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Water and Sewer System Master Plans

October 23rd, 2019

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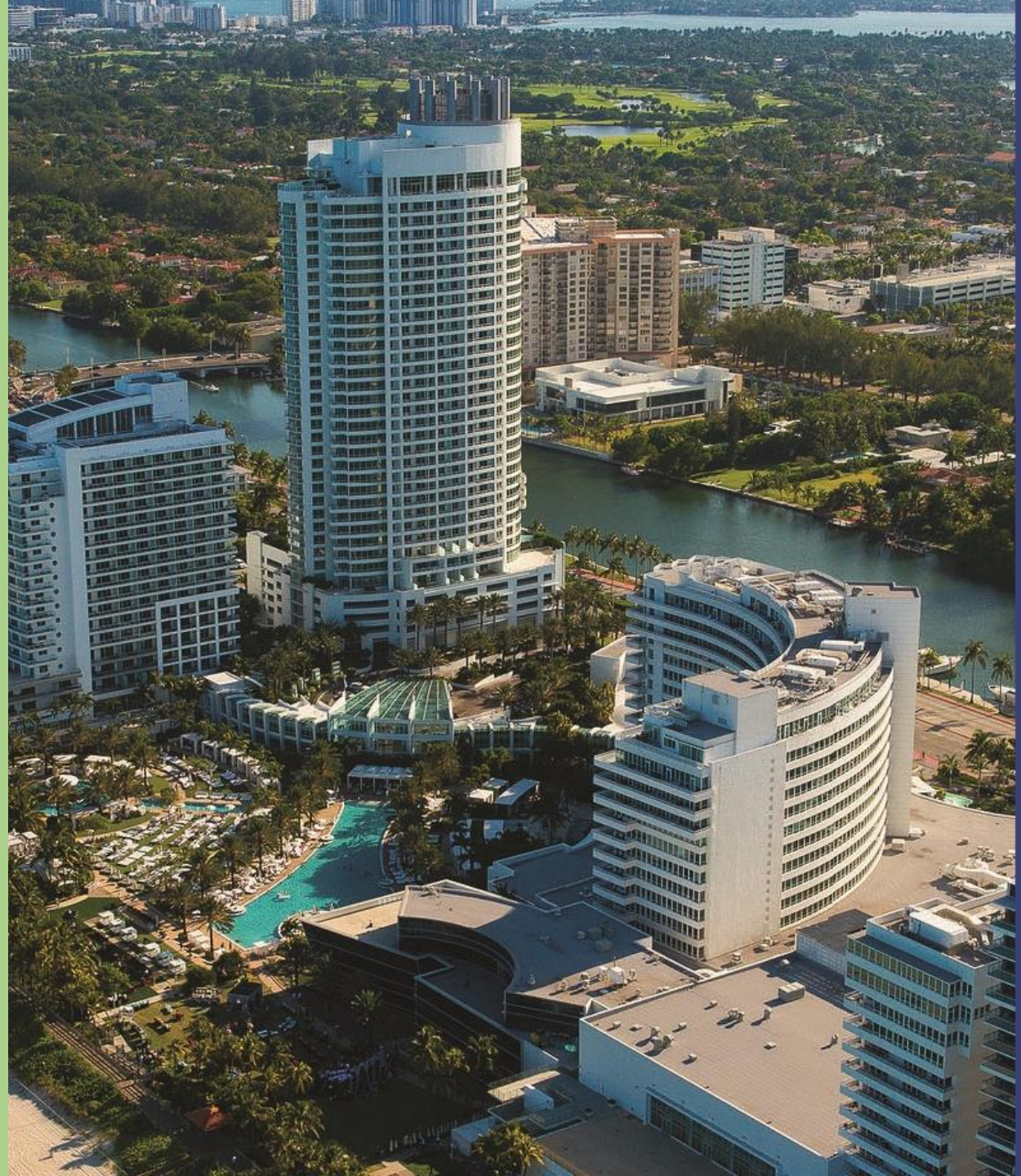
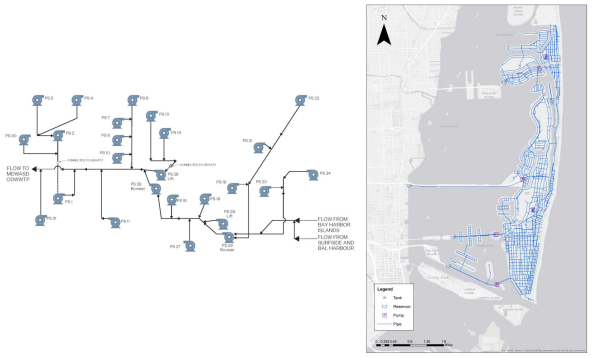
Master Plan Development



Methodology

Evaluation of the Existing System

Capacity Evaluation using Hydraulic Modeling



Evaluation of Above Ground Assets

Evaluation of Underground Assets (Risk Assessment)

Consequence of Failure (CoF)	Low Medium High
Probability of Failure (PoF)	Low Medium High

Capital Improvement Plan

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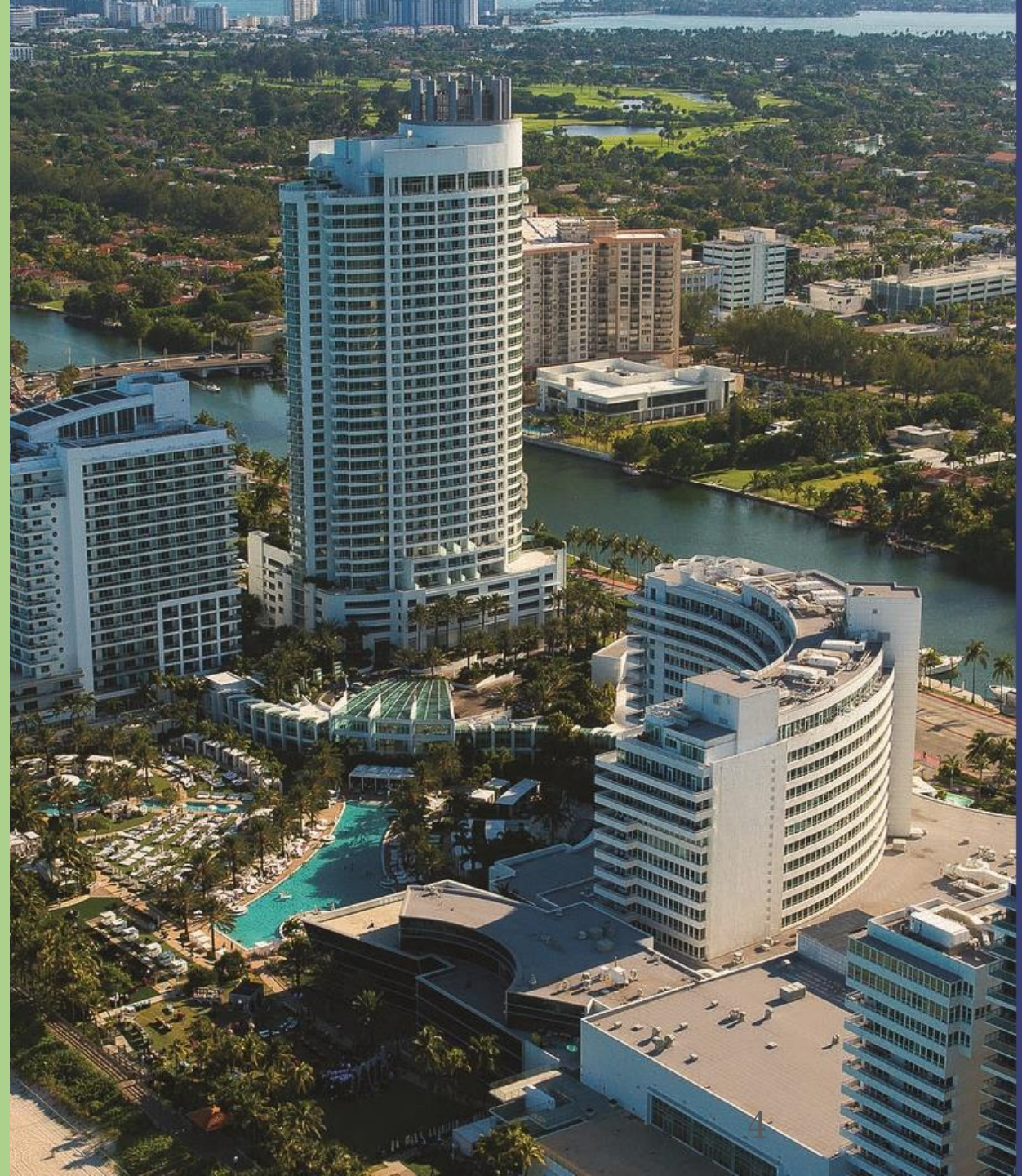
Population, Water Demand and Sewer Flows Forecast



