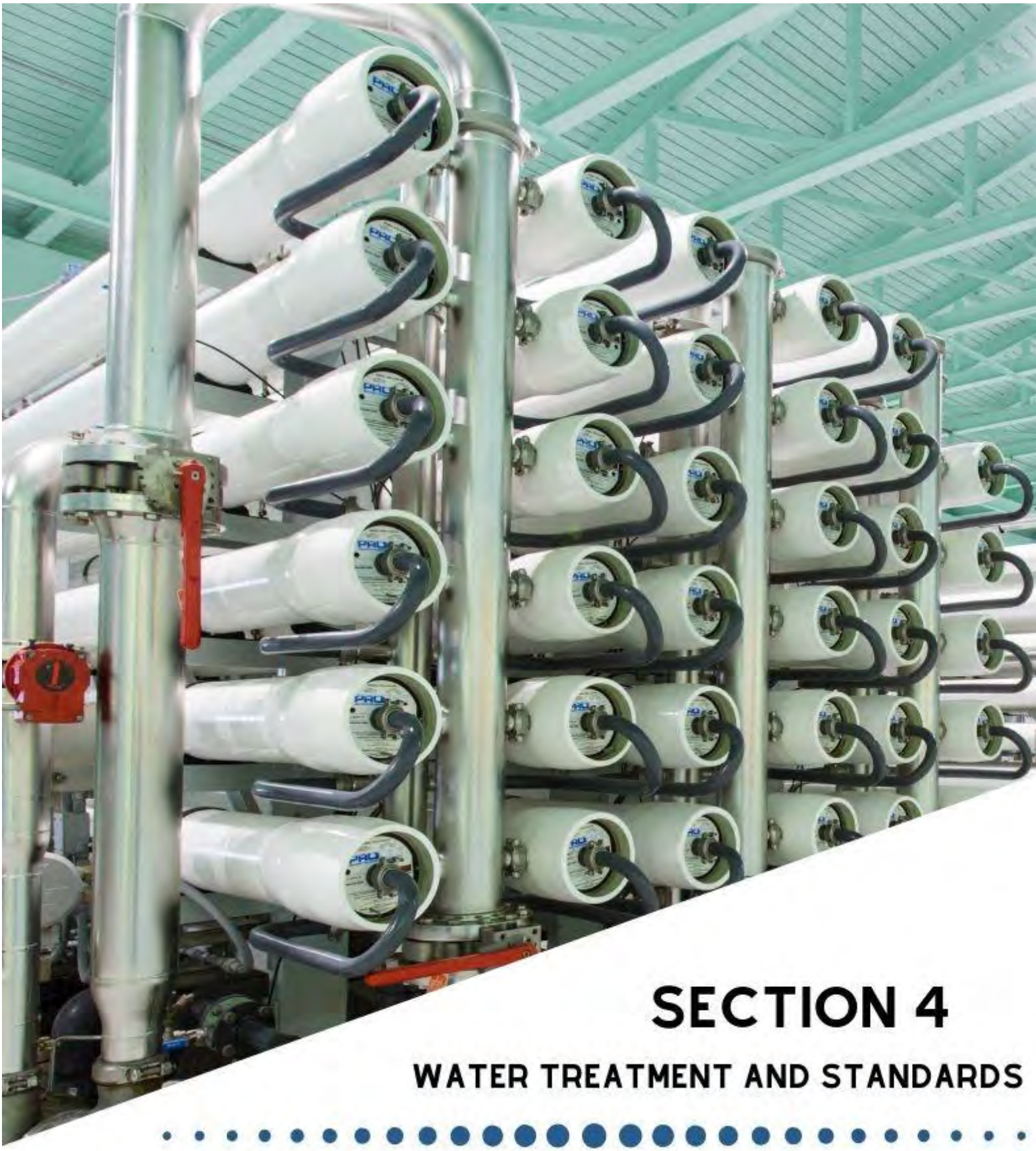
Recommended Projects	Cost
Miami Dade Interconnect	$ 2,000,000
New Wellfield	$ 5,500,000
Stock Island RO (SIRO)	$ 50,000,000
Total	**$ 57,500,000**

3.5.1 Biscayne Aquifer Well Replacement

Water supply wells have a typical service life of 50 years. As shown in **Table 3-2**, most of FKAA's supply wells were installed in the 1980s and will reach the end of their useful lives during this 20-year planning period. When replacing these wells, locations farther away from the saline water interface should be considered to ensure long-term supply of fresh water. This project would procure the land required for the future wellfield and install the first three wells and raw water supply piping.

3.5.2 Miami-Dade Water Interconnect

This project would provide an interconnect between the Miami-Dade Water and FKAA pipelines. This interconnect could provide an additional capacity of up to 4 MGD of potable water that would be used during emergencies or to supplement maximum day demands.



SECTION 4

WATER TREATMENT AND STANDARDS

FLORIDA KEYS AQUEDUCT AUTHORITY

SECTION 4
Water Treatment and Standards

FKAA operates three water treatment plants (WTPs) to produce potable water. The J. Robert Dean WTP in Florida City is the primary source, treating groundwater from the Biscayne Aquifer using a lime-softening process and treating brackish groundwater from the Floridan Aquifer using a low-pressure reverse osmosis (LPRO) process. FKAA also has two seawater desalination facilities, located in Stock Island and Marathon, which are used to supply water to the Middle/Lower Keys during emergency conditions.

4.1 J. Robert Dean Water Treatment Plant

4.1.1 Overview

The J. Robert Dean WTP has a total permitted facility output capacity of 29.8 MGD, which includes both the lime softening plant (23.8 MGD) and LPRO system (6 MGD). The flow schematic showing the inter-relation of the two water supply sources and WTPs is included as **Figure 4-1**. The individual process units and design criteria are summarized in **Appendix E**.

Although the rated treatment capacity is 29.8 MGD, FKAA's water use permit allows for a "special event peaking factor" (with prior notice), which increases the maximum daily withdrawal to 33.57 MGD. Otherwise, the permit limits the source water to an annual average of 23.97 MGD during non-drought conditions, as described in Section 3. This water supply capacity includes both the Biscayne Aquifer (17.79 MGD) and Floridan Aquifer (6 MGD). During drought conditions, the water supply from the Biscayne Aquifer is reduced to 17 MGD, resulting in a total withdrawal capacity of 23 MGD. Additionally, the monthly total withdrawal cannot exceed 809 MG, equal to 26 MGD for a 31-day month.

4.1.2 Lime Softening Facility

Figure 4-2 shows the general flow schematic of the existing lime softening process at the J. Robert Dean WTP. The process includes Biscayne Aquifer raw water wells, three lime softening reactors, and five gravity filters, as well as several chemical injection points for disinfection, fluoride addition, and corrosion control. The finished water from the lime softening facility and the LPRO facility is blended in the clearwell and product transfer tank. Solids from the lime softening process are dewatered using a vacuum filter press and hauled off-site for disposal.

FIGURE 4-1
Process Flow Diagram

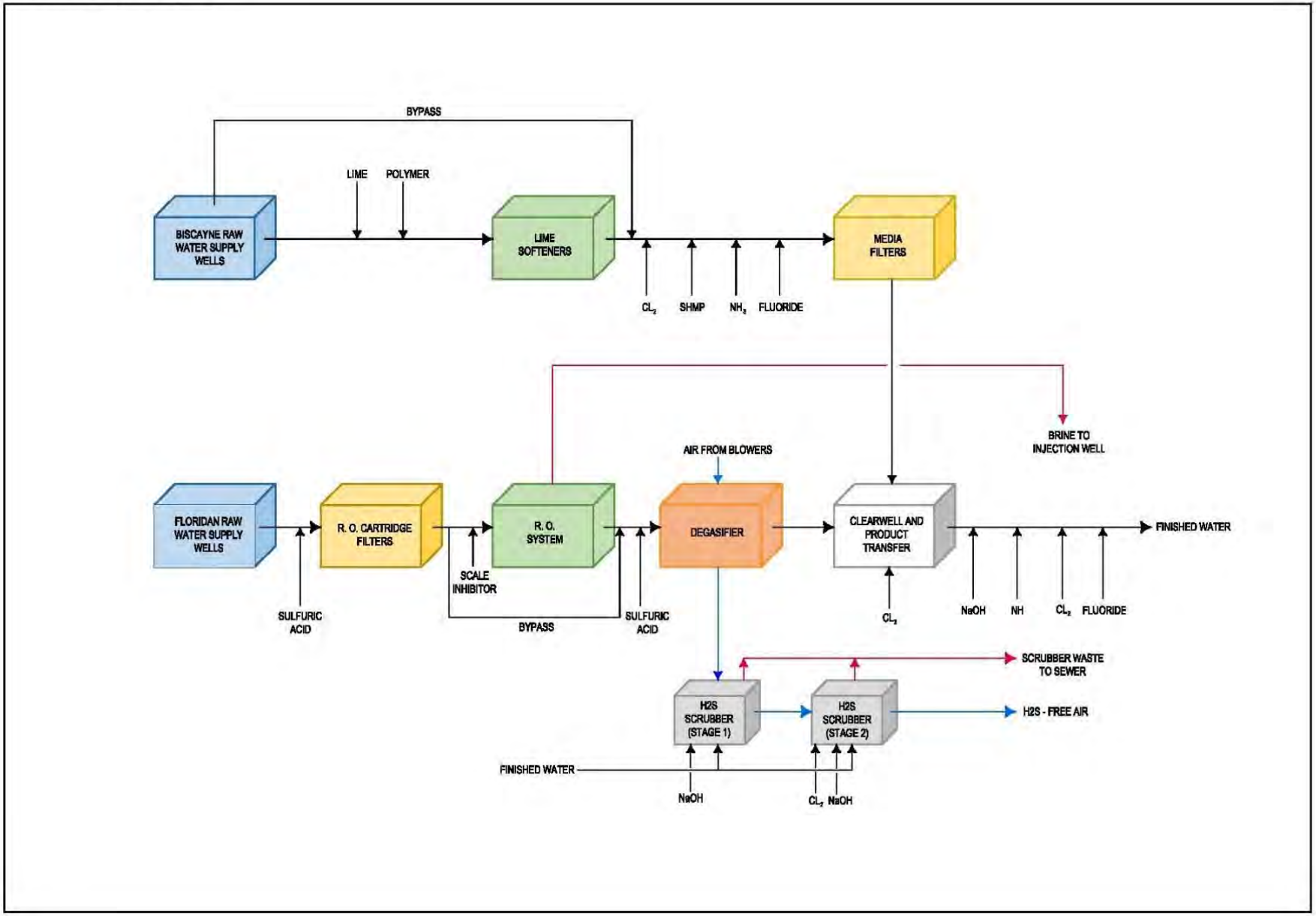
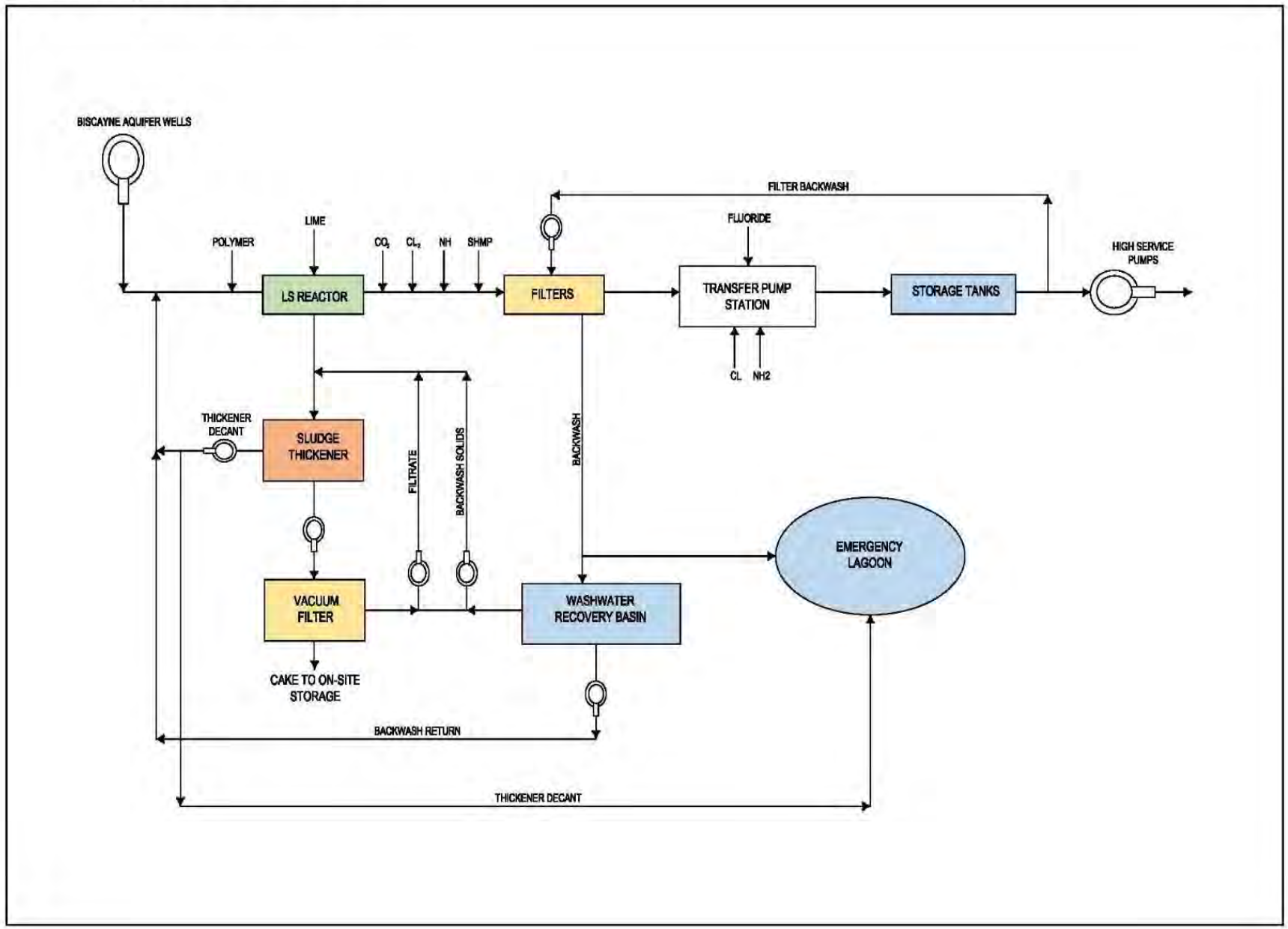


FIGURE 4-2
Lime Softening Process Flow Schematic



4.1.2.1 Biscayne Raw Water Wells

Ten wells, with capacities ranging from 3 MGD to 3.45 MGD, provide the raw water supply from the Biscayne aquifer. The raw water is combined from the individual wells into a single 24-inch diameter pipeline, where it is later split between the three reactor clarifiers.