Population Projections

Residents

Source: Traffic Analysis Zones (TAZ) Projections by Miami-Dade RER

2019	2045
96,000	121,000

+

Employees

Source: Traffic Analysis Zones (TAZ) Projections by Miami-Dade RER

2019	2045
70,000	96,000

+

Hotel Guests

Source: Current: Greater Miami Convention and Visitors Bureau, Future: Hazen

2019	2045
25,000	43,000

Population and Water Demand Projections

Equivalent Population

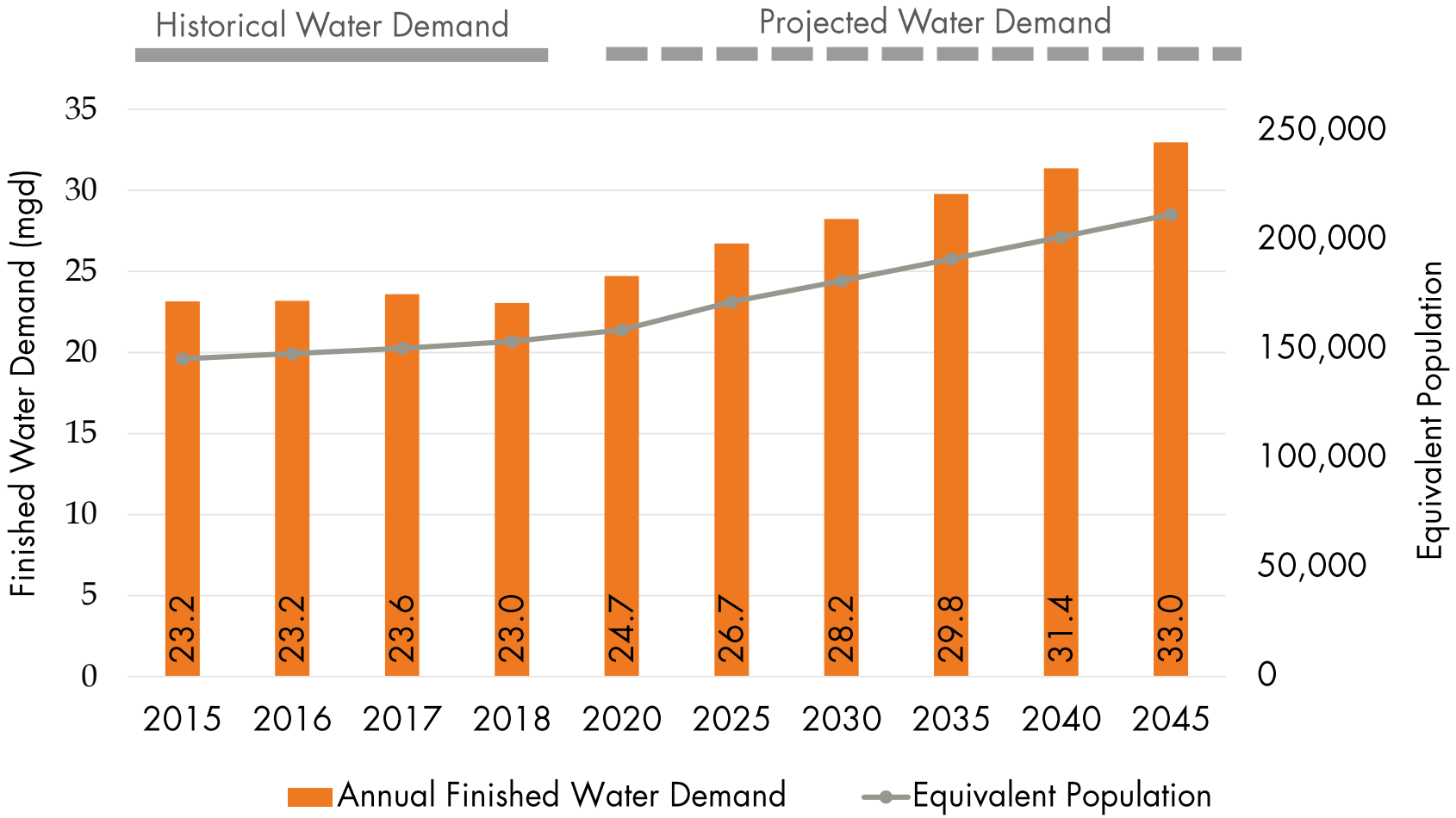
Residents (x 1)

\+

Employees (x 0.5)

\+

Hotel Guests (x 1)



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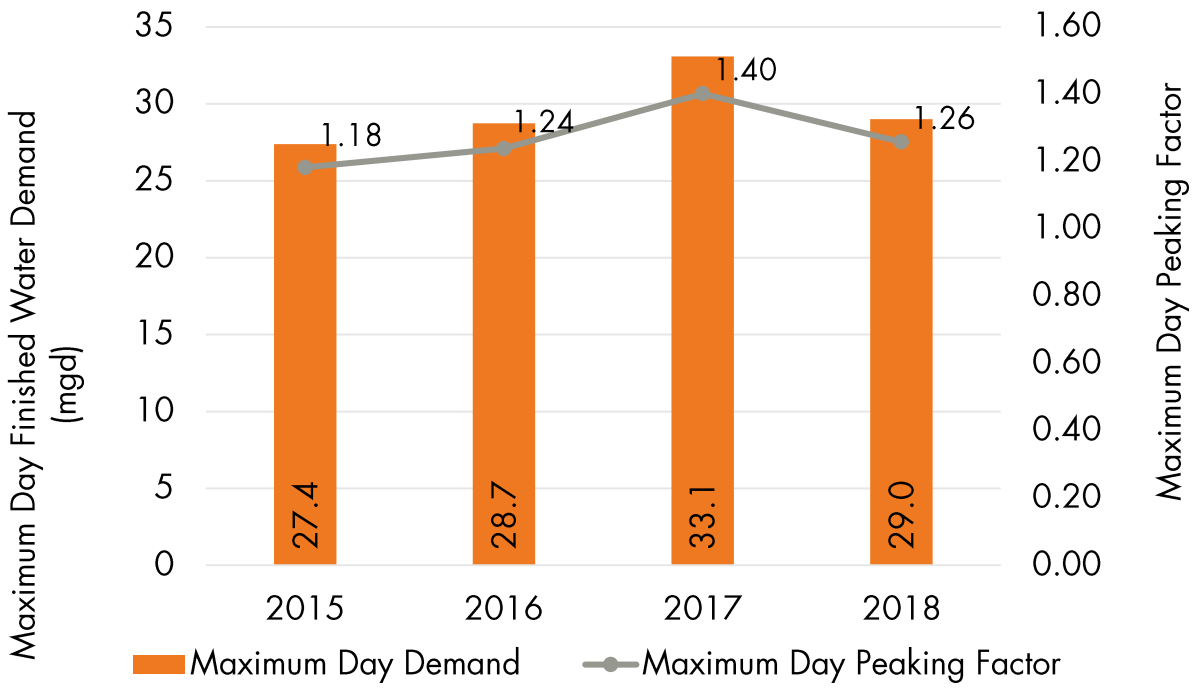
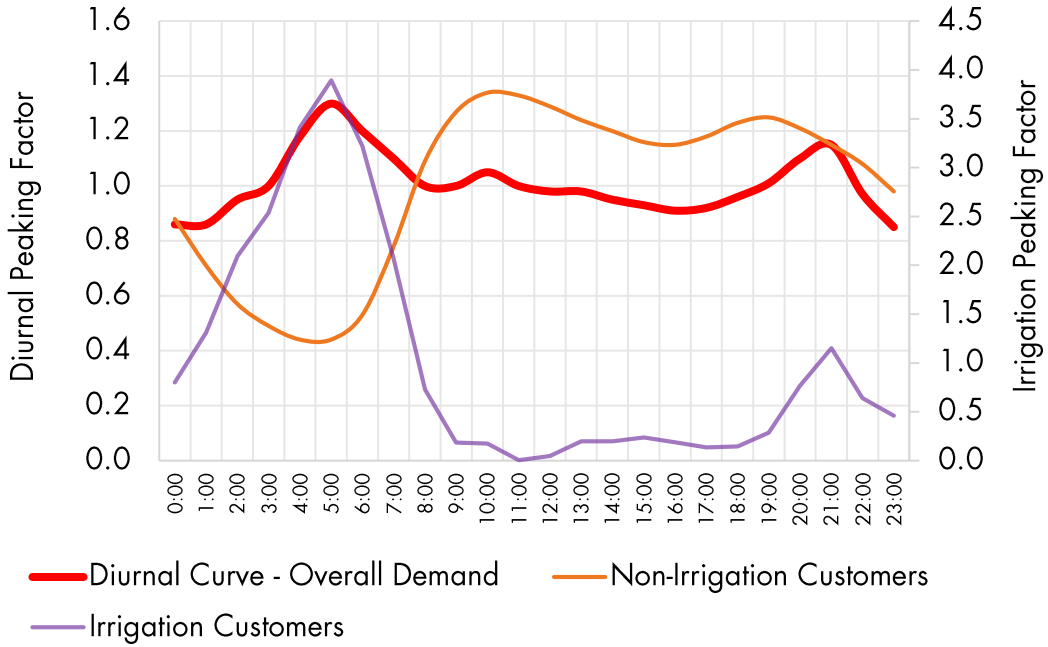
Seasonal and Diurnal Water Demand Fluctuations

The evaluation takes into account the day-to-day and hourly variations

Average maximum day peaking factor = 1.27



Overall diurnal peaking factor = 1.30



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Estimation of Sewer Flows

Sewer Flows

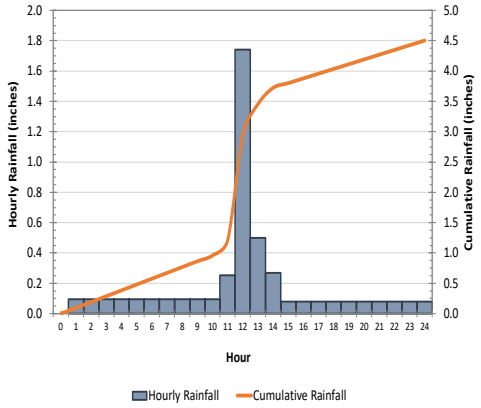
Base Sanitary Flow

- **96,000 residents**
- **70,000 Employees**
- **25,000 hotel guests**

Groundwater Infiltration (GWI)

Pipe age, material and distance to groundwater

Rainfall Dependent Infiltration and Inflow (RDII)



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Water System Master Plan

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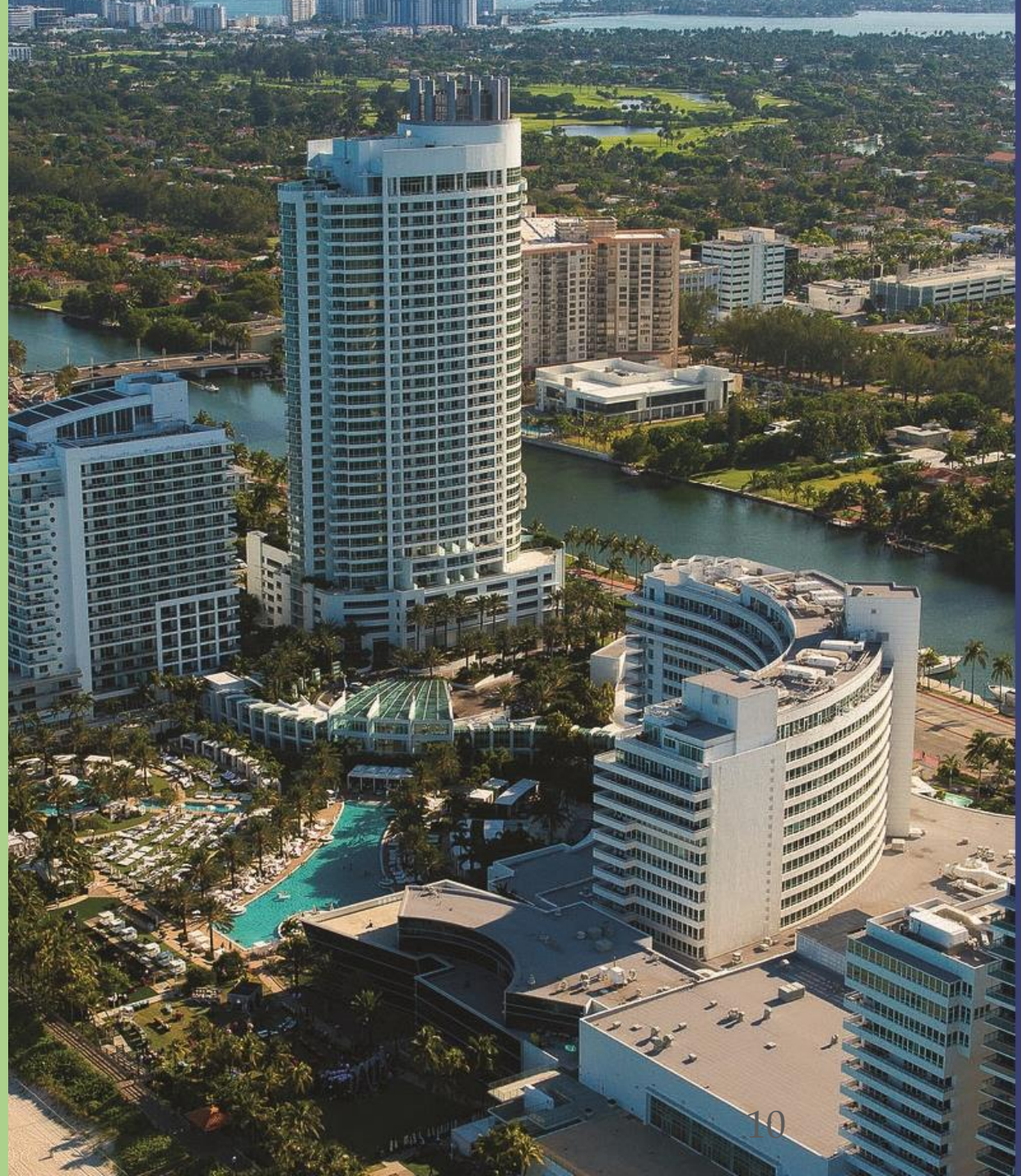
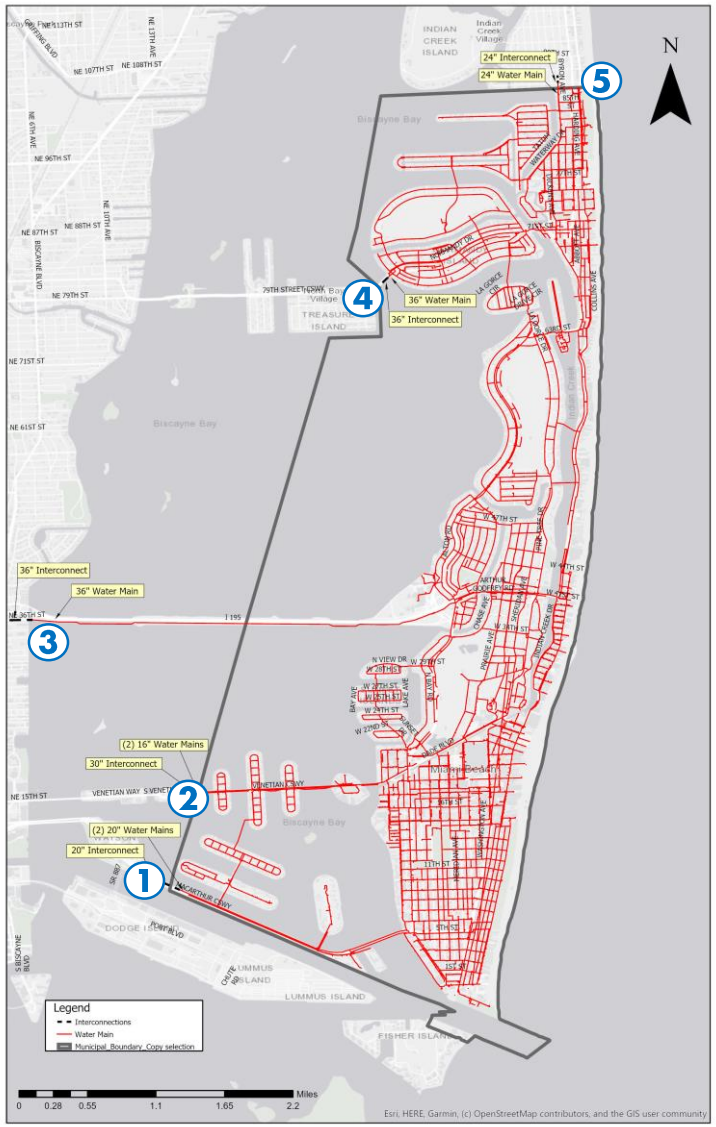
Summary of Existing Water Facilities



Existing Water Facilities



Miami Beach is a wholesale water customer of MDWASD

- Interconnects with MDWASD

1: 20-Inch water main on Watson Island (Mac Arthur Causeway)

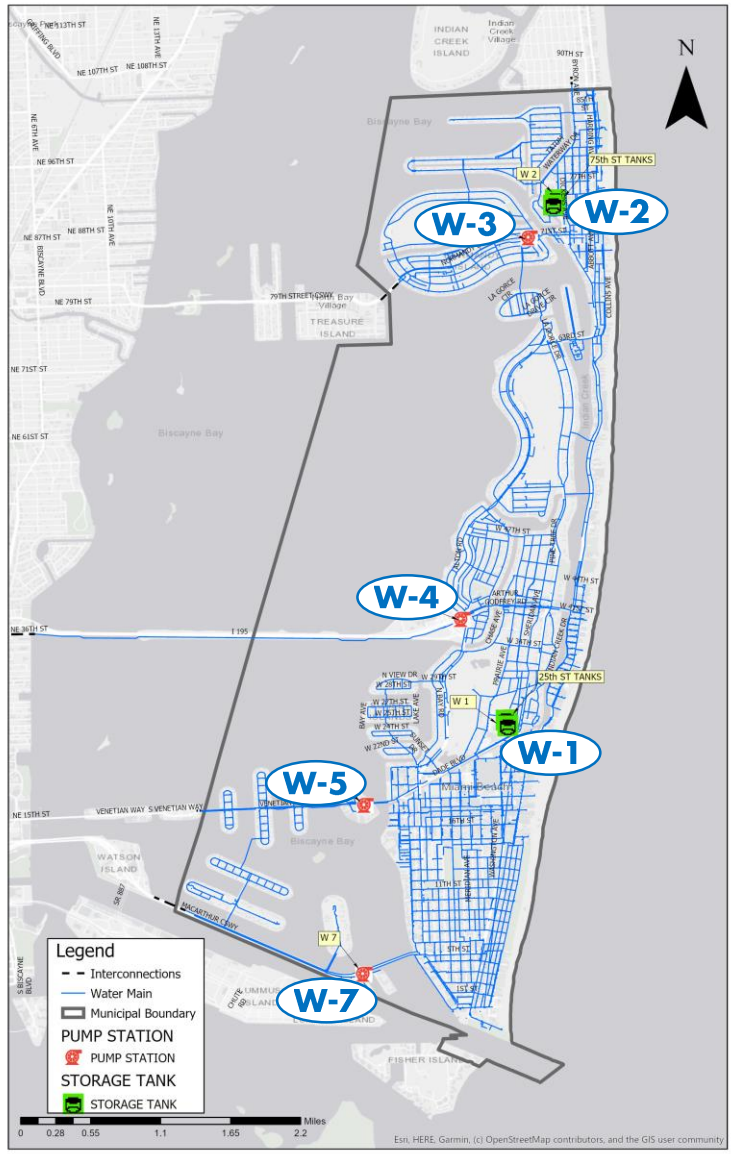
2: 30-Inch water main on San Marco Island (Venetian Causeway)

3: 36-Inch water main on Julia Tuttle Causeway (Norwood)

4: 36-Inch water main on Normandy Isle (79th Street Causeway)

5: 24-Inch water main on Byron Avenue (Emergency Interconnect)