4.1.2.2 Reactor Clarifiers

Three lime softening Infilco Degremount Accelator™ reactor clarifiers are used to soften raw water. Two of the reactor clarifiers are rated at 11 MGD each, but operate satisfactorily at flows as high as 16 MGD. The third reactor clarifier has a maximum capacity of 6 MGD. For the two larger reactors, operational experience has shown that softened water turbidity increases when the process flow is less than 8 MGD; as a result, flow turndown can occasionally raise concerns.

Lime and polymer are added to the raw water in the lime reactors. Lime is dosed based on a target pH of 10.5 measured continuously from a pH probe in each reactor clarifier. The lime is fed from a lime slurry recirculation system with a flow control pinch valve and magnetic flow meter at each treatment unit. The lime slurry is prepared with dual 2,000 lb/hr batch-type slaker systems (one in operation and one on standby). The lime feed system consists of a lime storage silo, two lime slakers, and lime slurry pumps.

Heavy chaia polymer (Clarifloc A 210P) is also added as a flocculent aid to improve settling of the calcium carbonate formed after lime addition. A Dynablend system is used to effectively blend the polymer with finished water used as “make-up water” prior to dosing at the lime reactors. The polymer flocculant aid system consists of storage, transfer pumps, solution tanks, and metering pumps. The average polymer dose is approximately 0.25 mg/L.

The lime sludge (3 to 8 percent dry solids content) produced by the reactor clarifiers is pumped to the sludge thickener via the sludge blowdown pumps. There is one sludge blowdown station that serves the two larger reactor clarifiers and a second blowdown station that serves the smaller treatment unit.

4.1.2.3 Filters

Five gravity filter units are utilized for filtering the lime-softened water using dual media consisting of anthracite coal and silica sand. This design assumes that one filter is on standby at peak production. The maximum filtration rate is 6.7 gpm/sf as shown in **Appendix E**.

The granular media filters are backwashed with finished water using dedicated backwash pumps, and the spent backwash water is discharged to a washwater recovery basin. The supernatant from this basin is pumped back to a raw water stream upstream of the lime softening reactors and the sludge is periodically pumped to a sludge thickener. Two filter backwash pumps (one service and one standby pump) are used for filter backwashing using plant-finished water.

Each filter is backwashed approximately every 60 hours. Each backwash (water only) has a duration of approximately 15 minutes.

4.1.2.4 Emergency Lagoon

If the filter backwash wash water recovery basin or sludge handling facilities are out of service, an emergency lagoon is available for temporary storage. The lagoon has a maximum volume of 700,000 gallons. No additions or major modifications are anticipated.

4.1.2.5 Disinfection

There are five chlorinators on-site: two 2000 lbs./day, two 500 lbs./day, and one 100 lbs./day. The two chlorinators that are rated at 2000 lbs./day provide most of the chlorine to the system and are used for the RO and lime softening process at the transfer station. When forming monochloramines at the transfer pump station, one 2000 lbs./day chlorinator is in use and the other chlorinator is in stand-by mode. If forming monochloramines at the filter one 2000 lbs./day chlorinator is used, and the other chlorinator is in stand-by mode.

There are two pre-filter chlorinators, which are rated at 500 lbs./day each. These are used at the filter system to meet the primary demand and to establish a free chlorine residual of 1mg/L over the filter system, after demand. This process is only used forming monochloramines at the transfer pump station.

If monochloramines are being formed at the filter, both pre-filter system chlorinators are offline and secured and a 2000 lbs./day chlorinator is used. There is one chlorinator used at the post chlorinator site which is rated at 100 lbs./day. This is used to control any excess free ammonia that may be overdosed in the treatment process. The Florida City Water Treatment Plant can configure all five chlorinators in multiple situations.

When adding chlorine to water, there is the potential to create a disinfection byproduct which may cause cancer in lab rats. The two byproducts of concern are trihalomethane (THM) and haloacetic acid (HAA5), precursors which are in the water and come from organic properties. When chlorine is added to the water that have these organic compounds, it may form THM or HAA5. When chlorine is added to water, it has two formations, hypochlorous acids and hypochlorite. It is the free hypochlorous acid that forms the THM and HAA5 in the water system. By adding ammonia to the system with chlorine, it forms monochloramines and that bond/reaction with hypochlorous acid renders it from being free and available.

There are two anhydrous ammonia storage tanks and two ammonia gas feed systems (ammoniators) on-site. One ammoniator is used for meeting the primary dosing demand and is added at the transfer pump station when making monochloramines at that location. If monochloramines are formed at the Lime Softening Plant, ammonia is added at the recarbonation station. The other ammoniator is in stand-by mode or used in high demand situations, i.e., PPM greater than 350PPM. At this time, we may use both ammoniators together.

4.1.2.6 Fluoridation

Liquid Hydrofluosilicic acid is dosed upstream of the filters at the lime softening plant to achieve a target fluoride concentration in finished water of 0.7 mg/L. A second injection point is located at the transfer pump station, but is currently not used. The fluoridation system consists of a storage tank, transfer pumps, a day tank, and metering pumps.

4.1.2.7 Phosphate (SHMP) Dosing

Sodium Hexametaphosate is made into a solution with a concentration of 0.0625 and dosage at approximately 0.2-0.3mg/L in the finished water.

4.1.2.8 Sludge Thickening System

Sludge generated at the lime softening reactors is pumped to the sludge thickeners. The sludge thickener converts the 3-8 percent (dry solids) sludge from the reactor clarifiers to approximately 20-40 percent. The thickened sludge is transferred with thickened sludge pumps to the vacuum filter. The sludge thickener supernatant is pumped to the raw water line by the thickener decant pumps.

4.1.2.9 Vacuum Filtration System

The thickened sludge is pumped to a vacuum filter where it is dewatered into a cake and trucked to the onsite storage area. The sludge dewatering system consists of the vacuum filter, vacuum pump, and filtrate pump.

The vacuum filter dewaters the thickened sludge to a dry cake with approximately 50-60 percent solids concentration. The vacuum filter filtrate is pumped back to the thickener influent line.

When the vacuum filter is in operation, the dewatered cake drops by gravity into a truck and is transported to a sludge storage area near the emergency lagoon. An outside contractor periodically (approximately every 1 to 2 weeks) loads and hauls the dry sludge from the site for ultimate disposal (beneficial use) as sub-base material or for use as clean fill.

4.1.3 Low-Pressure Reverse Osmosis

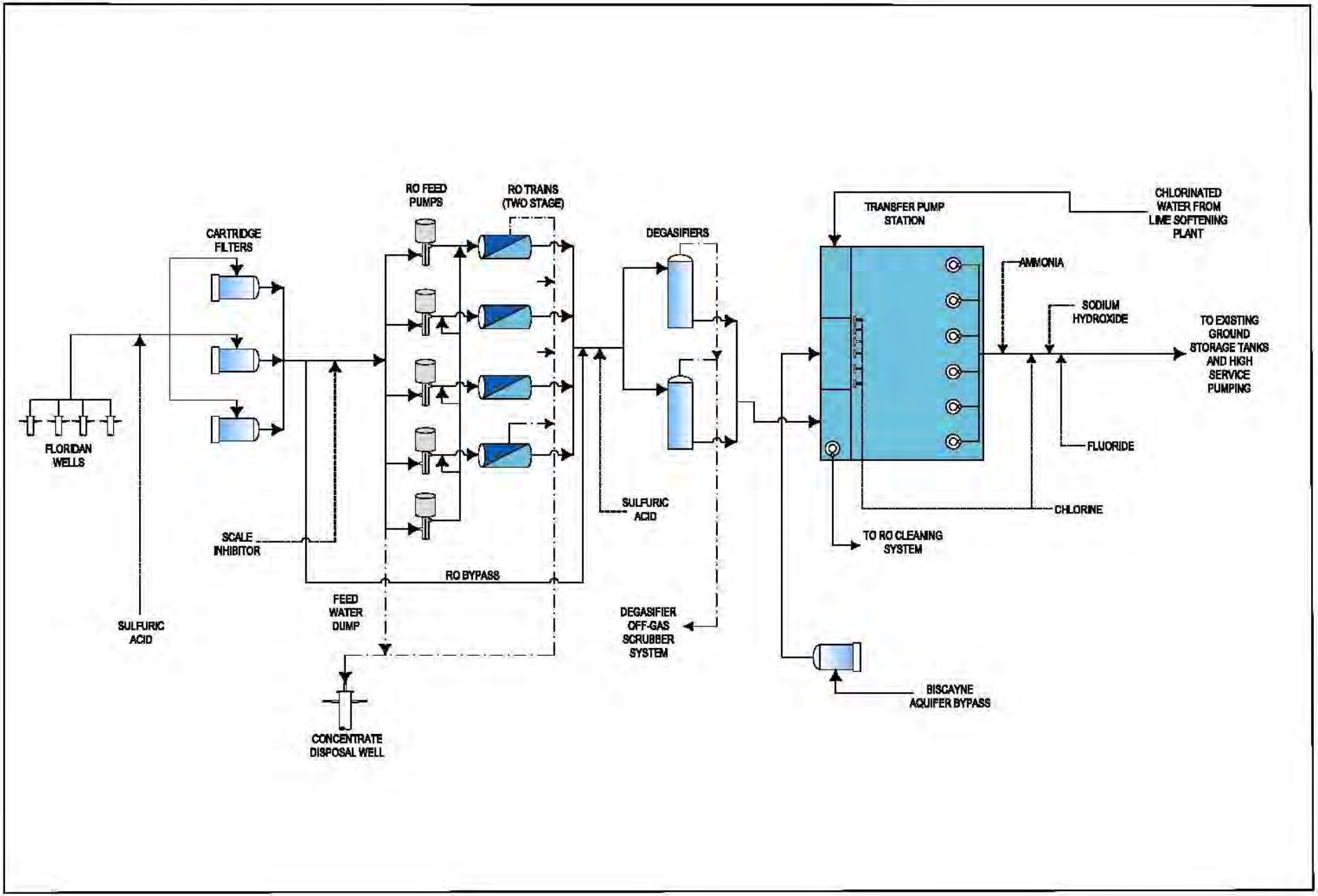
The LPRO facility has a rated capacity of 6 MGD to treat water from the Floridan Aquifer wellfield, which produces brackish groundwater. The LPRO has been operational since October 2009. Because this facility is costlier to operate than the lime softening plant, it is generally used either to prevent exceedances in Biscayne Aquifer withdrawal limits or as requested by the SFWMD in times of drought. **Figure 4-3** presents the general RO facility process flow diagram.

4.1.3.1 Floridan Raw Water Wells

Brackish water is drawn from four production wells with a capacity of approximately 2.0-2.3 MGD (1,400–1,600 GPM each). Groundwater from these wells is pumped to the RO treatment plant using submersible pumps with variable frequency drives (VFDs). The flow rate from each well is controlled by the VFD speed and the overall flow rate through the RO system.

It is desirable to operate the wells at less than maximum capacity to minimize the potential for upconing of very high-salinity groundwater from elevations below the well production zone. The design assumes the groundwater has total dissolved solids concentrations between approximately 5,000 and 8,000 mg/L.

FIGURE 4-3
Low Pressure Reverse Osmosis



4.2 SIRO Emergency Facility

SIRO was constructed in the early 1980s with a capacity of 3 MGD and operated until a new transmission line was installed from Florida City to Key West. In the late 1990s, after years out of service, FKAA repurposed the facility as an emergency water production facility in the event of a transmission main disruption or other emergency. The upgrade included the relocation of 1 MGD of RO process equipment to Marathon. Today, SIRO has a maximum capacity of 2 MGD, consisting of four parallel RO membrane trains. Currently, each train is operated for approximately four hours per month to maintain functionality and to allow staff opportunities to remain current with operational procedures.

The SIRO facility has two seawater supply wells approximately 100 feet deep. Each well has a vertical turbine well pump set at a depth of approximately 30 feet with a capacity of approximately 3,500 GPM. Scale inhibitor is added to the raw seawater at a dose of approximately 1 mg/L as a scale preventative (primarily calcium carbonate, $CaCO_3$). After the addition of scale inhibitor, the water passes through a bank of five parallel cartridge filters, nominally rated at 5 microns. The cartridge filter effluent then passes under well pump pressure to the RO high-pressure feed pumps and RO membrane trains.

There is one RO feed pump for each RO train. Each process train of RO membranes (permeators) is fed by a dedicated feed pump (with energy recovery turbines) with an operating pressure of 800-1,000 PSIG and flow rate of 1,160 GPM. The membrane trains are designed for a permeate (product water) flow rate of 0.5 MGD each at a recovery rate of 30 percent. The design concentrate (reject brine) flow rate from each train is approximately 810 GPM and passes through energy recovery turbines before discharging to the concentrate injection well. The energy recovery turbine device for each feed pump is mounted on the pump shaft and reduces the total power consumption by approximately 25 percent.

The permeate flow stream from all the trains is collected in a header pipe and flows at low pressure to a drawback tank. Permeate enters the bottom of the drawback tank and exits at the top. The tank provides an immediately available supply of water back to the permeators at loss of RO membrane feed pressure, which prevents possible damage to the permeators and piping should there be a power failure. The drawback tank also provides chlorine-free permeate water for flushing the salt water from the feed pumps, permeators, and piping upon system shutdown and start-up.

After the product exits the drawback tank, it passes to the top of the degasifiers where it falls by gravity through a packing material to a clearwell located below. Blowers force air up through the packing, stripping the minimal amount of hydrogen sulfide and carbon dioxide in the permeate, and discharging the gasses to the atmosphere.

In the clearwell, sodium hydroxide is fed to raise the pH to near-neutral. Product water transfer pumps are used to transport the finished water to a nearby offsite ground storage and high-service pumping facility. Chlorine and ammonia (chloramines) are added to the product transfer pump discharge line for disinfection. FKAA intermittently operates the RO trains for short durations for testing.

4.3 Marathon RO Emergency Facility

The Marathon RO plant provides an alternative source of water for the Lower and Middle Keys. The treatment process at the Marathon RO facility is similar to that of the SIRO facility and it also serves as an emergency water supply in the event that the major transmission pipeline from Florida City is out of service. The existing RO seawater desalination plant has a capacity of 1 MGD. There are two 0.5-MGD process trains that were refurbished and relocated from the original desalination plant at Stock Island. FKAA intermittently operates the RO trains for short durations for testing.

4.4 Drinking Water Standards and Water Quality

This section provides a summary of recent and upcoming changes in the state and federal Safe Drinking Water Act (SDWA) regulations associated with the production and distribution of potable water. A detailed description of the various SDWA and Florida state regulations can be found in **Appendix C**. Based on the current operating information, the treatment facilities operated by FKAA should not be significantly impacted by anticipated or recent changes to the SDWA applicable regulations.

4.4.1 Recent Drinking Water Regulatory Changes

The following revisions to the SDWA regulations will require the FKAA to perform studies and/or document that the water system complies with the new regulations. It is anticipated that FKAA will be in compliance with each new regulatory requirement; however, the studies will need to be performed and verified to the state.

4.4.1.1 Groundwater Disinfection for Virus Inactivation

In accordance with 62-555.320 (12)(b), FAC, groundwater systems with a source that is not under the direct influence of surface water and is exposed to the atmosphere during treatment must provide at least 4-log inactivation or removal of viruses before the first customer at all flow rates. The virus inactivation/removal requirement is not applicable if aerators and other facilities are protected against contamination from birds, insects, wind-borne debris, rainfall, and drainage.

4.4.1.2 Ground Water Rule

EPA's Ground Water Rule (GWR) was published in the Federal Register in November 2006. The GWR applies to public water systems that use ground water as a source of drinking water. The rule also applies to any system that delivers surface and ground water to consumers where the ground water is added to the distribution system without treatment. Basic requirements implemented in this rule are as follows:

- Routine sanitary surveys of systems that require the evaluation of eight critical elements of a public water system and the identification of significant deficiencies (e.g., a well located near a leaking septic system);

- Triggered source water monitoring for a system that (not treating drinking water to remove 99.99 percent (4-log) of viruses) identifies a positive sample during regular Total Coliform monitoring or assessment monitoring (at the option of the state) targeted at high-risk systems;
- Corrective action for any system with a significant deficiency or source water fecal contamination; and
- Compliance monitoring to ensure that treatment technology installed to treat drinking water reliably achieves 99.99 percent (4-log) inactivation or removal of viruses.

Corrective actions, such as determining source water alternatives and requiring 4-log inactivation/removal of viruses, may be enforced under this rule if deemed appropriate.

4.4.1.3 Contaminant Candidate List

The Contaminant Candidate List (CCL) is a list of contaminants that are currently not subject to any proposed or promulgated national primary drinking water regulations but are known or anticipated to occur in public water systems. In November 2016 the fourth Contaminant Candidate List (CCL 4) was finalized. The updated list includes 97 chemicals or chemical groups and 12 microbial contaminants, as shown in **Appendix C.** As of October 2018, the EPA is requesting nominations of chemicals, microbes, or other materials for consideration on the CCL 5.

4.4.2 Emerging Contaminants

Concern has arisen in recent years regarding the presence of per- and polyfluoroalkyl substances (PFAS) in drinking water supply as a result of several studies indicating potential adverse health effects. PFAS have been developed and used for their ability to repel water (in hydrophobic fabric sprays and non-stick materials) as well as reduce corrosion, among several other useful properties.

FKAA has recently begun a pilot study to investigate potential treatment options for reducing and eliminating PFAS from the water supply. Currently, PFAS is present in the Biscayne Aquifer supply water at a level of approximately 60 parts per trillion (PPT), which is below the EPA's 2016 health advisory limit of 70 PPT. The pilot unit will focus on two types of PFAS, perfluorooctanoate (PFOA) and perfluorooctane sulfonate (PFOS).

4.4.3 Water Quality Data

Typical water quality data for the finished water from the Florida City, Stock Island, and Marathon WTPs can be found in FKAA's Water Quality Program Manual (WQPM), included as **Appendix C.** Raw water quality data as well as the associated "Below Detection Limits" (BDL) values are listed in the WQPM. The reviewed water quality data indicate that the FKAA water treatment systems are meeting or exceeding the current drinking water standards. Analytical results show compliance with the arsenic MCL, and the 4-log removal/inactivation of viruses requirement that applies to plants which have treatment processes that are open to the atmosphere is being met.

The finished water at the J. Robert Dean WTP is comprised of lime-softened water and treated water from the LPRO. As expected, the lime softening process reduces the alkalinity and hardness of the water for the benefit of FKAA customers. Water hardness is not a regulated drinking water standard, although softening has definite benefits to the consumer, such as reduced soap usage for washing. Historically, FKAA has softened Biscayne Aquifer water at the J. Robert Dean WTP and intends to continue utilizing this method of treatment. Post treatment processes include fluoridation and disinfection with chloramines.

4.5 Evaluation of Water Treatment Facilities

Water supply systems must be designed to meet maximum day and peak flow demands. In many water systems, including FKAA's, water treatment production capacity is sized to meet maximum daily demands and storage is used to meet peak hourly flows.

4.5.1 Capacity

FKAA's Conditional Use Permit (CUP #13-00005-W) includes a special dry season Biscayne Aquifer withdrawal limit of 17 MGD from December 1 through April 30 if the groundwater level in USGS monitoring well G-613 falls below 1.25 NDGV 29. This limiting condition is a key factor in this Master Plan and impacts the determination of when additional treatment capacity will be required. For this Master Plan, it is assumed that the lime softening plant will be limited to 17 MGD from the Biscayne Aquifer during this 5-month period. The WTP flow would be supplemented with up to 6 MGD from the Floridan Aquifer, using LPRO, for a total capacity of 23 MGD.

Table 4-1 summarizes the available capacity for the water supply system based on average day and maximum day demands.

In summary, the J. Robert Dean WTP has sufficient capacity to meet the annual average demand, even under drought restrictions, for the entire planning period. Additionally, during non-drought conditions, the WTP has surplus capacity to meet maximum day demands. However, during drought conditions, FKAA has an immediate need to construct 0.9 MGD of additional capacity to meet the maximum day demand. By 2040, the amount of additional capacity needed to meet the maximum day demand increases to 2.0 MGD.

The following assumptions are used when evaluating the average day and maximum day capacities:

- Expansions are constructed to keep the projected maximum day flow within 95 percent of the available water supply.
- The projected maximum day demand will occur during the dry season (December to April) under drought conditions, resulting in a maximum withdrawal from the Biscayne Aquifer of 17 MGD.

- For the purposes of determining the available capacity during maximum day demand conditions, the total capacity for LPRO is used, which is 6.0 MGD. This assumes all four trains are in service. Since the LPRO system typically does not operate, or only operates with one train in service, this Master Plan assumes that maintenance activities will be scheduled such that all four trains are available during periods of maximum day demand. For the purposes of determining the available capacity during average demand conditions, the firm capacity for LPRO is used, which is 4.5 MGD. This assumes one train is not available due to maintenance.
- The RO plants at Marathon and Stock Island are currently only available for emergency conditions and cannot reliably meet peak day demands under normal operating conditions.

TABLE 4-1
Capacity Requirement Projections

Year	Future Demand		Max. Day Capacity Required (MGD)	Average Capacity		Maximum Capacity		Surplus/Deficit Capacity		
	Avg Day (MGD)	Max. Day (MGD)		Lime Softening (MGD) [1]	LPRO (MGD)	Lime Softening (MGD) [1]	LPRO (MGD)	Avg. Day (MGD)	Max. Day (MGD)[1]	Max. Day (MGD)[2]
2020	18.3	22.9	24.1	17	4.5	17	6	3.2	-1.1	5.7
2021	18.4	23.0	24.2	17	4.5	17	6	3.1	-1.2	5.6
2022	18.4	230	24.2	17	4.5	17	6	3.1	-1.2	5.6
2023	18.5	23.1	24.3	17	4.5	17	6	3.0	-1.3	5.5
2024	18.5	23.2	24.4	17	4.5	17	6	3.0	-1.4	5.4
2025	18.6	23.2	24.4	17	4.5	17	6	2.9	-1.4	5.4
2026	18.6	23.3	24.5	17	4.5	17	6	2.9	-1.5	5.3
2027	18.7	23.4	24.6	17	4.5	17	6	2.8	-1.6	5.2
2028	18.8	23.4	24.7	17	4.5	17	6	2.8	-1.7	5.1
2029	18.8	23.5	24.7	17	4.5	17	6	2.7	-1.7	5.1
2030	18.9	23.6	24.8	17	4.5	17	6	2.7	-1.8	5.0
2031	18.9	23.6	24.8	17	4.5	17	6	2.6	-1.8	5.0
2032	18.9	23.6	24.9	17	4.5	17	6	2.6	-1.9	4.9
2033	18.9	23.7	24.9	17	4.5	17	6	2.6	-1.9	4.9
2034	18.9	23.7	24.9	17	4.5	17	6	2.6	-1.9	4.9
2035	19.0	23.7	24.9	17	4.5	17	6	2.5	-1.9	4.9
2036	19.0	23.7	25.0	17	4.5	17	6	2.5	-2.0	4.8
2037	19.0	23.8	25.0	17	4.5	17	6	2.5	-2.0	4.8
2038	19.0	23.8	25.0	17	4.5	17	6	2.5	-2.0	4.8
2039	19.1	23.8	25.1	17	4.5	17	6	2.5	-2.1	4.7
2040	19.1	23.8	25.1	17	4.5	17	6	2.4	-2.1	4.7

[1] The Water Supply Permit (CUP #13-00005-W) limits maximum day withdrawal of 17 MGD from Biscayne Aquifer during drought conditions between December and April

[2] During Non-Drought Conditions permitted facility output capacity of 29.8 MGD (6 MGD of LRPO)

The following four alternatives were evaluated to mitigate the maximum day capacity deficit during drought conditions:

- **Increase Storage –** FKAA has approximately 46 MG of storage capacity in the transmission and distribution systems, as described in Sections 5 and 6. However, the maximum day demand could potentially last multiple days and deplete the available storage capacity, which is needed to provide water during unplanned interruptions such as a plant shutdown or transmission main break.
- **Expand LPRO –** The LPRO plant was originally designed for the eventual addition of a fifth train, increasing its capacity to 7.5 MGD. However, hydraulic limitation in the transmission main may preclude delivering the full capacity (24.5 MGD) to the Keys. Also, this option would only meet the capacity demands through 2030.

- **Reduce Demand –** FKAA can strictly enforce water conservation measures and lower system operating pressures to reduce demand. While this option is the least costly to implement, it also lowers the level of service to its customers.
- **Seawater RO –** FKAA can design the new SIRO plant to provide supplemental capacity to meet maximum day conditions. This option would also provide a water supply in the Lower Keys, thus avoiding the capacity limitations of the transmission main.

The recommended alternative is the design and construction of a new reverse osmosis facility in Stock Island, as this option provides the needed capacity as well as system redundancy in the Lower Keys.

4.5.2 Climate Change and Sea Level Rise

Two impacts of climate change and sea level rise have been discussed in previous Sections of this Master Plan. These include potentially reducing the permanent population in Monroe County, which reduces water consumption, and potentially degrading water quality in the existing Biscayne Aquifer wells, which requires relocation of the supply wells.

While climate change and sea level rise may expose the existing water treatment plants to additional threats, FKAA does not need to implement any specific projects to protect the plants at this time. However, as FKAA makes major capital upgrades to its system, such as constructing the new SIRO Facility, it is recommended that FKAA design the facilities to meet the anticipated future conditions over the next 70 years, rather than adhering to existing minimum building code requirements.

4.5.3 J. Robert Dean Water Treatment Plant

The existing J. Robert Dean WTP is in good condition and will not require many major upgrades during this planning horizon.

The Capital Improvement Plan has identified three projects that should be completed; two projects, totaling $1.4 million, are related to replacement of existing equipment, which include the Accelator™ clarifiers at the lime softening plant, and generator control panels. The third project involves chemical system improvements, which will improve the operation of the chemical feed systems and has an estimated cost of $500,000.