Existing Water Facilities



The water pressure is boosted from the MDWASD Interconnects

- Main Facilities

W-1: 25th Street Booster Station and 2 x 3MG Storage Tanks

W-2: 75th Street Booster Station and 2 x 4MG Storage Tanks

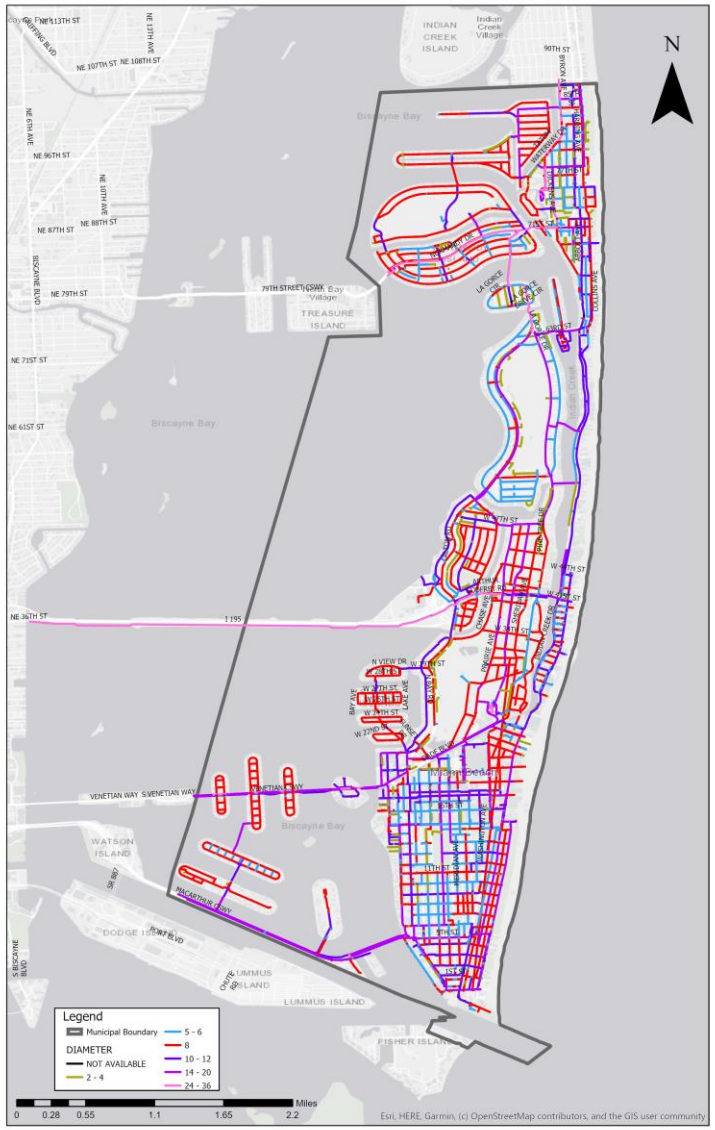
W-3: Normandy Isle Booster Station

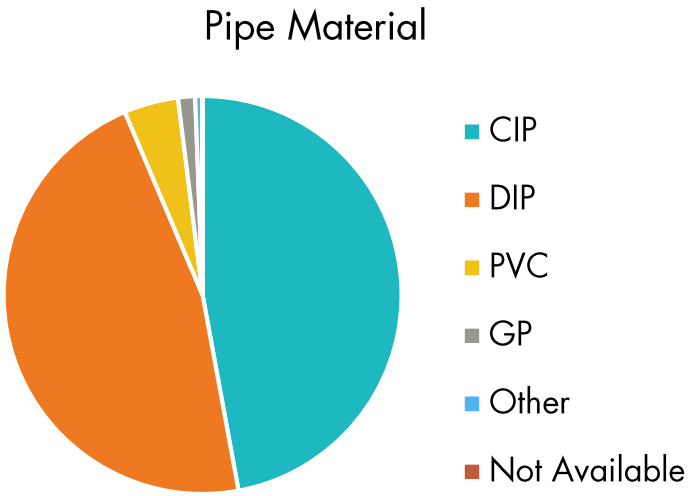
W-4: 41st Street Booster Station

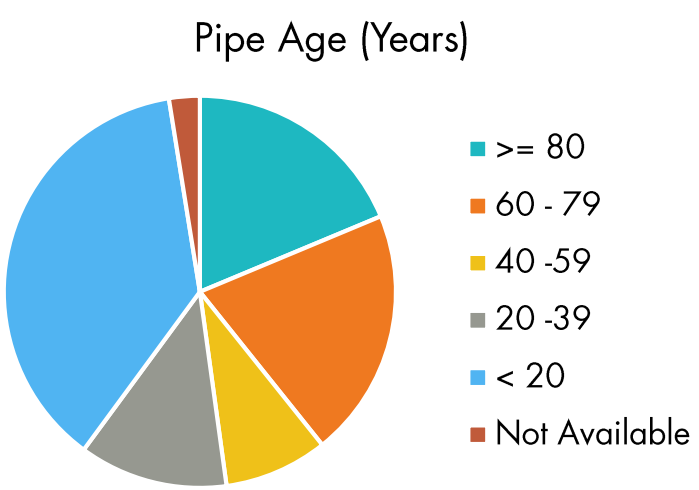
W-5: Belle Isle Booster Station

W-7: Terminal Island Booster Station

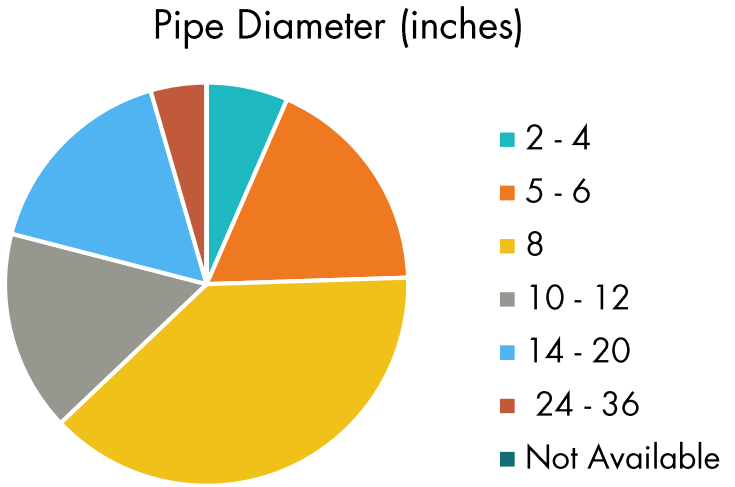
Water Distribution Network







Notes:
CIP = Cast Iron Pipe
DIP = Ductile Iron Pipe
GP = Galvanized Pipe
PVC = Polyvinyl Chloride Pipe



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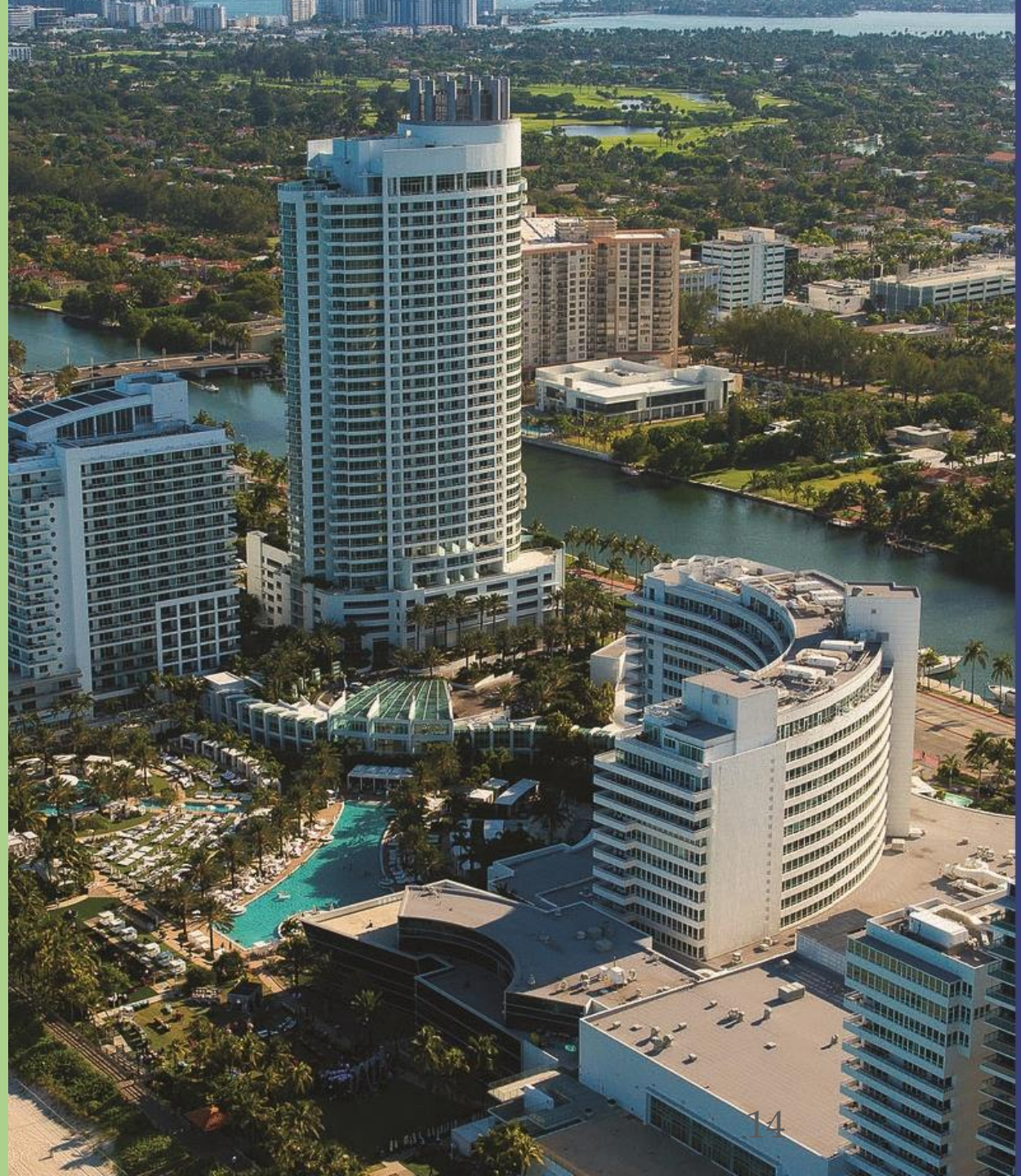
Water Distribution System Hydraulic Model



A dynamic computer model of the City's water system was created using Innovyze InfoWater

- Represents the components of the water system **starting at the points of connection with the MDWASD** system and the downstream pipe network
- **Developed using information from City's GIS database**, as-built records, pump curves, data collected during field visits, and other documentation provided by the City
- **Calibration** was conducted to obtain agreement between observed and model predicted flows

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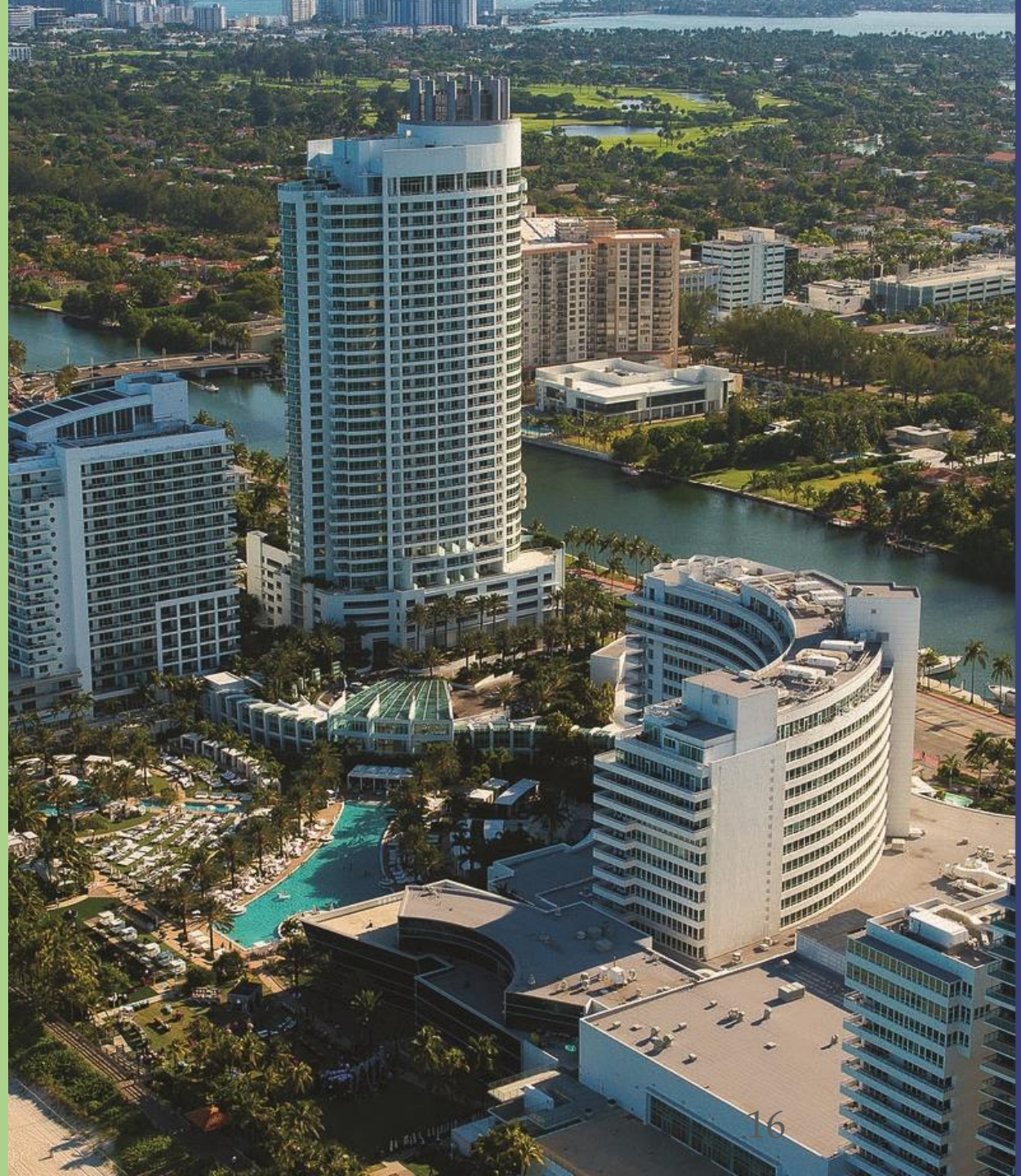
Water Supply System Evaluation



System evaluation conducted using the hydraulic model

Adequate Pressure

- During Maximum Day – Peak Hour Flows
- Pressures >= 35 psi

Fire Flow Adequacy

- Assessed based on land use
- Assessed large fire events in different parts of the network