4.5.4 Stock Island Reverse Osmosis Desalination Facility

The Stock Island Reverse Osmosis (SIRO) facility is in poor condition. FKAA plans to begin design of a replacement system during the 2020 fiscal year. Currently, SIRO is equipped with hollow-fiber RO membrane technology that is not as widely used as spiral-wound reverse osmosis configurations. This technology is no longer manufactured by the original US supplier (DuPont) and can only be obtained from Japanese manufacturer Toyobo.

These membranes have the benefit of tolerating a chlorine residual and are used in plants that have a significant biofouling risk. However, SIRO utilizes seawater wells as a source of supply for the facility and biofouling is not a significant risk for this facility.

Also, most new seawater RO systems contain spiral-wound reverse osmosis membrane technologies because they provide more efficient performance. The continued use of hollow fiber membrane technology presents a future risk of cost and availability issues due to limited use and application.

4.5.5 Marathon RO Seawater Desalination Facility

The Marathon RO system shares the same technology risk as the SIRO system, as previously described. Additionally, the equipment is reaching the end of its design life and has developed pinhole leaks in the high-pressure feed piping. Therefore, major upgrades to the Marathon RO system will be required within this planning horizon.

4.6 Water Treatment System Recommendations

The J. Robert Dean WTP is well-maintained and will remain the primary source of water treatment well beyond this planning horizon. However, in preparing a long-range plan, it is prudent to reserve funds for potential repairs and replacements. The estimated annual budget for maintaining the treatment facilities, shown in **Table 4-2**, is based on the replacement value and design lives of the facilities.

TABLE 4-2
Recommend Annual Budget for Treatment Facilities

Facility	Capacity (MGD)	Capital Cost ($ Mil)	Design Life (yr)	Annual Renewal ($ Mil/yr)
Lime Softening Plant	23.8	$ 69	75	$ 0.90
Low Pressure Reverse Osmosis	6.0	$ 55	40	$ 1.40
Seawater Reverse Osmosis (SIRO)	4.0	$ 50	40	$ 1.25
Seawater Reverse Osmosis (Marathon)	1.0	$ 20	40	$ 0.50
Total		**$ 194**		**$ 4.05**

These values were determined using the Cost Estimating Manual for Water Treatment Facilities and adjusted to reflect the most recent Construction Cost Index (CCI) of 11213. A location adjustment of 30 percent was added to the estimates for Marathon and Stock Island to reflect the higher cost of doing work in the Lower Keys. A 30 percent allowance was added for engineering, administration and contingencies to estimate the total capital cost.

Even though the facilities may last beyond the design life shown, the recommended investment of $4.05 million per year, on average, is needed to maintain their existing conditions.

It is also important to note that reverse osmosis systems have shorter design lives than traditional water treatment system. The RO systems operate at much higher pressures, are exposed to corrosive saline source water, and subject to routine membrane replacement.

J. Robert Dean Water Treatment Plant

Overall, the lime softening and LPRO systems are in good condition, and no major repairs are anticipated in the near future. The current CIP has identified only $1.9 million in recommended projects, as previously described. It is likely that over the course of this planning horizon, the required upgrades for the lime softening and RO systems will be below the recommended budget of $2.3 million per year. However, during the next planning horizon (2040–2060), significant investments will likely be needed for the LPRO system as it will reach the end of its design life.

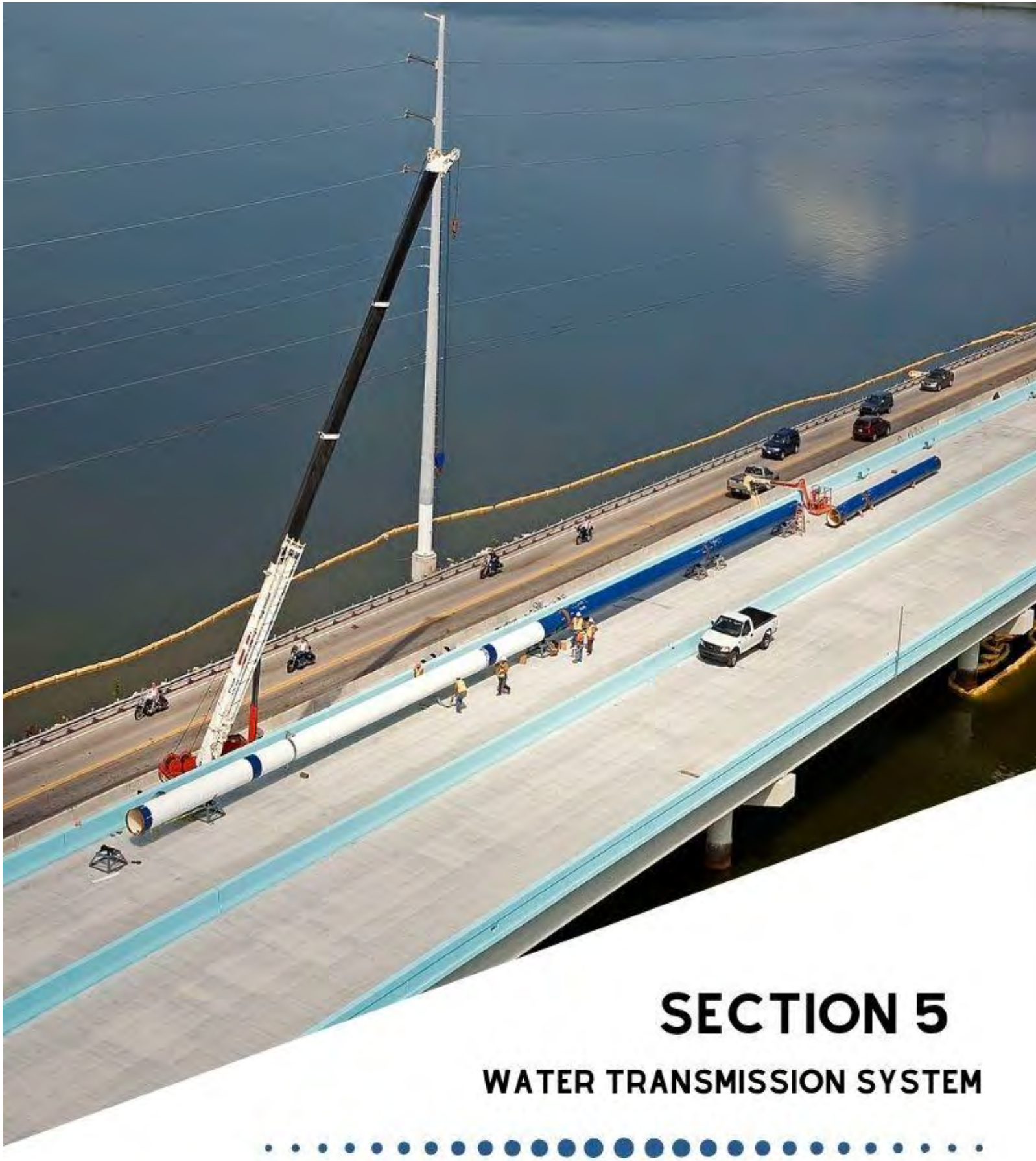
4.6.1 SIRO Seawater Desalination Facility

The SIRO facility should have a minimum capacity of 6 MGD to serve the needs of the Lower Keys in the event of a disruption of water supply from Florida City. However, because this facility is rarely used and has a very high capital cost, FKAA plans to install a smaller facility within its proposed $50 million budget. To put this cost into perspective, this project alone uses over 12 years of the recommended annual budget for all treatment facilities.

Currently, FKAA has applied for various grants and low interest loans to fund this project. Due to the urgent need to replace the current facility, FKAA plans to design the facility with bid alternatives of 2-, 3- and 4-MGD. The facility will also be designed to accommodate up to 6 MGD of RO equipment. This approach allows FKAA to progress with the design of the facility while awaiting the outcome of the grant applications.

4.6.2 Marathon RO Seawater Desalination Facility

The Marathon RO Facility was constructed at the same time as SIRO. While this facility is in better condition than SIRO, it still shares the same issues of equipment age and obsolescence. While there are no projects on the CIP for Marathon, it is likely that there will be a need for a major capital upgrade during this planning horizon. Therefore, FKAA should continue to budget $0.5 million per year until a final decision is made. If the Marathon RO plant needs to be completely replaced, it will likely be more cost effective to expand SIRO than to construct a 1-MGD facility at Marathon.



SECTION 5

WATER TRANSMISSION SYSTEM

FLORIDA KEYS AQUEDUCT AUTHORITY

SECTION 5
Water Transmission System

The transmission system is a critical component of the FKAA water supply infrastructure, conveying water from FKAA's water treatment facilities in Florida City to its customers throughout the Keys. The FKAA's transmission system is unique because there are 130 miles between the water treatment plant and its furthest distribution tank in Key West, with very little redundancy. As previously described in Section 4, the emergency seawater reverse osmosis treatment plants, located in Marathon and Stock Island, have a combined maximum capacity of 3 MGD. Because the emergency treatment facilities provide only a small fraction of the daily system demand, the FKAA must ensure that the transmission system is very reliable.

5.1 Existing Transmission System

Figure 5-1 shows the current transmission system facilities (mains, pump stations, ground storage tanks) and their proximity to the water treatment facilities. The transmission system is configured to supply approximately 70 separate distribution systems, as described in Section 6. In more populated areas, the transmission system supplies distribution system storage tanks. However, in less populated areas along the 130 mile stretch between Florida City and Key West, the local distribution systems are supplied directly from the transmission main by master taps. Consequently, these areas are more susceptible to service interruptions if there is a break in the transmission main.

5.1.1. Pipeline

The FKAA has approximately 196 miles of transmission system piping, ranging from 12 to 36 inches in diameter, as shown in **Table 5-1**. The pipe diameter is largest in the Upper Keys and decreases in size as it approaches Key West. Along some portions of the transmission system, the original 18-inch steel pipe is operated in parallel with the newer, larger-diameter pipe.

TABLE 5-1
Transmission System Pipe Diameters

Diameter (in)	Length (miles)	Percent (%)
12	11	6%
18	58	30%
24	43	22%
30	45	23%
36	39	20%
Total	**196**	

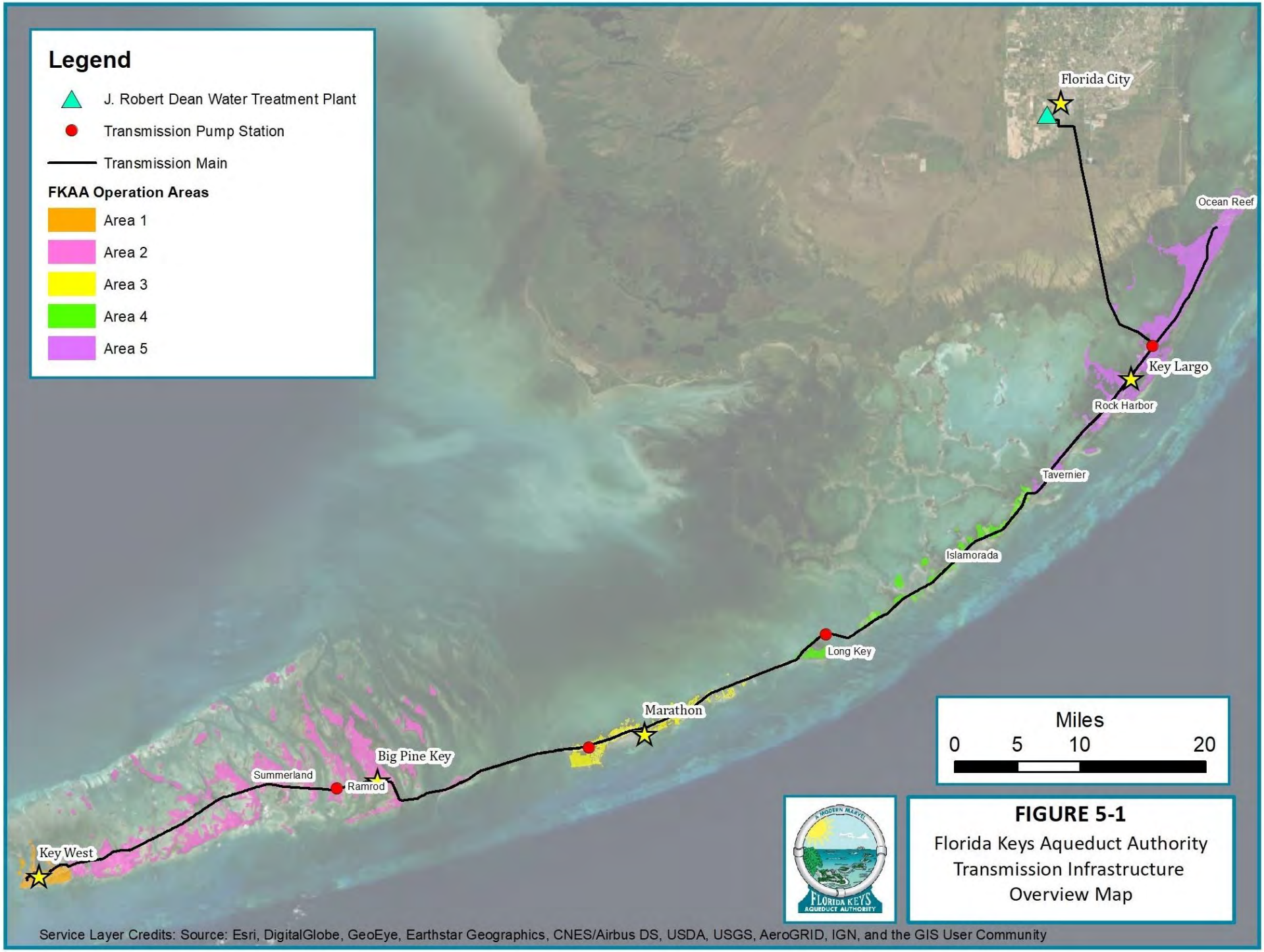


FIGURE 5-1

Florida Keys Aqueduct Authority
Transmission Infrastructure
Overview Map

The original transmission main is an 18-inch diameter steel pipeline that was constructed by the U.S. Navy in the early 1940s to transport potable water from the WTP at Florida City to the Naval facilities in Key West. This transmission main served as the sole means of transporting potable water to the Keys until the early 1980s, when increasing water demands required upgrades to the transmission system. During the 1980s, the FKAA began using ductile iron pipe with a protective coating to eliminate the need for cathodic protection. However, around 2007, FKAA began to experience failures in the ductile iron pipe and has since reverted to using welded steel with cathodic protection for its high pressure transmission mains.