Water Age Analysis

- Storage Tank Turnover
- System wide and localized water age evaluation

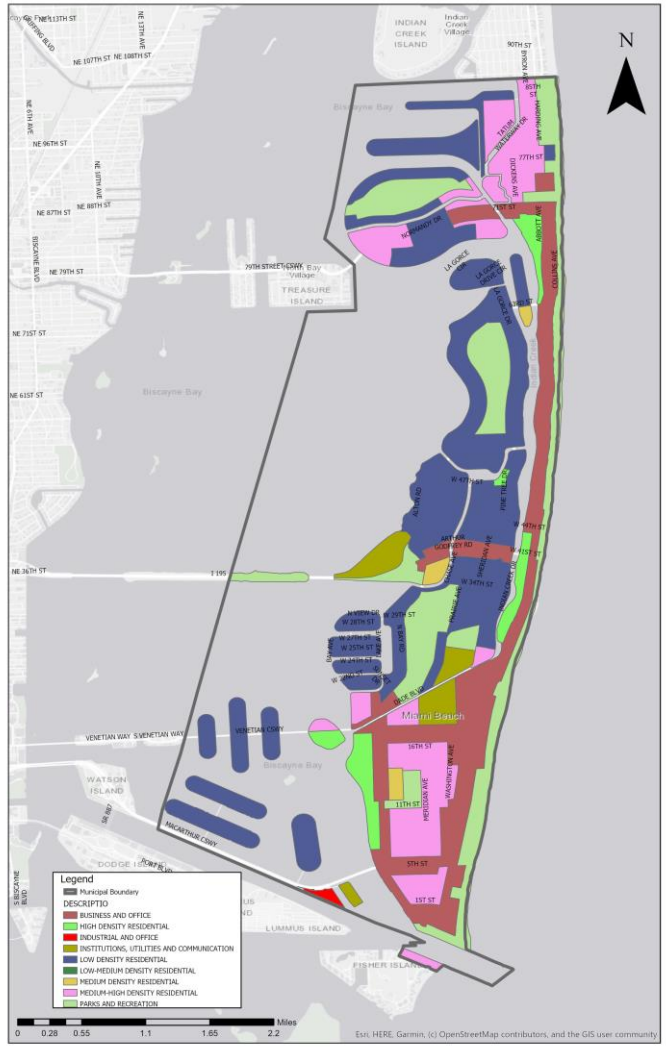
What-if Scenarios

- One of the 20" pipes from Terminal Island to the Beach offline
- Alternate supply from Byron Ave

The required water flow for fire suppression purposes from fire hydrants based on land use

Land Use Classification	Needed Fire Flow (gpm)
Business and Office	3,000
High Density Residential	3,000
Industrial and Office	3,000
Institutions, Utilities, and Communication	1,000
Low Density Residential	1,000
Low-Medium Density Residential	1,500
Medium Density Residential	2,000
Medium-High Density Residential	2,500
Parks and Recreation	750

A second step in evaluating fire flow availability was carried out evaluating the performance of the water system during large concentrated fire events at specific locations within the distribution system.



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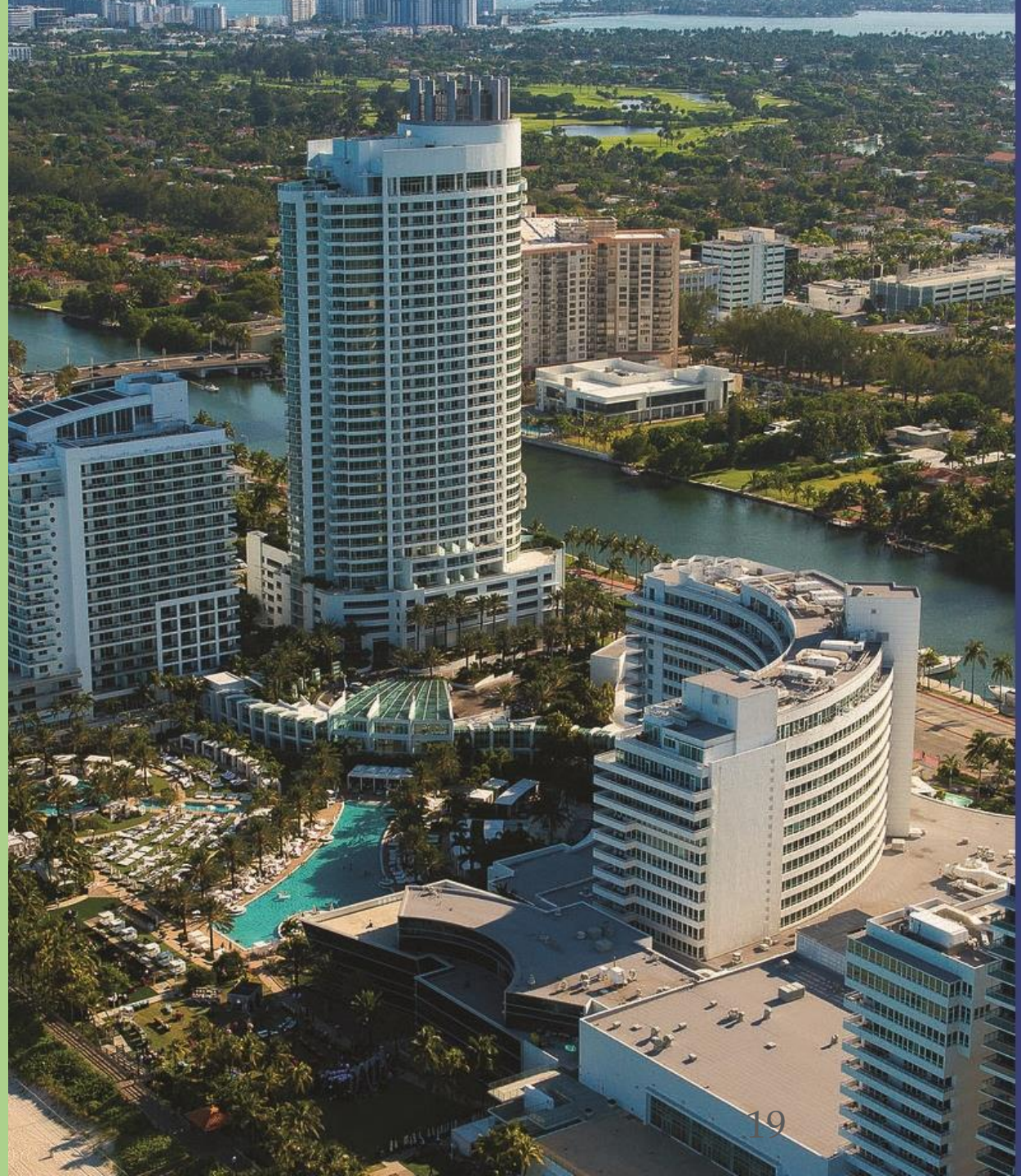
Risk Assessment and Renewal and Replacement (R&R) Projects for Water System Aboveground Assets



CIP Projects Identified as part of Condition Assessment of Water System Aboveground Assets

- Hazen performed a condition assessment of the major aboveground water and sewer assets
- Pump stations, storage tanks, and aerial crossings were evaluated
- Medium and high critically projects identified:
  - Two aerial crossing replacements: Venetian and MacArthur Causeway Aerial Crossings
  - Rehabilitation of six booster stations

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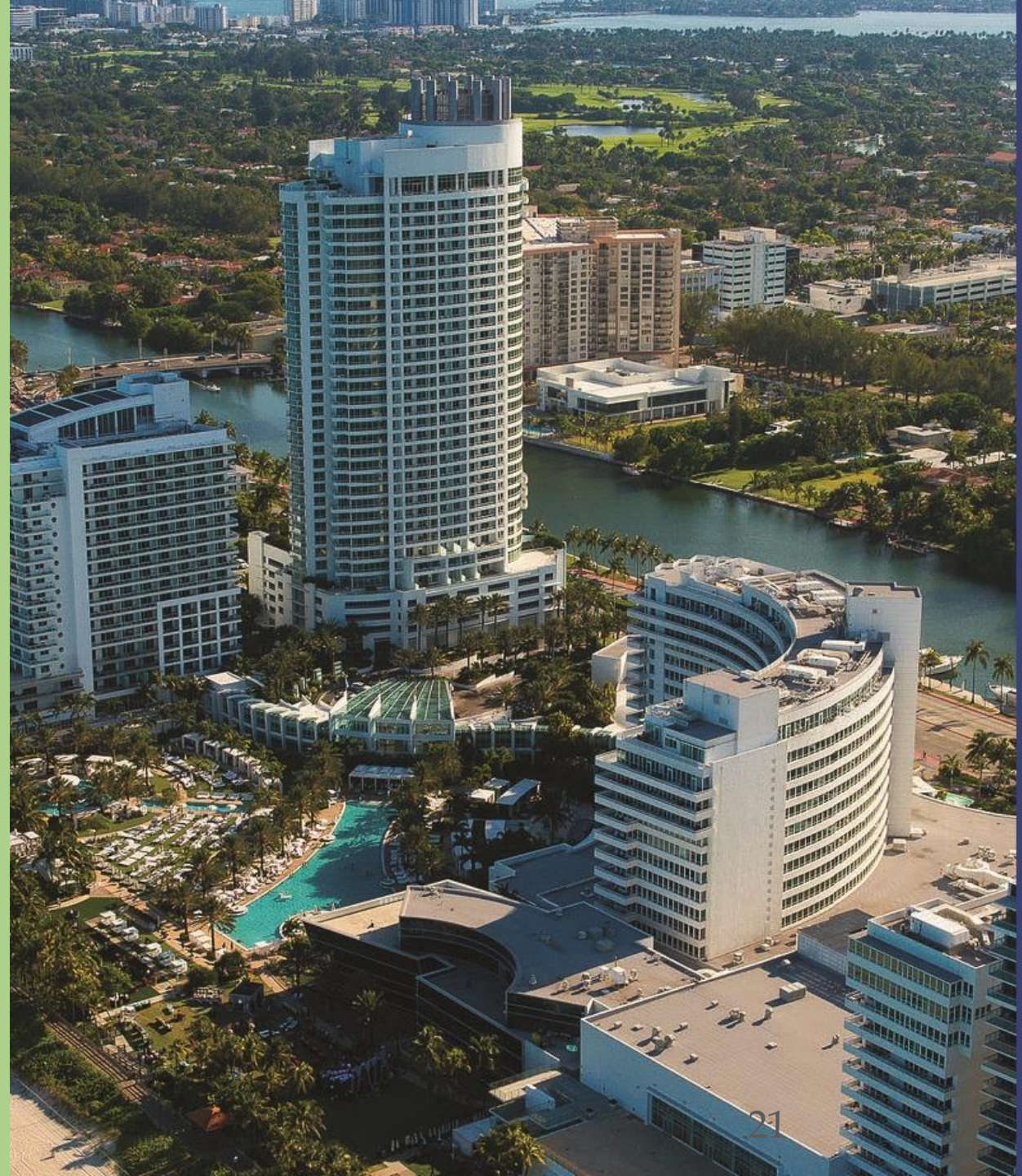
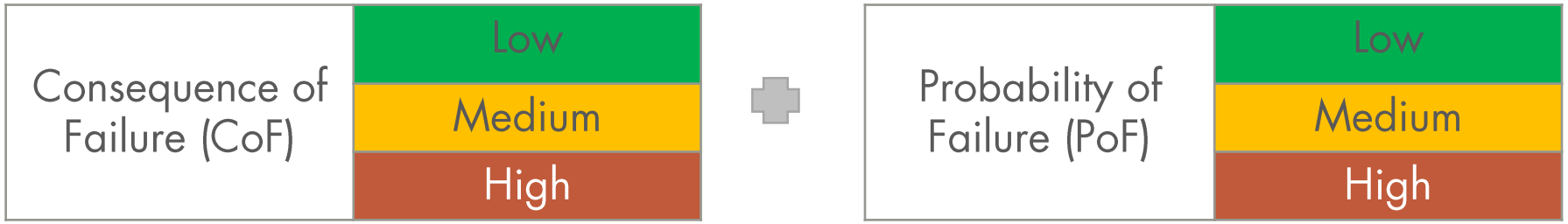
Risk Assessment and Renewal and Replacement (R&R) Projects for Water System Underground Assets



Risk Analysis Project Prioritization for Underground Assets

- R & R Project Prioritization was developed based on a Risk Analysis that combined Consequence of Failure (CoF) and Probability of Failure (PoF) to obtained a combined scored use to rank each project.
- Three levels (Low, Medium and High) were developed for CoF and PoF



CoF relates to factors such as the cost of repair, social/health impacts, and environmental impacts.