The FKAA is currently replacing a section of transmission main between Key Largo and Ocean Reef using Polyvinyl Chloride (PVC) C900. This project marks the first time that FKAA has used PVC pipe to replace a transmission main because the pressure requirement for this section of pipe is within the allowable limits for PVC pipe. Normally, steel pipe is required due to the high pressures in the transmission system.

5.1.2. Pump Stations and Storage Tanks

FKAA has six pump stations and 29 million gallons (MG) of storage capacity available for the transmission system, as shown in **Table 5-2.** The storage volume is distributed between the Upper, Middle and Lower Keys. The transmission system pump stations are needed to maintain a pressure of at least 65 PSI to provide adequate distribution pressure at the master tap locations. Due to the long distances between pump stations, the pressures can range from 60 to 250 PSI in the transmission mains.

TABLE 5-2
Transmission System Pump Stations and Storage Volumes

Location	Capacity (MGD)	Storage Volume (MG)
Florida City	32.0	11
Key Largo	18.8	NA
Long Key	14.0	NA
Marathon[1]	11.5	3
Ramrod	10.5	NA
Stock Island[2]	5.0	15

[1] Marathon has a total of 3.5 MG of storage. For the purposes of this evaluation, 3 MG is apportioned to the transmission system and 0.5 MG is apportioned to the distribution system

[2] Stock Island has a total of 20 MG of storage. For the purposes of this evaluation, 15 MG is apportioned to the transmission system and 5 MG is apportioned to the distribution system

The Stock Island Backpump Station and Marathon Booster Pump Station provide the FKAA with the ability to back-pump into the transmission main. In the event of an emergency along the transmission route (such as pipeline rupture or other failure), FKAA can use these stations to back-pump water up the Keys towards the Florida City WTP and maintain pressures until the emergency situation is resolved.

5.1.3. Existing System Capacity

Theoretically, the transmission system has sufficient capacity to meet the projected 2040 maximum day demand. The system is designed to convey up to 24 MGD within the 250-PSI allowable design pressure of the pipeline and pump stations. However, the current pipeline capacity is lower (approximately 21.5 MGD) because the FKAA is operating the system at reduced pressures to avoid catastrophic pipe breaks.

On a systemwide basis, FKAA has 29 MG of storage available for the transmission system. While this total volume of storage exceeds the average daily demand, only 11 MG is located at the Florida City WTP, resulting in less than 15 hours of detention time under average demand conditions.

Furthermore, while the transmission capacity is sufficient to meet the 2040 maximum day demand, there is little excess capacity to refill the storage tanks should a service interruption occur. In some instances, it has taken up to 10 days to refill the storage tanks at Stock Island following a break in the transmission system. During this time, the Lower Keys could potentially have been without water if a second transmission main break had occurred.

5.1.4. Replacement Costs

Capital cost estimates were developed for the transmission system pipeline, storage tanks and pump stations. These estimated costs are intended only for long term planning and budgeting purposes. The intent is to simply determine the cost to replace existing assets so FKAA can have adequate funds to replace these assets as they reach the end of their useful lives. Recommendations for replacement of specific assets will be made during the annual Capital Improvement Planning process, which will be based on the asset's actual condition and cost to replace.

The estimated capital cost to replace the transmission system pipeline is $903 million, as shown in **Table 5-3.** The pipeline replacement costs are based on recent construction projects in the Upper and Lower Keys and include a 30 percent allowance for engineering, project administration and contingency. The replacement cost also reflects the difference in construction costs between the Upper and Lower Keys.

TABLE 5-3
Transmission System Pipeline Replacement Cost

Diameter (in)	Lower Keys			Upper and Middle Keys			Total	
	Length (miles)	Unit Cost ($/ft)	Cost ($ Mil)	Length (miles)	Unit Cost ($/ft)	Cost ($ Mil)	Length (miles)	Cost ($ Mil)
12	0.1	440	$ 0.2	11.0	350	$ 20.4	11.1	$ 20.6
18	19.9	900	$ 94.5	38.2	750	$ 151.3	58.1	$ 245.8
24	36.3	1000	$ 191.9	6.7	800	$ 28.4	43.1	$ 220.3
30			$ -	44.6	900	$ 212.1	44.6	$ 212.1
36			$ -	38.7	1000	$ 204.3	38.7	$ 204.3
Total			**$ 286.6**			**$ 616.5**		**$ 903.1**

The estimated capital cost to replace the transmission system storage tanks is $38.7 million, as shown in **Table 5-4.** These estimates were developed using *Cost Estimating Manual for Water Treatment Facilities.* This manual provides equations to estimate the costs based on the size of the facility. The cost curves were compared to past projects for the FKAA. In order to account for the higher construction costs in the Keys, a location adjustment of 30 percent was added to the cost curves. The costs were escalated from Construction Cost Index (CCI) at the time of publishing (8889) to the February 2019 CCI (11213). The capital costs presented below include a 30 percent allowance for engineering, project administration and contingency.

TABLE 5-4
Transmission System Storage Tank Replacement Cost

Location	Capacity (MG)	Capital Cost ($ Mil)
Florida City	11	$ 14.6
Marathon [1]	3	$ 4.3
Stock Island [2]	15	$ 19.8
Total		**$ 38.7**

[1] Marathon has a total of 3.5 MG of storage. For the purposes of this evaluation, 3 MG is apportioned to the transmission system and 0.5 MG is apportioned to the distribution system

[2] Stock Island has a total of 20 MG of storage. For the purposes of this evaluation, 15 MG is apportioned to the transmission system and 5 MG is apportioned to the distribution system

The estimated capital cost to replace the transmission system pump stations is $34.9 million, as shown in **Table 5-5.** These estimates were also developed using the *Cost Estimating Manual for Water Treatment Facilities*, as previously described.

TABLE 5-5
Transmission Pump Station Cost

Location	Capacity (MGD)	Cost ($ Mil)
Florida City	32.0	$ 10.1
Key Largo	18.8	$ 6.7
Long Key	14.0	$ 5.5
Marathon	11.5	$ 4.8
Ramrod	10.5	$ 4.6
Stock Island	5.0	$ 3.2
Total		**$ 34.9**

5.2 Condition Assessment

In recent years, the FKAA has observed a higher failure rate in the ductile iron pipe than in the original steel pipe. At the time of installation, measures were put in place to protect the ductile iron pipe from corrosion. However, due to the aggressive nature of the soil, any defects in the pipe coating will cause premature deterioration of the pipe. According to literature published in the *Journal* by American Water Works Association, *"The lifespan of ductile iron pipe installed in an aggressive environment without appropriate protection may be between 21 and 40 years"*.[3] This shortened lifespan is consistent with FKAA transmission main break history on the ductile iron pipe that was installed in the 1980s.

As previously mentioned, the FKAA has reduced the system operating pressure at certain locations in the transmission system due to recent pipe failures in the ductile iron pipe. This reduction in system pressure reduces the amount of water that can be conveyed to the Lower Keys. More importantly, successive pipe breaks in the transmission main could deplete the reserve of water stored at Stock Island, resulting in an interruption of water service to Key West.

3 Bonds, Richard W.; Barnard, Lyle M.; Horton, A. Michael; Oliver, Gene L. (2005). "Corrosion and corrosion control of iron pipe: 75 years of research". Journal (American Water Works Association). **97** (6): 88–98.

Currently, three major transmission system capital improvement projects (Grassy Key, Transmission Terminus Rehabilitation, and Islamorada) are underway to replace deteriorated sections of ductile iron pipe. FKAA anticipates that many other sections will need to be replaced within this 20-year planning horizon and has recently implemented an asset management program (Cityworks) to provide the necessary data to prioritize future replacement of transmission mains.

In addition to the challenge of replacing the deteriorating ductile iron pipe, the FKAA has observed storm related damage at some of its water crossings. In a few cases, where the pipeline is laid under the water surface, the foundation of the pipe has either been exposed or washed away. Additionally, during a recent inspection of the Seven Mile Bridge, it was observed that the bridge experienced lateral shifts causing a deflection in the pipe. The FKAA is currently investigating options of repairing the existing pipe and also installing a new pipe parallel to the bridge.

The FKAA recently completed an inspection of its storage tanks. The 3 MG storage tank at Marathon is in fair condition and need of replacement.

The transmission system pump stations are in good condition and are anticipated to have a service life well beyond this planning horizon. However, it is anticipated that the pump stations will need on-going capital improvement projects to replace various components, such as pumps, motors, variable frequency drives, and ancillary equipment.

5.3 Resiliency and Sustainability

The transmission system has reliably supplied water to the Florida Keys since it was placed it service in the 1940s. However, while the upgrades in the 1980s increased the capacity of the transmission system, these upgrades did not appreciably improve the resiliency and sustainability of the system. As previously discussed, the ductile iron pipe that was used to replace the original welded steel pipe has a higher failure rate.

Several projects included in this Master Plan will inherently make the FKAA transmission system more resilient. For example, the pipeline projects identified to replace portions of the transmission system will be constructed in parallel with the existing transmission mains. This will allow the existing pipes to be rehabilitated in the future, which will provide the necessary redundancy in the system. Also, the new Stock Island Reverse Osmosis facility will allow FKAA to rapidly blend the SIRO water with water from Florida City, thus reducing the risk of a water outage in the Lower Keys due to a failure of the transmission main.

5.4 Transmission System Recommendations

The transmission system has adequate capacity to meet the 2040 maximum day demand. However, due to known problems with the ductile iron pipe and lack of system redundancy, the FKAA needs to establish a program of continual transmission system replacement projects. Over the next 20 years, FKAA should budget $10.3 million per year (2020 dollars) as shown in **Table 5-6.**

This level of investment is based on a 100-year design life for the pipe, 75 years for the pump stations and 50 years for the storage tanks. While it is likely that these assets may last longer than the design lives shown, many of these assets are currently approaching or have already exceeded their design lives. Even if the assets are not replaced in their entirety, they will need investments to replace mechanical, structural, and electrical components.

TABLE 5-6
Recommended Transmission System Annual Budget

Facility	Lifespan	Capital Cost ($ Mil)	Annual Cost ($ Mil/yr)
Pipelines	100	$ 903.0	$ 9.0
Pump Stations	75	$ 34.8	$ 0.5
Storage Tanks	50	$ 38.7	$ 0.8
Total		**$ 976.5**	**$ 10.3**

The recommended annual budget for transmission system replacement ($10.3 million) is very close to the estimated cost of the transmission system projects identified in the current CIP. The specific projects that have been identified in the CIP total $98.6 million over ten years, resulting in an average cost of $9.9 million per year.

The pipeline projects should be designed and constructed at a uniform rate (linear feet per year) to maintain a consistent workload for the FKAA's engineering and inspection staff and to obtain better pricing from construction contractors. The FKAA should re-evaluate the specific sections of pipe to be replaced during the annual CIP planning process based on the most current asset management data.

As the FKAA replaces the transmission system mains, some pipelines should be replaced with pipe that is one diameter size larger. The larger pipe diameter will reduce the system's operating pressure, which will lower the annual pumping costs, reduce water loss, extend the life of the existing pipe, and reduce emergency repairs.

FKAA should keep the retired transmission mains so they can be rehabilitated in the future. The rehabilitation process involves installing a new high density polythene pipe within the existing pipe. This process would reduce the interior diameter, and capacity, of the rehabilitated pipe, such that it could not provide a fully redundant system. However, the cost of lining the transmission main is significantly less than the cost of replacement and should provide sufficient redundancy to the system during planned and unplanned outages.

Whereas pipeline projects should be designed and constructed at a uniform rate each year, pump station and storage tank projects should performed when the specific asset needs to be replaced or upgraded.

FKAA should anticipate that pump station and storage tank projects will occur every few years and establish its annual capital improvement budget with an allowance set aside for these projects. The specific transmission system projects that have currently been identified in the current CIP are listed in **Appendix D.**

SECTION 6

WATER DISTRIBUTION SYSTEM

FLORIDA KEYS AQUEDUCT AUTHORITY

SECTION 6
Water Distribution System

The distribution system network consists of approximately 70 individual distribution systems and 600 total miles of pipeline. In addition to providing water to its residential and commercial customers, FKAA also operates and maintains approximately 39 miles of distribution piping at various Naval facilities.

The distribution systems are supplied from the transmission system (Section 5) in one of two ways:

- **Master Taps**: Generally, small and medium distribution systems are supplied by one or more master taps. The master taps include a pair of pressure reducing valves to lower the pressure from the transmission system to between 45 and 55 PSI.
- **Local Storage and Pumping Facilities:** In more densely populated areas, FKAA has dedicated storage tanks and pump stations to supply the local distribution systems. Additional taps to the transmission main also supplement the distribution pump station systems. The pressures at these supplemental taps are set slightly lower than the distribution system pressure normally maintained by the pumps. Therefore, if the distribution pump station is out of service (for example, from a power failure or during maintenance), or does not maintain normal operating pressure, the supplemental taps will open at the pre-set pressure and supply water to the distribution system. This provides a complete backup to all individual distribution systems from the transmission main system.