Consequence of Failure Criteria (Weight)	Range or Value	Score
Flow [a] (40%)	< 10 gpm	1
	10 – 50 gpm	2
	50 – 150 gpm	3
	150 – 500 gpm	4
	> 500 gpm	5
Land Use (40%)	Any other Land Use	1
	Business and Offices	5
Proximity to Major Roads (20%)	Other	1
	Collector Roads	2
	Federal / State Roads	3
	Divided Access / Major Roads	4
	Limited Access Roads	5

Note:
[a] 2019 DWF from hydraulic model.

A composite CoF was calculated for each water main segment based on the scores and relative weights presented in the table.

Consequence of Failure	Composite Score	Total Water Main Length (ft)
Low	< 1.8	452,190
Medium	1.8 – 2.6	198,200
High	> 2.6	323,640

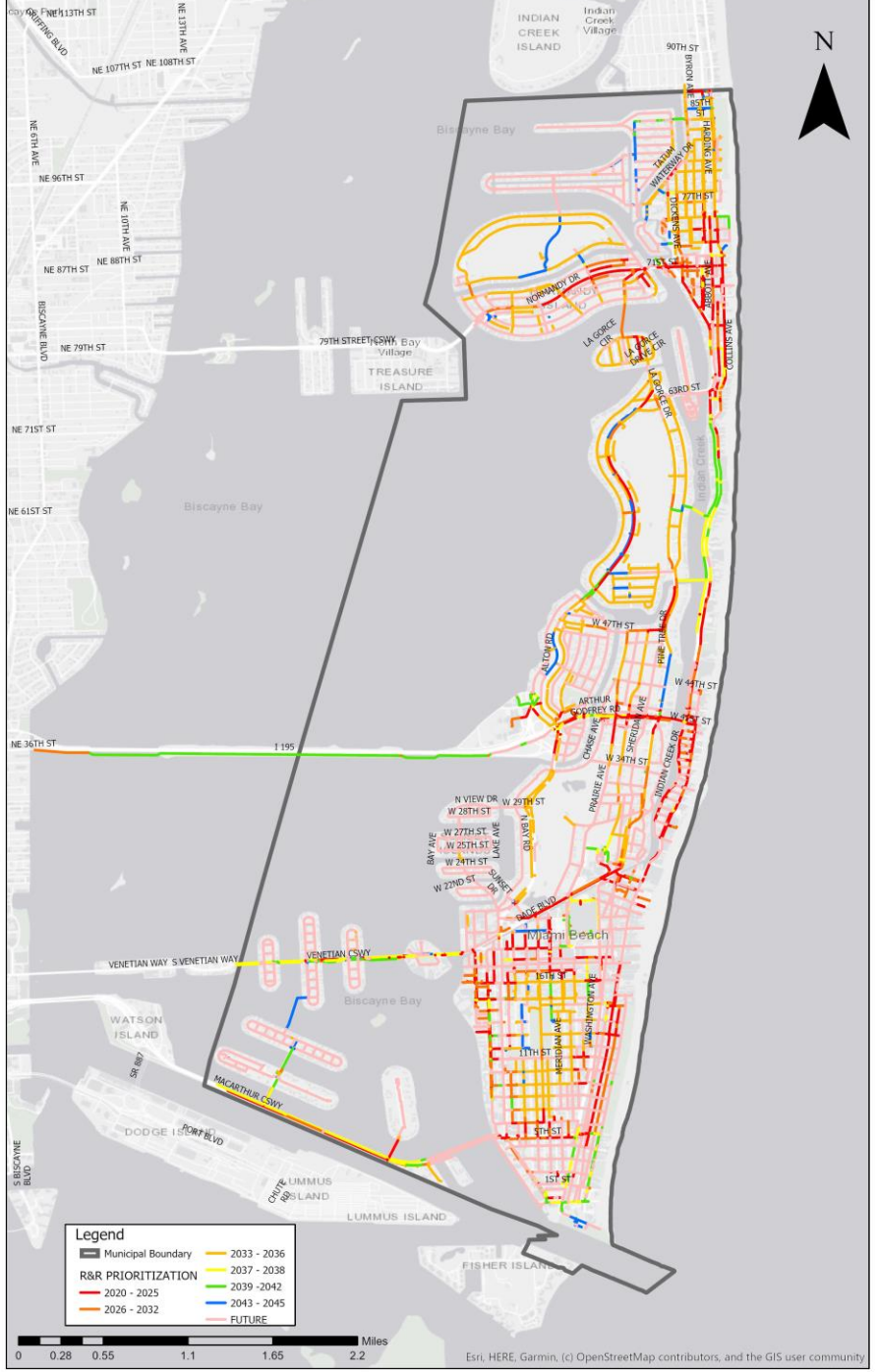
Water Mains' PoF and CoF ratings were combined in 3x3 matrix

Water Mains' Risk Matrix by Length (Feet)

Consequence of Failure (CoF)	Probability of Failure (PoF) Low	Medium	High
High	158,770 (16%)	46,780 (5%)	118,090 (12%)
Medium	82,230 (8%)	42,780 (4%)	73,190 (8%)
Low	222,190 (23%)	28,170 (3%)	201,830 (21%)

Recommended Replacement Timeframe

Consequence of Failure (CoF)	Probability of Failure (PoF) Low	Medium	High
High	Future	2037-2038	2020-2025
Medium	Future	2039-2042	2026-2032
Low	Future	2043-2044	2033-2036



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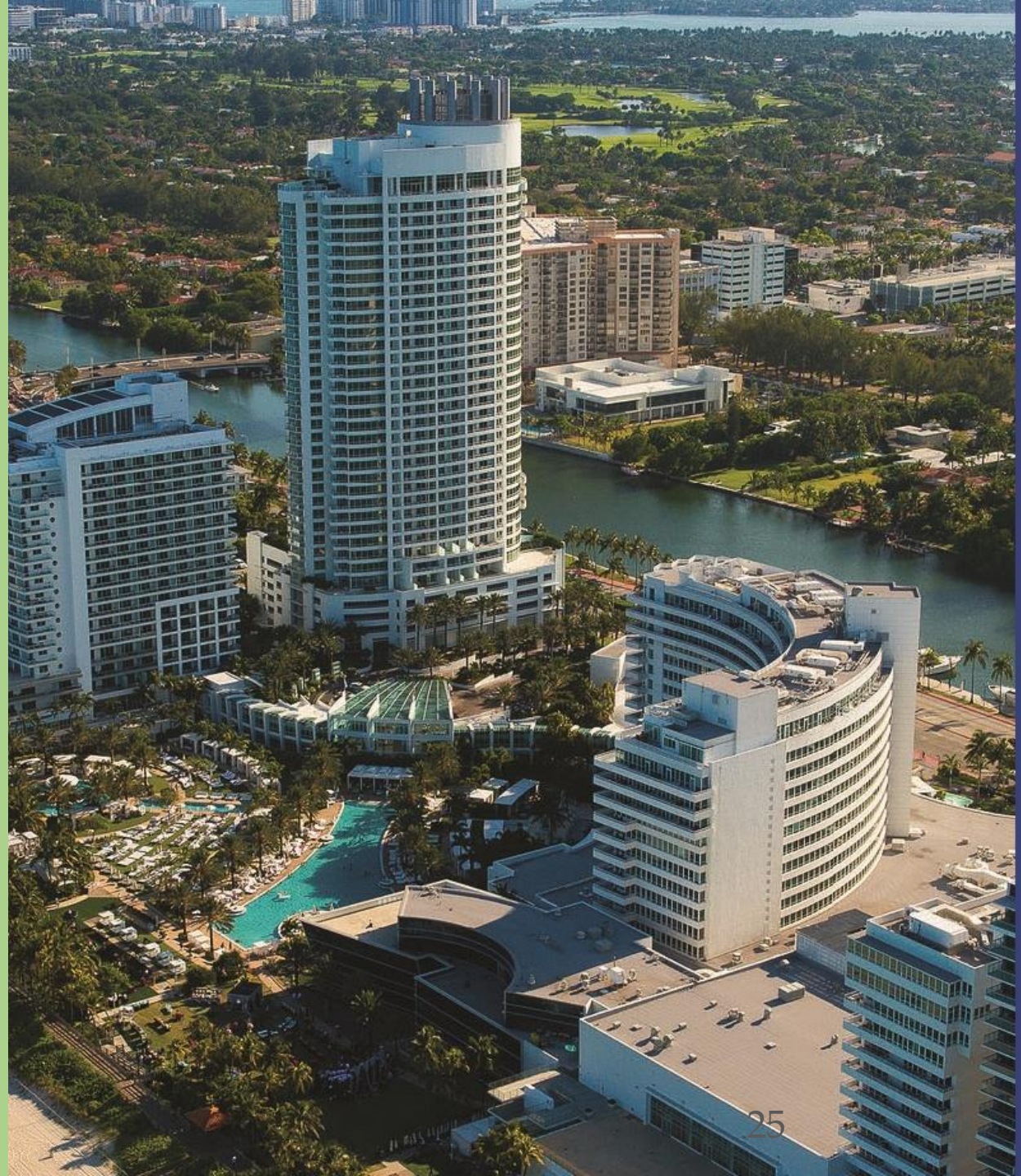
Water System Capital Improvement Program



Identified Water System Improvements Based on Evaluation of the Distribution System

49 CIP Projects Identified

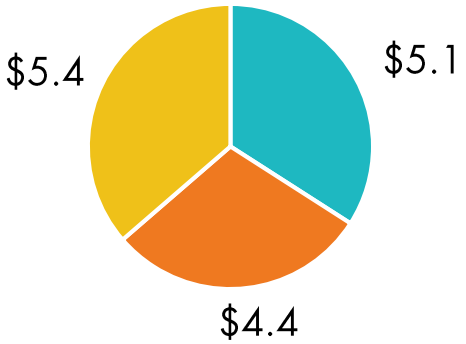
18 Capacity Based Improvements Identified (including improvements for fire flow)

31 R&R Based Improvements Identified

Total CIP Cost Through 2045 = **$167 M**

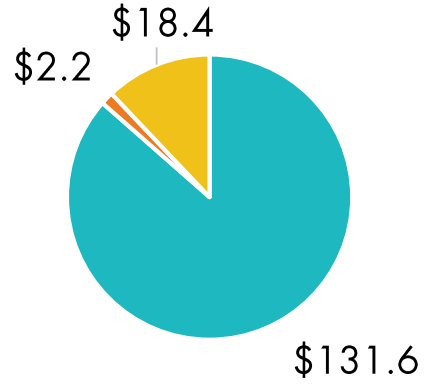
Capacity Based Improvement Projects

(Total Cost = $ 15 M)



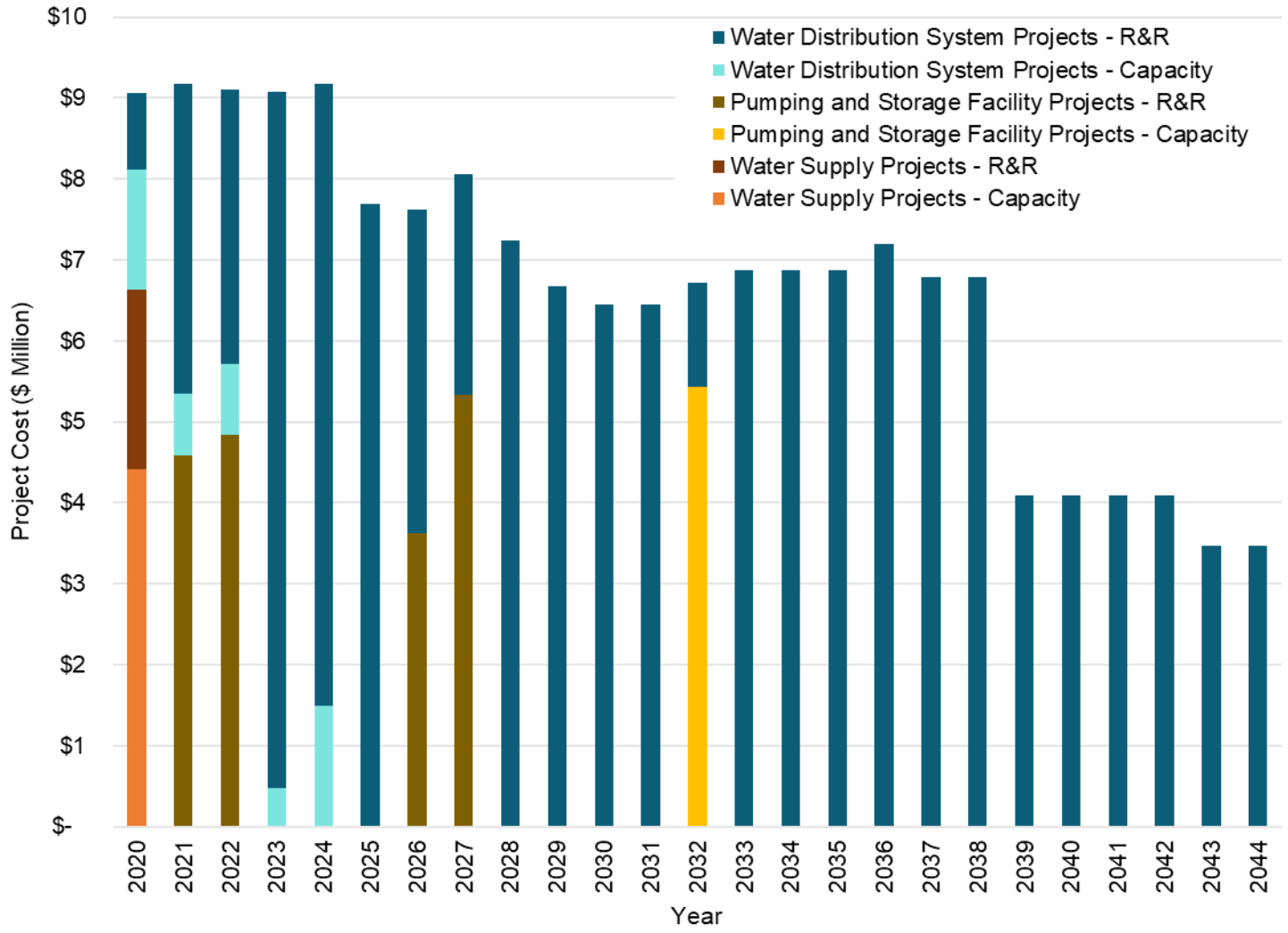
R&R Based Improvement Projects

(Total Cost = $ 152 M)



The total cost of the recommended projects in the Water Master Plan is $167 million (2018 dollars):

Water System CIP
$167M



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Sewer System Master Plan

September 25, 2019

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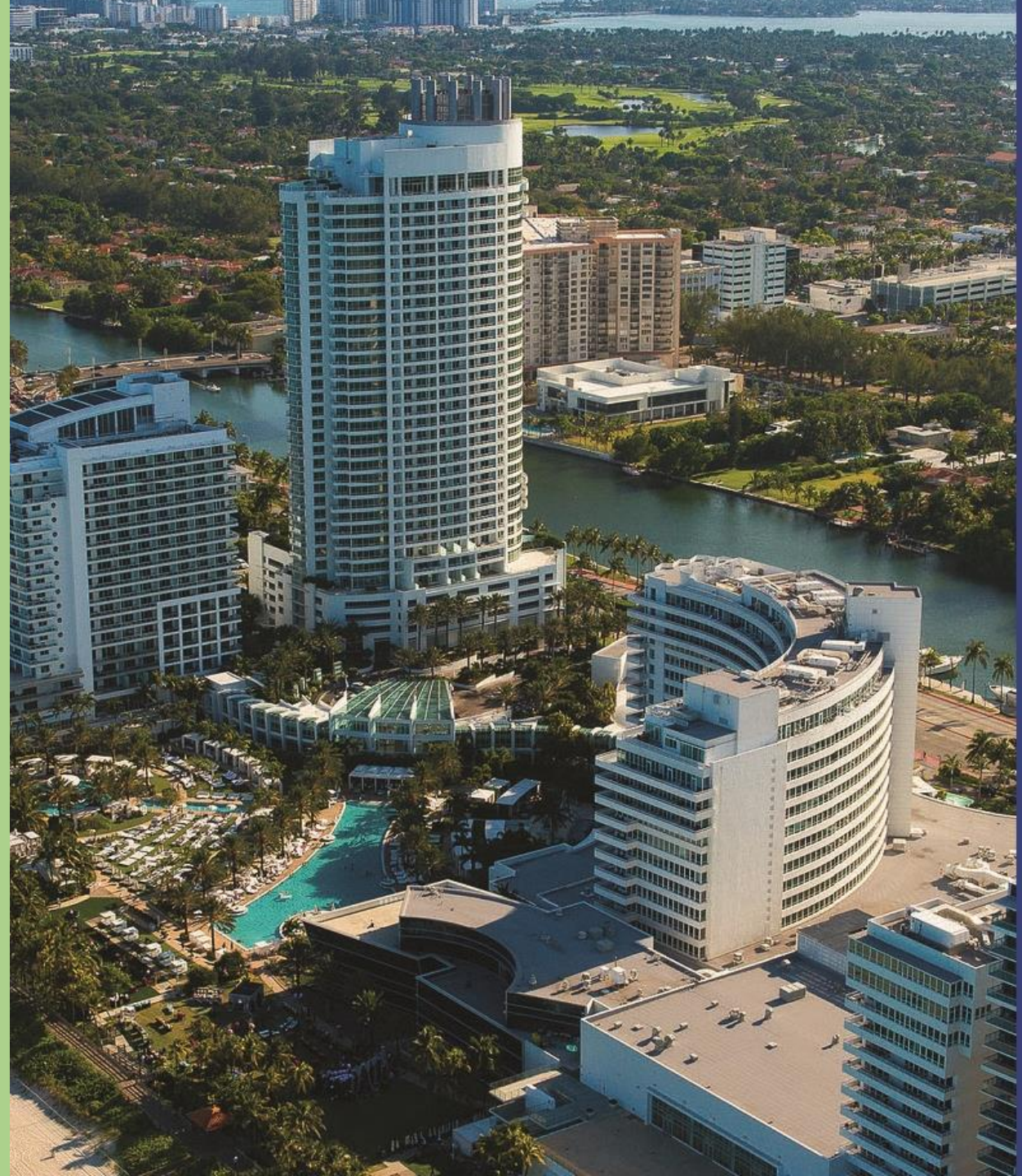
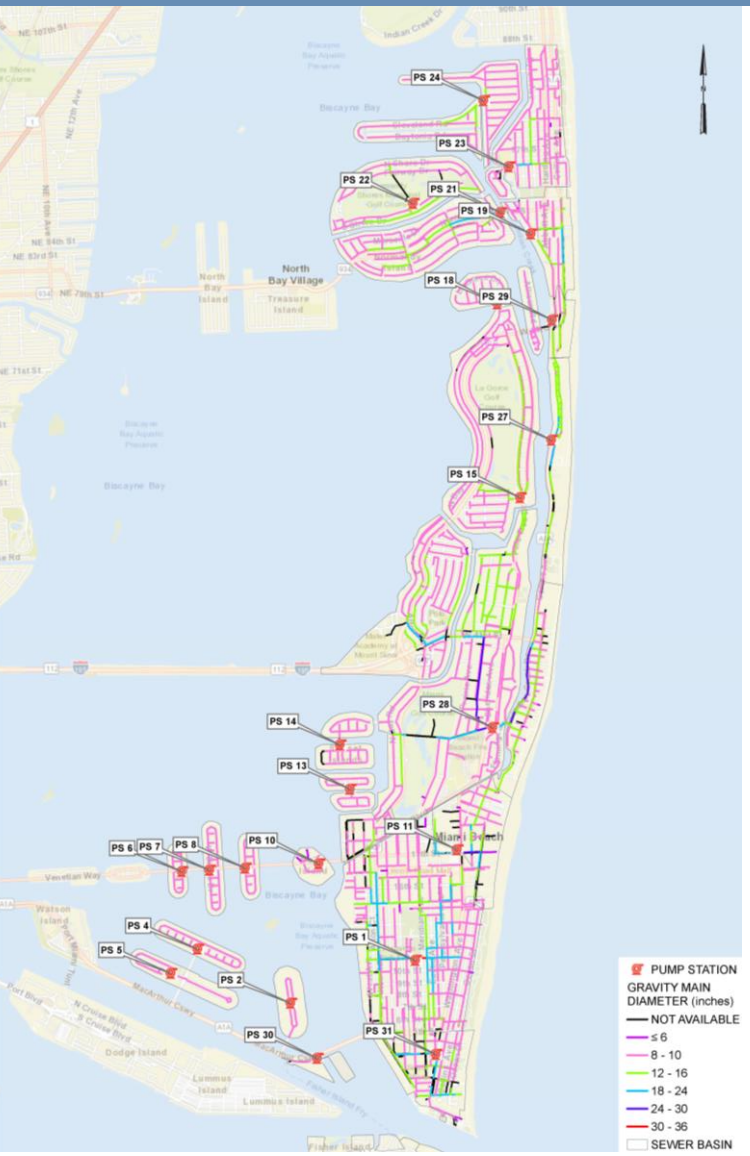
Summary of Existing Sewer System