6.1 Existing Distribution Systems

6.1.1 Pipeline

The distribution system pipe diameters range from 2 to 20 inches, as summarized in **Table 6-1.** Approximately 13 percent of the distribution pipe is 2-inch diameter, which does not meet FKAA's current design standards; these segments are often constructed of galvanized metal or thin-walled PVC. The minimum pipe diameter for new construction is 4 inches.

Most of the pipe in the FKAA distribution system is constructed of polyvinyl chloride (PVC), as shown in **Table 6-2**. The other pipe materials include ductile iron pipe (DIP), cast iron pipe (CIP), galvanized steel (GLV) and high-density polyethylene (HDPE).

TABLE 6-1
FKAA Distribution System Pipe Diameters

Diameter (in)	Lower Keys		Upper and Middle Keys		Total	
	Length (mi)	Percent (%)	Length (mi)	Percent (%)	Length (mi)	Percent (%)
2	37	13%	41	13%	79	13%
4	64	23%	69	21%	133	22%
6	88	32%	121	37%	209	35%
8	46	17%	69	21%	115	19%
10	4	1%	2	1%	5	1%
12	32	12%	24	7%	55	9%
16	3	1%	0	0%	3	1%
20	1	0%	0	0%	1	0%
Total	**274**		**326**		**600**	

TABLE 6-2
FKAA Distribution System Pipe Materials

Material	Lower Keys		Upper and Middle Keys		Total	
	Length (mi)	Percent (%)	Length (mi)	Percent (%)	Length (mi)	Percent (%)
PVC	259	95%	312	96%	571	95%
DIP	3	1%	4	1%	7	1%
CIP	6	2%	6	2%	12	2%
GLV	1	0%	3	1%	4	1%
HDPE	0	0%	1	0%	1	0%
OTHER	5	2%	0	0%	5	1%
Total	**274**		**326**		**600**	

6.1.2 Pump Stations and Storage Tanks

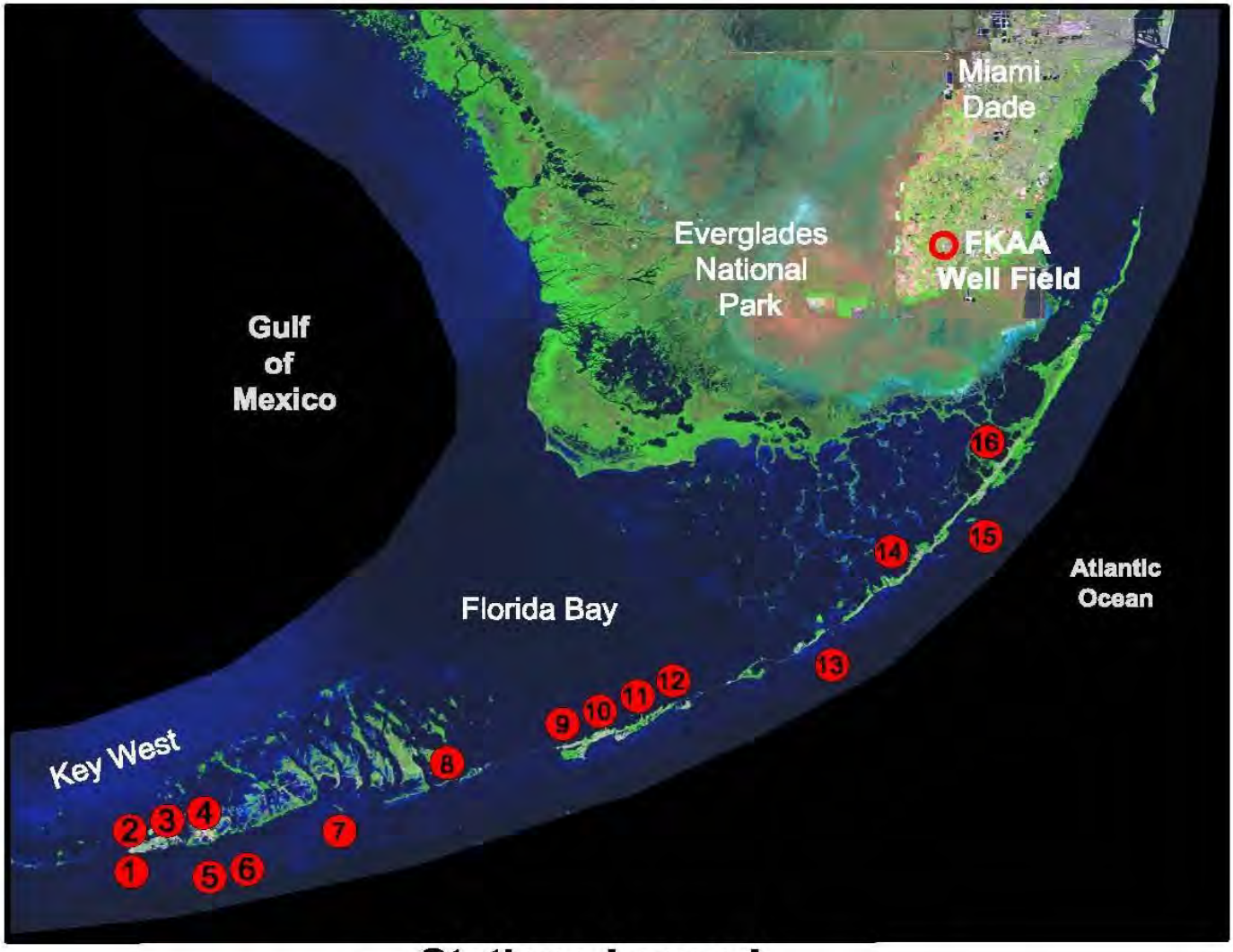
FKAA has 16 pump stations and 29 storage tanks that serve the distribution system, as shown on **Figure 6-1.** The pump stations and storage tanks that are dedicated to the transmission system are presented in Section 5 of this Plan. Additionally, there are storage tanks and pump stations at Trumbo Point, Truman Annex, Sigsbee and Boca Chica which is funded and maintained under a separate agreement with the Navy.

6.1.3 Existing System Capacity

FKAA currently uses InfoWater™ to perform hydraulic analyses of the transmission and distribution systems. Although the model is currently not fully developed to include the entire distribution system, FKAA is continuing to expand the hydraulic model. Currently, Ocean Reef is the only distribution system that requires additional capacity.

The Ocean Reef ground storage tanks and pump station are located within the North Key Largo Utilities wastewater treatment and irrigation water complex, where there is no space for expansion. Under normal daytime conditions, these storage tanks and pump station have sufficient capacity to provide adequate flow and pressure to the system. However, during night-time irrigation, the storage tanks are depleted to near critical levels and the distribution system pressure can drop below 30 PSI. FKAA is currently installing a 16-inch transmission main to replace the existing 12-inch transmission main. While this project will increase the transmission capacity to Ocean Reef, FKAA is also evaluating other options to increase storage and system pressures within the Ocean Reef distribution system.

FIGURE 6-1
Distribution Pump Stations and Tanks



Stations Legend

1 Key West - 2 MG Storage 500 HP Pump Station	9 Marathon - 0.5 MG Storage 80 HP Pump Station
2 Truman Annex - 0.7 MG Storage 45 HP Pump Station	10 69th Street - 0.5 MG Storage 60 HP Pump Station
3 Sigsbee - 1 MG Storage 150 Hp Pump Station	11 Vaca Cut - 0.5 MG Storage 150 Hp Pump Station
4 Stock Island - 5 MG Storage 940 Hp Pump Station	12 Crawl Key - 0.5 MG Storage 80 Hp Pump Station
5 Boca Chica - 0.4 MG Storage 66 HP Pump Station	13 Islamorada - 1 MG Storage & .5 MG Storage 150 HP Pump Station
6 Big Coppitt Key - 1 MG Storage 150 HP Pump Station	14 Tavernier - 0.5 MG Storage 80 HP Pump Station
7 Summerland Key - 0.2 MG Storage 60 HP Pump Station	15 Rock Harbor - 0.5 MG Storage 80 HP Pump Station
8 Big Pine Key - 0.5 MG Storage 150 HP Pump Station	16 Ocean Reef - 2 MG Storage 150 HP Pump Station

6.1.4. Replacement Costs

The estimated cost to replace the distribution system pipeline is $683 million, as shown in **Table 6-3.** The estimated costs are based on recent construction projects in the Upper/Middle and Lower Keys and include a 30 percent allowance for engineering, administration and contingency. The replacement cost also reflects the difference in construction costs between the Upper/Middle and Lower Keys.

TABLE 6-3
Distribution System Replacement Costs

Diameter (in)	Lower Keys			Upper and Middle Keys			Total	
	Length (mi)	Unit Cost ($/ft)	Cost ($ Mil)	Length (mi)	Unit Cost ($/ft)	Cost ($ Mil)	Length (mi)	Cost ($ Mil)
2	37	$ 230	$ 44.9	41	175	$ 37.9	79	$ 83.0
4	64	$ 230	$ 77.7	69	175	$ 63.5	133	$ 141.2
6	88	$ 240	$111.1	121	185	$ 118.4	209	$ 229.5
8	46	$ 260	$ 63.6	69	200	$ 72.9	115	$ 136.5
10	4	$ 275	$ 5.3	2	210	$ 2.0	5	$ 7.2
12	32	$ 300	$ 50.1	24	225	$ 28.0	55	$ 78.1
16	3	$ 330	$ 6.1	0	240	$ -	3	$ 6.1
20	1	$ 360	$ 1.2	0	270	$ -	1	$ 1.2
Total			**$ 360**			**$ 323**		**$ 683**

The estimated cost to replace the distribution system storage tanks is $29 million, as shown in **Table 6-4.** These estimates were developed using the AWWA Cost Estimating Manual for Water Treatment Facilities.

TABLE 6-4

Distribution System Storage Tank Replacement Cost

Location	Capacity (MG)	Cost ($ Mil)
Ocean Reef	2.0	$ 3.0
Rock Harbor	0.5	$ 1.1
Tavernier	0.5	$ 1.1
Islamorada	1.0	$ 1.7
Crawl Key	0.5	$ 1.1
Vaca Cut	0.5	$ 1.1
69th St.	0.5	$ 1.1
Marathon[1]	0.5	$ 1.1
Big Pine Key	0.5	$ 1.1
Summerland Key	0.2	$ 0.7
Big Coppitt Key	1.0	$ 1.7
Boca Chica	0.4	$ 1.0
Stock Island[2]	5.0	$ 6.9
Sigsbee	1.0	$ 1.7
Truman Annex	0.7	$ 1.4
Key West	2.0	$ 3.0
Total		**$ 28.8**

[1] Does not include 3 MG of storage for Marathon included in Transmission (Section 5)

[2] Does not include 15 MG of storage for Stock Island included in Transmission (Section 5)

The estimated cost to replace the distribution system pump stations is $52.8 million, as shown in **Table 6-5.** These estimates, with the exception of the Stock Island Pump Station, were developed using the AWWA Cost Estimating Manual for Water Treatment Facilities. A 25 percent allowance was added to include the standby power generator. The Stock Island Pump Station was estimated based on preliminary cost estimates from the design engineer, which is scheduled to be replaced in 2020.

TABLE 6-5
Distribution System Pump Station Replacement Cost

Location	Size (Hp)	Cost ($ Mil)
Ocean Reef	150	$ 3.6
Rock Harbor	80	$ 2.4
Tavernier	80	$ 2.4
Islamorada	150	$ 3.6
Crawl Key	80	$ 2.4
Vaca Cut	150	$ 3.6
69th St.	60	$ 2.0
Marathon	80	$ 2.4
Big Pine Key	150	$ 3.6
Summerland Key	60	$ 2.0
Big Coppitt Key	150	$ 3.6
Boca Chica	66	$ 2.2
Stock Island	940	$ 7.0
Sigsbee	150	$ 3.6
Truman Annex	45	$ 1.7
Key West	500	$ 7.5
Total		**$ 53.6**

6.2 Condition Assessment

6.2.1 Pipeline

As previously stated, the majority of the distribution system consists of PVC pipe, which has proven to be a durable material with a life expectancy of 100 years. However, other pipe materials, such as ductile iron (DIP), cast iron (CIP), and galvanized (GLV), are more suspectable to failure and can cause water quality problems. FKAA has approximately 29 miles of metallic pipe in the distribution system that should be replaced during this planning period.

6.2.2 Pump Stations

The FKAA operations staff routinely perform preventive and corrective maintenance at the pump stations, keeping the facilities in good working order. One pump station that requires major capital improvement is the Stock Island distribution pump station, originally built in 1956. The building was constructed with concrete that had a relatively high chloride content. As a result, this building has experienced spalling concrete for many years. The pump station will be replaced in 2020.

6.2.3 Storage Tanks

FKAA recently completed an inspection of its storage tanks. The results of the inspections are as follows:

- The existing 0.5 MG tank at Marathon is out of service due to operational constraints
- The existing 0.5 MG at Crawl Key needs repair. Two of the radial I-beams from the roof of the tank have fallen and are resting at the bottom of the tank, and the existing ladder is unserviceable due to corrosion.
- The Boca Chica steel tank sacrificial anodes were recommended to be replaced.

These deficiencies are not unusual considering the age of the service tanks. Any necessary repairs will be performed as needed on a priority basis.

6.3 Distribution System Recommendations

The current distribution projects that have been identified and prioritized by FKAA to be included in the 5-year CIP have an average expenditure rate of $9.96 million per year, as shown in **Appendix D.** This appendix includes each project's overall ranking when compared with other projects in the water/wastewater capital improvement program. The level of spending in the 5-year CIP is slightly higher than the recommended annual renewal cost (8.1 million), which accounts for the life expectancy and replacement cost of the assets, as shown in **Table 6-6**.

TABLE 6-6
Recommended Distribution System Budget

Facility	Lifespan	Capital Cost ($ Mil)	Annual Cost ($ Mil/ yr)
Pipelines	100	$ 682.9	$ 6.8
Pump Stations	75	$ 5	$ 0.7
Storage Tanks	50	$ 29.0	$ 0.6
Total			**$ 8.1**

In the past, FKAA had the goal of reducing the number of direct taps on the transmission main and to serve more of the service area with local storage tanks and pump stations. This approach would reduce the risk of water service interruption and increase the level of service for fire protection. However, FKAA has had difficulty acquiring property and gaining public acceptance for building new storage tanks and pump stations. As a result, this Master Plan will focus FKAA resources on maintaining the existing infrastructure.

6.2.1 Distribution Piping

FKAA currently prioritizes its distribution system projects based on recent maintenance history and analysis of water loss data. Pipes that have a frequent history of breakage and/or water loss are prioritized for replacement. Therefore, FKAA should prioritize replacement of non-PVC pipes, which have an approximate total length of 29 miles. (It should be noted that most of the galvanized pipe is 2 inches in diameter, so replacement of this pipe is the greatest priority.) While distribution projects generally rank lower than urgently-needed treatment plant projects, it is important that FKAA has a program to consistently replace water mains each year to even the workload with in-house engineering staff and the local construction community.

It should be noted that the renewal cost accounts for replacement of existing assets. However, the 5-year CIP includes projects to install new distribution water main to provide water service to No Name Key, Middle Torch Key and Big Torch Key for an estimated total cost of $ 9.2 million, which accounts for approximately 18 percent of the 5-year CIP budget. Additionally, FKAA is also required by Florida Department of Transportation to relocate water mains if they conflict with road projects. The cost for the line relocations would also be funded from this budget.

6.2.2 Distribution Storage Tanks and Pump Stations

Over the past several years, FKAA operations staff have upgraded the pump stations with new pumps and variable frequency drives. These upgrades have resolved prior capacity issues and reduced electrical consumption.

In May 2019, a specialty diving contractor conducted inspections and cleaning on all of FKAA's storage tanks. With the exception of the previously noted deficiencies, the storage tanks are in good condition.

6.2.2.1 Ocean Reef

Based on current operating conditions, Ocean Reef requires additional storage and pumping capacity. However, options to construct new or upgraded facilities are limited due to site constraints. FKAA staff is currently evaluating an alternative to maintain the existing 12-inch transmission main in service and connect it directly to the distribution system. This will allow the 16-inch transmission main to fill the storage tank while the 12-inch transmission main directly supplies the distribution system.

6.2.2.2 3375 Overseas Highway, Marathon

FKAA plans to construct a 4-MG storage tank at Marathon that will replace three storage tanks: 3-MG transmission tank (3375 Overseas Highway), 0.5-MG distribution tank (3375 Overseas Highway), and 0.5-MG distribution tank (69th Street). The existing 0.5-MG distribution tank at 3375 Overseas Highway is no longer in service and the distribution system pump station is currently supplied directly from the 3-MG transmission system tank. FKAA is currently performing a hydraulic analysis of the Marathon distribution system to determine if the 69th Street pump station and storage tank can be decommissioned once the 3-MG storage tank is replaced with a 4-MG storage tank.

6.2.2.3 Stock Island Distribution Pump Station

A new vertical turbine pump station will be constructed to replace the existing pump station. The vertical turbine pumps will allow the tank to be completely emptied without cavitating the pumps. This feature will increase the total usable storage volume of the three tanks by approximately 2 million gallons. FKAA is currently performing a hydraulic analysis of the Key West distribution system. The results from this study will be integrated into the pump station design to improve operational efficiencies in the Key West distribution system.

SECTION 7

FINANCIAL PLAN

FLORIDA KEYS AQUEDUCT AUTHORITY

SECTION 7
Financial Plan

This Section describes the financial plan to fund the current 5-year Capital Improvement Program. The funding will be provided by various sources of revenue available from the Water System. It is expected that the majority of the funding will come from leveraging water revenues from the rate payers as a source of repayment on long term bond issues. Sound financial practices and financing tools will be utilized to protect the financial integrity of the system as well as reduce interest costs to minimize the impact on rate payers.

7.1 Capital Improvement Funding Strategy

The projects outlined in this section will be detailed in a rolling 5-year capital funding program, which will be presented to the FKAA Board of Directors annually as part of the budget process. FKAA will maintain the integrity of the existing System's credit ratings in the bond market by maintaining or improving the ratings that currently exist on the outstanding bonds as shown in Section 7.2. Implicit in maintaining the System's bond ratings is strict adherence to the bond covenants under FKAA's Master Bond Resolution. The overall capital improvement funding strategy will strive to minimize and spread out on an intergenerational basis the impact of rate adjustments required to amortize the proposed bond issues with a fair allocation of costs to current and future beneficiaries or users.

7.2 Existing Debt and Bond Covenants

As of September 30, 2018, FKAA has the following outstanding water bonds in the aggregate principal amounts, interest rates, and bond ratings as shown in **Table 7-1**.

TABLE 7-1

Existing Water Bonds

Description	Interest Rate	Final Maturity	Amount Outstanding as of 9/30/18	Bond Ratings		
				Moody's	S&P	Fitch
Series 2008 refunding water bonds	Variable rate	9/1/2035	$ 52,625,000	A3	A-	A+
Series 2013A water bonds	1.64%	9/1/2021	$ 7,820,000			
Series 2013B water bonds	3.52%	9/1/2033	$ 6,280,000			
Series 2014A water bonds	3.52%	9/1/2033	$ 2,195,000			
Series 2015A water refunding bonds	3.75%-5.00%	9/1/2037	$ 34,560,000	A3	A-	A+
Series 2015B water refunding bonds	2.52%	9/1/2030	$ 15,600,000	A3	A-	A+
Series 2019A water bonds	4.18%	9/1/2049	$ 50,000,000	A3		A+

FKAA has a Master Bond Resolution authorizing the issuance of future bonds. Both the Master Resolution and Supplemental Series Resolutions have covenant with the bondholders which, in addition to other matters, dictates the funds and accounts to be established together with the flow of funds, establishment of rates, and coverage tests for the issuance of additional debt. All outstanding bonds are secured by net revenues of the water system after payment of operation and maintenance expenses. FKAA has covenanted to maintain rates such that net revenues together with impact fees will be adequate to pay 120 percent of annual debt service requirements. FKAA has the ability to pledge assessments as additional security for the payment of bonds but has currently not instituted an assessment program.

7.3 Five-Year Capital Improvement Funding

This section represents an update of the 5-year capital funding analysis. The 5-year funding analysis reflects specific funding for each project identified during this period. The major funding sources for projects during the next 5 years include the use of available water reserves, funds from additional water rate increases, and funds from the issuance of additional revenue bonds. Other potential sources of funding being pursued include a loan through the Water Infrastructure Finance and Innovation Act (WIFIA), state appropriations, and other grants for infrastructure repair and construction.

Table 7-2 shows the planned funding sources for each water project planned through Fiscal Year 2024. The 5-year estimated total cost to complete the projects identified from Fiscal Years 2020–2024 is $140.5 million, as shown on **Table 7-2**.

TABLE 7-2

Five-Year Capital Improvement Funding Plan

Line No.	Description	Funding Source	Projected Fiscal Year Ending September 30					Total
CAPITAL COSTS - WATER SYSTEM			**2020**	**2021**	**2022**	**2023**	**2024**	**2020-2024**
	Facilities and Structures							
1	Key West Administration Building Replacement	Series 2019A	$ 9,000,000	$ 9,000,000	$ 4,364,000	-	-	$ 22,364,000
2	Stock Island garage replacement	RR	-	-	-	-	$ 420,000	$ 420,000
3	**Total Water Supply**		**$ 9,000,000**	**$ 9,000,000**	**$ 4,364,000**	**-**	**$ 420,000**	**$ 22,784,000**
	Water Treatment Plant							
4	SIRO Facility	RR & Series 2021	$ 3,000,000	$ 14,000,000	$ 18,000,000	$ 15,000,000	-	$ 50,000,000
5	**Total Water Treatment Plant**		**$ 3,000,000**	**$ 14,000,000**	**$ 18,000,000**	**$ 15,000,000**	**-**	**-**
	Water Transmission System							
6	Grassy Key transmission line replacement	Series 2019A	$ 8,000,000	-	-	-	-	$ 8,000,000
7	Transmission Terminus rehabilitation	RR	-	-	-	$ 840,000	$ 3,360,000	$ 4,200,000
8	Islamorada transmission line replacement	Series 2019A & RR	$ 2,670,000	$ 13,350,000	$ 10,680,000	-	-	$ 26,700,000
9	**Total Water Transmission System**		**$ 10,670,000**	**$ 13,350,000**	**$ 10,680,000**	**$ 840,000**	**$ 3,360,000**	**$ 38,900,000**
	Distribution Mains							
10	Simonton, Front and Whitehead Streets Distribution Line Replacement	RR	$ 750,000	-	-	-	$ 1,250,000	$ 2,000,000
11	Ocean Reef distribution and storage improvements	RR	-	-	-	$ 3,200,000	$ 3,900,000	$ 7,100,000
12	New distribution system at No Name Key	RR	$ 2,600,000	-	-	-	-	$ 2,600,000
13	**Total Distribution Mains**		**$ 3,350,000**	**-**	**-**	**$ 3,200,000**	**$ 5,150,000**	**$ 11,700,000**
	Repairs and Upgrades							
14	Box girder bridge coating/coupling replacement	RR	-	-	-	-	$ 3,870,000	$ 3,870,000
15	Generator control panel replacement at Florida City	RR	-	-	-	-	$ 500,000	$ 500,000
16	Stock Island pump station and generator replacement	RR	$ 7,000,000	-	-	-	-	$ 7,000,000
17	Repair/upgrade subaqueous crossing	RR	$ 2,000,000	-	-	-	-	$ 2,000,000
18	Repair/upgrade cathodic protection	RR	$ 2,700,000	-	-	-	-	$ 2,700,000
19	Repair/Upgrade electrical and instrumentation	RR	$ 1,000,000	-	-	-	-	$ 1,000,000
20	**Total Distribution Pump Station & Storage**		**$ 12,700,000**	**-**	**-**	**-**	**$ 4,370,000**	**$ 17,070,000**
21	**Total**		**$ 38,720,000**	**$ 36,350,000**	**$ 33,044,000**	**$ 19,040,000**	**$ 13,300,000**	**$ 140,454,000**
22	Revenue and reserves	RR	$ 19,756,400	$ 17,532,000	$ 2,825,600	$ 4,040,000	$ 13,300,000	$ 57,454,000
23	Series 2019A Bonds	Series 2019A	$ 18,963,600	$ 18,818,000	$ 12,218,400	-	-	$ 50,000,000
24	Future Revenue Bonds	Series 2021	-	-	$ 18,000,000	$ 15,000,000	-	$ 33,000,000
25	**TOTAL WATER SYSTEM FUNDING SOURCES[1]**		**$ 38,720,000**	**$ 36,350,000**	**$ 33,044,000**	**$ 19,040,000**	**$ 13,300,000**	**$ 140,454,000**

The total five-year funding sources are summarized on **Table 7-3**.

TABLE 7-3

Five-Year Capital Funding Sources

Funding Source	Five-Year Amount	% of Total
Revenue and Reserves	$ 57,454,000	40.91%
Series 2019A Bonds	$ 50,000,000	35.60%
Series 2021 Bonds	$ 33,000,000	23.50%
Total	**$ 140,454,000**	**100.00%**

As shown above, the capital funding plan through Fiscal Year 2024 is dependent on the issuance of additional revenue bond financing (Bond4) as summarized in **Table 7-4.**

TABLE 7-4

Issuance of Additional Revenue Bonds

Series 2021 Bonds	
Principal Amount	$ 50,000,000
Project Funds Available	$ 50,000,000
Issuance Date	Jun-20

Figure 7-1 illustrates the annual debt service for existing debt for FKAA's water system. The issuance of additional debt is contingent on the ability of FKAA water revenues to meet the debt service payments and other bond covenants of existing and future debt instruments. Previous analyses have indicated the need to increase water rates over a several-year period. This process began with an initial water rate adjustment implemented by FKAA effective October 2019.

FIGURE 7-1

Annual Debt Service

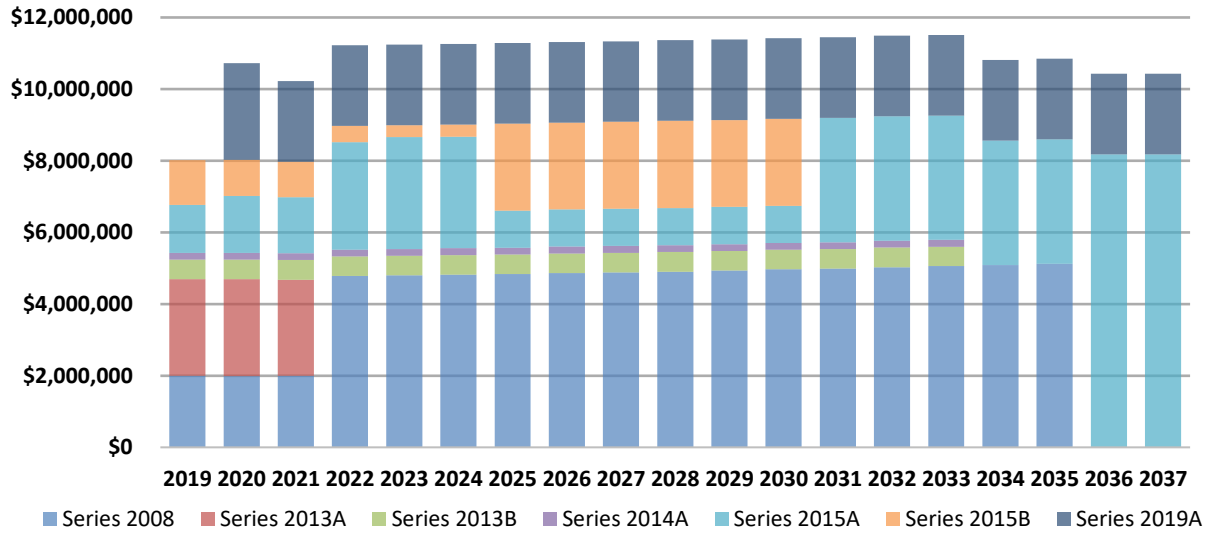


Table 7-5 illustrates future projected water rate adjustments beyond October 2019. As shown below, additional rate adjustments of 3 percent annually are projected for Fiscal Year 2020 through Fiscal Year 2022 (October 2019 through October 2021) in addition to annual rate adjustments set forth in the FKAA Rules. These rate adjustments are consistent with previous projections completed prior to issuance of the Series 2019 Bonds. The financial forecast supporting the rate projections will be reviewed prior to the issuance of additional bonds and the initiation of the rulemaking process in each year to determine the actual water rate levels necessary.

TABLE 7-5

Projected Water Rate Adjustments

Fiscal Year	Annual Rate Indexing[1]	Additional Rate Increase[2]	Cumulative Rate Adjustment
2020	2.50%	3.00%	5.50%
2021	1.50%	3.00%	10.00%
2022	1.50%	3.00%	14.50%
2023	1.50%	0.00%	16.00%
2024	1.50%	0.00%	17.50%

[1]Amounts reflects projected annual rate indexing as set forth in the FKAA Rules.

[2]Additional rate adjustments are calcualted based on rates effective October 2019. Additonal rate adjustments shown are assumed to become effective in October at the beginning of the fiscal year (e.g., the Fiscal Year 2020 rate adjustment of 5.5% is assumed to become effective October 2020).

Based on similar financial assumptions used in the financial feasibility of the Series 2019 Bonds, the projected rates are expected to adequately fund the cash needs of the FKAA Water System and exceed the minimum debt service coverage ratios required to satisfy the revenue bond obligations. The projected debt service coverage under the proposed rates is summarized on **Table 7-6**.

Other factors that could adversely (or positively) affect the results and financing strategy during the next 5 years include the following:

- Changes in interest rates prior to issuance of additional bonds
- Construction and other cost changes above or below projected levels
- Operating cost increases due to inflation and other factors
- Amount of grant funds or other outside revenue sources available
- Regulatory or other changes to operating conditions
- Changes to customer growth patterns and water demand projections

In addition to the factors above, FKAA staff will continue to pursue debt reduction strategies, financing alternatives, or other initiatives in order to mitigate future rate adjustments. Such factors have not been quantified as part of the financial forecast used to project future water rates and debt financing.

TABLE 7-6

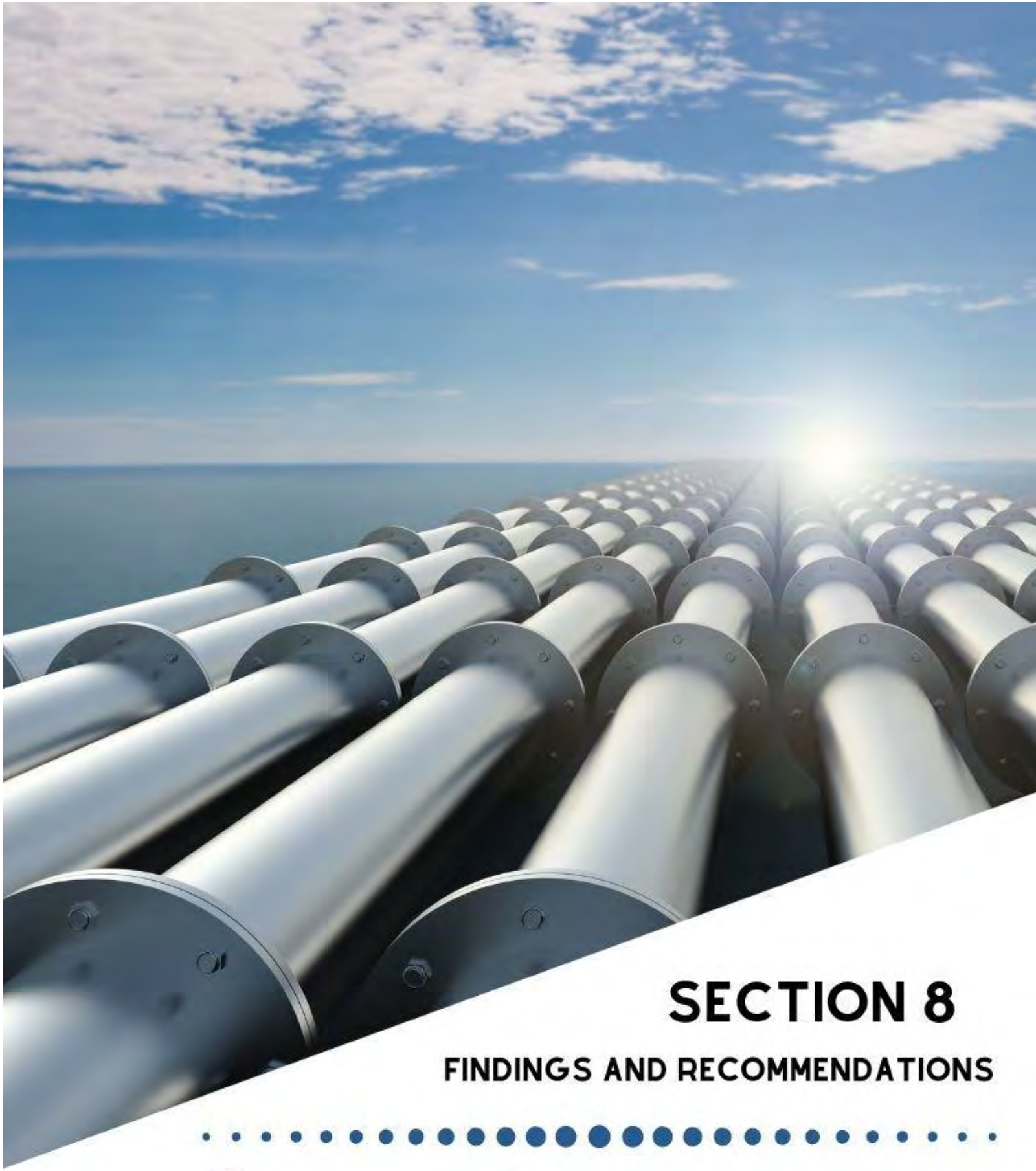
Projected Debt Service Coverage[1]

Fiscal Year	Debt Service Coverage (without System Development Charge Revenue)[1]	Debt Service Coverage (including System Development Charge Revenue)[1]
2020	1.37	1.48
2021	1.66	1.77
2022	1.48	1.57
2023	1.56	1.64
2024	1.63	1.71
Min. Required	1.1	1.2

[1]Debt service coverage equals Water System net revenues divided by the total Water System annual debt service. Amounts are based on the water rate adjustments projected herein.

7.4 20-Year Capital Improvement Funding

The preceding Section 7.3 and exhibits provide the financing plan and projected water rate adjustments needed to fund capital improvements through Fiscal Year 2024. Because financial forecasting is less reliable beyond a 5-year period, a detailed funding analysis has not been completed past Fiscal Year 2024. As future projects move within the 5-year planning horizon, specific capital strategies will be developed. Such capital funding will likely include additional borrowing as well as cash funding from rates. The underlying objective will be to continue to fund necessary capital improvements, minimize future water rate adjustments, and maintain the creditworthiness of the FKAA Water System.



SECTION 8

FINDINGS AND RECOMMENDATIONS

FLORIDA KEYS AQUEDUCT AUTHORITY

SECTION 8
Findings and Recommendations

The section summarizes the findings and recommendations from earlier sections of the Master Plan, as follows:

TABLE 8-1
Findings and Recommendations

Section	Findings	Recommendations
Section 2 *Population and Water Demand Forecast*	• The permanent population in Monroe County is not expected to grow over the next 20 years and the seasonal population will grow at an annual rate of 0.2 percent. • FKAA has a historic and projected consumption rate of 115 gpcd based on its combined permanent and seasonal population. This value includes non- revenue water.	• Continue to promote conservation to reduce max day demand. • Continue to reduce non-revenue water • Update population growth and consumption estimates every two years.
Section 3 *Water Supply System*	• The existing water supply system has sufficient capacity to meet average and maximum day demands during non-drought conditions. • During drought conditions, an additional 2 MGD will be needed to meet future maximum day demand. • The boundary of seawater intrusion into the Biscayne Aquifer is slowly approaching the FKAA wellfields.	• Construct new Stock Island Reverse Osmosis Facility to supply maximum day demand. • Construct new Biscayne Aquifer wellfield further upstream of saline water interface.
Section 4 *Water Treatment and Standards*	• The existing water treatment plants have sufficient capacity for future average and maximum day demands. • The Stock Island Reverse Osmosis Facility is in poor condition and needs to be replaced. • New regulations for emerging contaminants, such as perfluoroalkyl and polyfluoroalkyl substances (PFAS) may be promulgated during this planning horizon.	• Construct new Stock Island Reverse Osmosis Facility to provide potable water in Lower Keys in the event of a failure of the transmission main. • Evaluate treatment alternatives for the lime softening WTO, such as Granular Activated Carbon, to meet future water quality standards.

Section	Findings	Recommendations
Section 5 *Water Transmission System*	• The transmission system is at the limit of its maximum capacity to convey the future maximum day demand assuming that the pipe is capable of operating at its design pressures. • However, due to the failing condition of the pipeline, the operating pressures in the transmission system have been reduced until the poor sections of pipe are replaced. • The Marathon Storage Tank is in poor condition and needs to be replaced.	• Replace approximately one percent of the transmission mains per year. • Prioritize pipe replacement using Asset Management System. • As the transmission system is replaced, increase the pipe diameter to increase system capacity and lower operation costs. • Replace 3-MG Marathon Storage Tank with 4-MG tank. • Maintain retired portions of the transmission main so they can be rehabilitated in the future to provide system redundancy.
Section 6 *Water Distribution System*	• Most of the distribution system is comprised of PVC pipe, which is generally in good condition. • The small diameter (2-inch) pipe, thin-walled PVC and galvanized pipe should be replaced. • The Capital Improvement Plan includes supplying potable water to some areas (No Name Key and Middle Torch Key) • The Ocean Reef storage tanks and pump station system are operating at the maximum capacity.	• Develop pipe replacement schedule using Asset Management System. • Implement recommended alternative to upgrade Ocean Reef storage and pumping system. • Once the Marathon Storage Tank is replaced, decommission the 69th Storage Tank and Pump Station.
Section 7 *Financial Plan*	• FKAA has a projected cumulative rate increase of 17.5% between 2020 and 2024. • FKAA debt service coverage will increase from 1.37 to 1.63 between 2020 and 2024.	• FKAA will evaluate the Capital Improvement Plan (CIP) and operating budget on an annual basis to determine appropriate funding needs.

8.1 Capital Improvement Funding

As the water system assets reach the end of their useful lives, FKAA will need to significantly increase the level of capital investment from its historical budget of approximately $8 million per year to $25.7 million per year, as shown in **Table 8-2**.

The methodology used in the development of the costs for supply, treatment, transmission and distribution are discussed in the respective sections of this report.

The cost for facilities was developed simply by adding all of the facility related projects identified in the current CIP and assuming they would be funded over the 20-year planning horizon.

TABLE 8-2
Recommended Capital Improvement Funding

Category	Annual Cost ($ Mil/ yr)
Supply	$ 0.2
Treatment	$ 4.1
Transmission	$ 10.3
Distribution	$ 8.1
Facilities	$ 3.0
Total	**$ 25.7**

8.2 Next Steps

This Master Plan is intended to be a living document and will be updated every two years to reflect the most current factors that affect the prioritization of the Capital Improvement Program, including water demand, regulatory requirements and asset condition. Prior to the next Master Plan update, FKAA should accomplish the following tasks:

Utilize Asset Management System for Capital Improvement Planning. FKAA has recently implemented an Asset Management System to manage its work orders for operations. This program has a separate module that can be utilized to develop and prioritize the projects in the Capital Improvement Program. FKAA should incorporate this module in development of its future CIP.

Expand Hydraulic Model. FKAA has developed a hydraulic model for a portion of its pipeline network. This model should be expanded to include the whole system network. The hydraulic model results can be transferred to the asset management system so that the system operating pressures can be included in the evaluation of the assets. Also, the model will also assist in troubleshooting operational issues and developing cost effective solutions for system upgrades.

Update Funding Requirements for Stock Island Reverse Osmosis Facility. The SIRO Facility requires a significant investment, with an estimated budget of $50 million. At the present time, FKAA has applied for various state and federal grants to offset or potentially fund the facility. However, the determination of whether FKAA will receive these funds may not be known until 2020.

Update Financial Model. The financial model presented in Section 7 incorporates the current CIP for the next five years, but then tapers down to the historic level of funding. Once a final determination is made regarding the amount that FKAA wants to invest in its CIP in the later years, the financial model, and Master Plan, will need to be updated to reflect those objectives.