Existing Sewer Collection and Transmission System



3,100 manholes

117 miles gravity sewer mains

24 miles active force mains

23 pump station service areas (basins)

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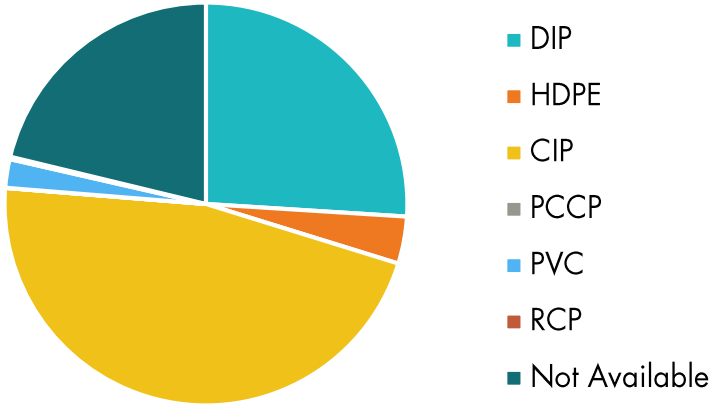
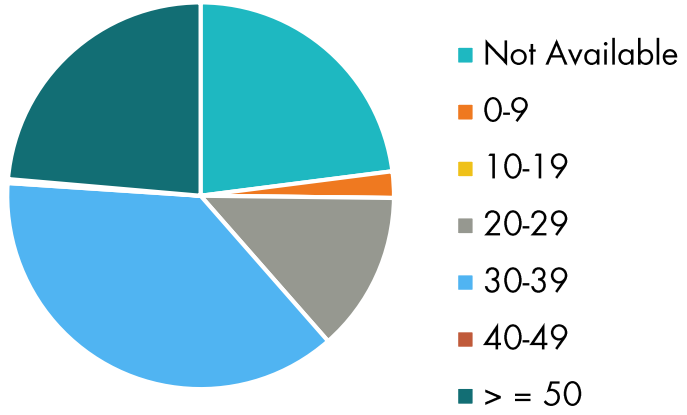
Sewer Force Main Network

Pipe Material

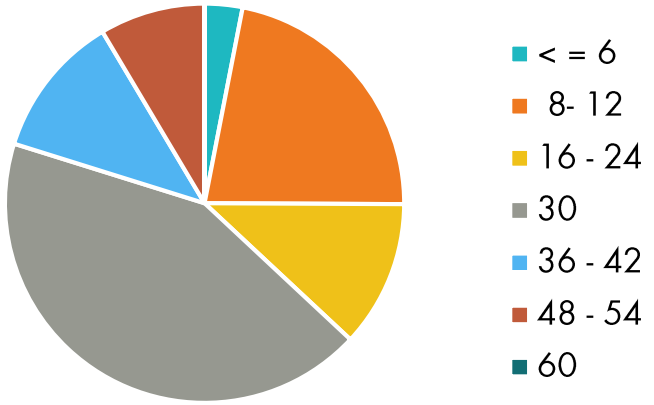


Notes:
CIP = Cast Iron Pipe
DIP = Ductile Iron Pipe
HDPE = high-density polyethylene
PCCP = Prestressed Concrete Cylinder Pipe
PVC = Polyvinyl Chloride Pipe
RCP = reinforced concrete pipe

Pipe Age (years)

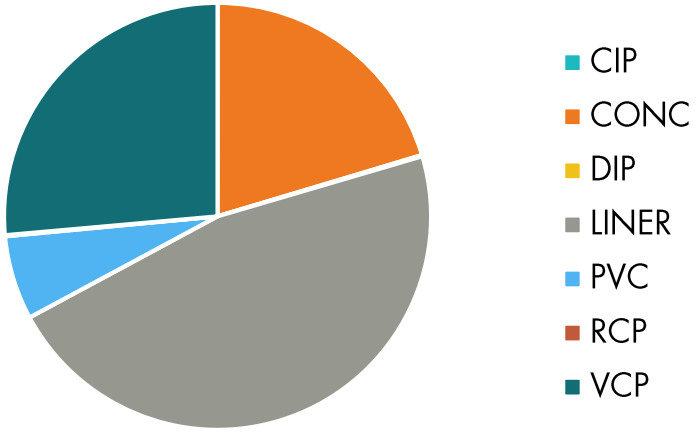


Pipe Diameter (inches)



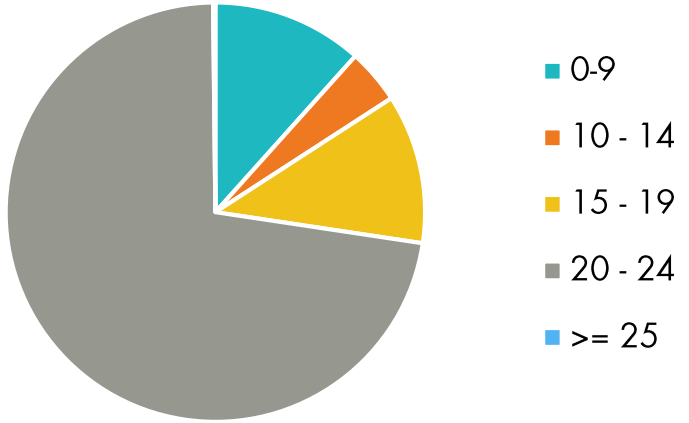
Sewer Gravity Main Network

Pipe Material

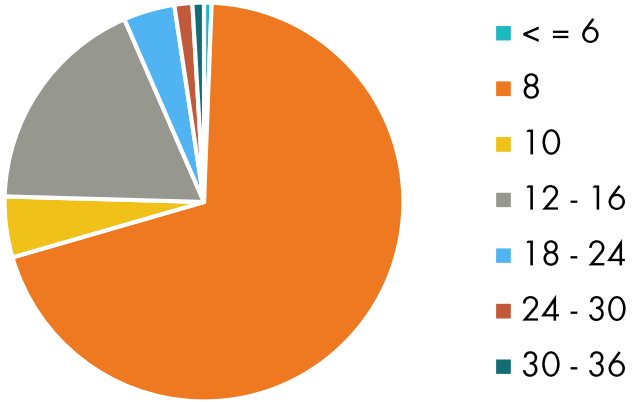


Notes:
CIP = Cast Iron Pipe
CONC = Concrete
DIP = Ductile Iron Pipe
PVC = Polyvinyl Chloride Pipe
RCP = Reinforced Concrete Pipe
VCP = Vitrified Clay Pipe

Pipe Age (years)



Pipe Diameter (inches)



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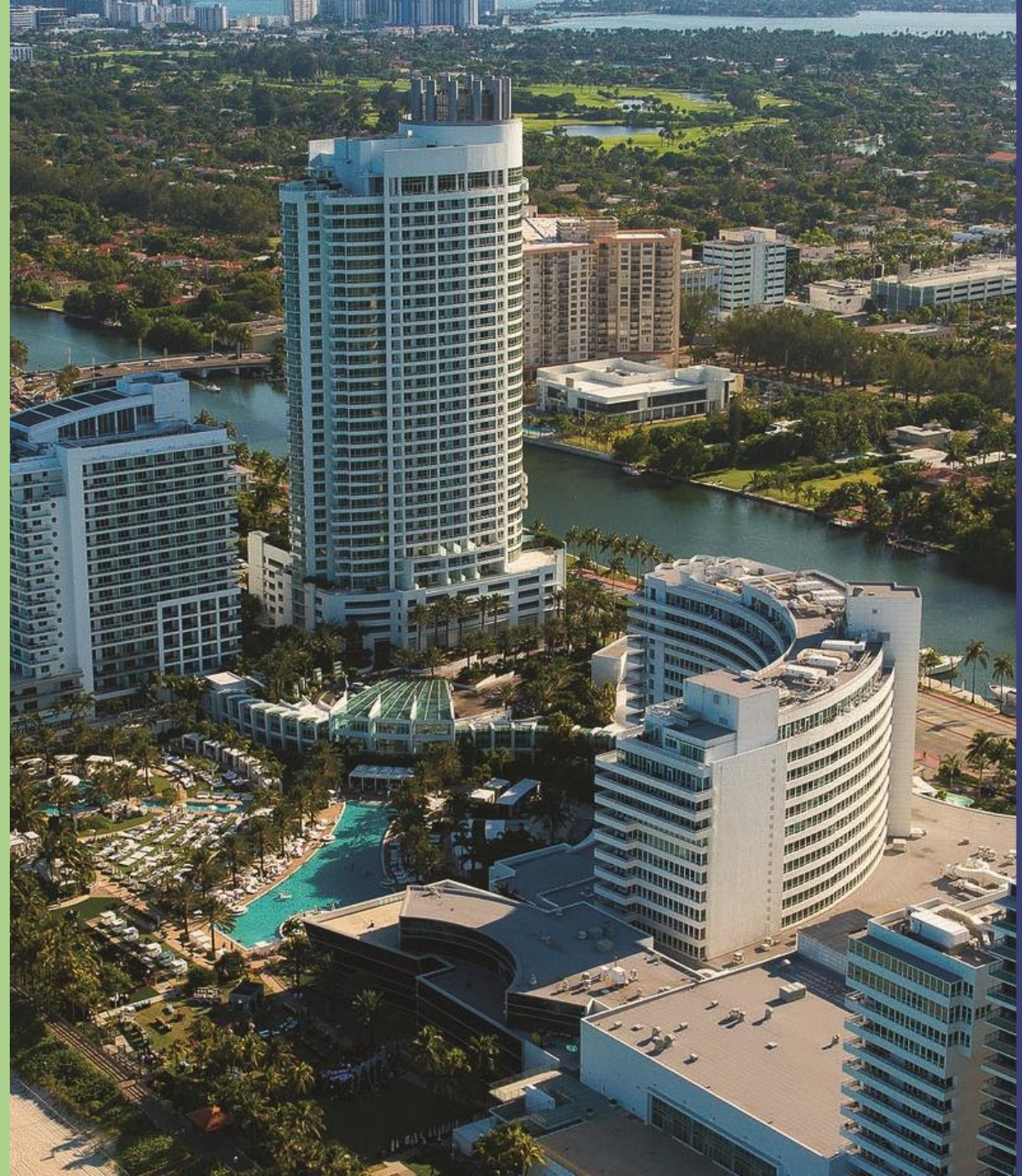
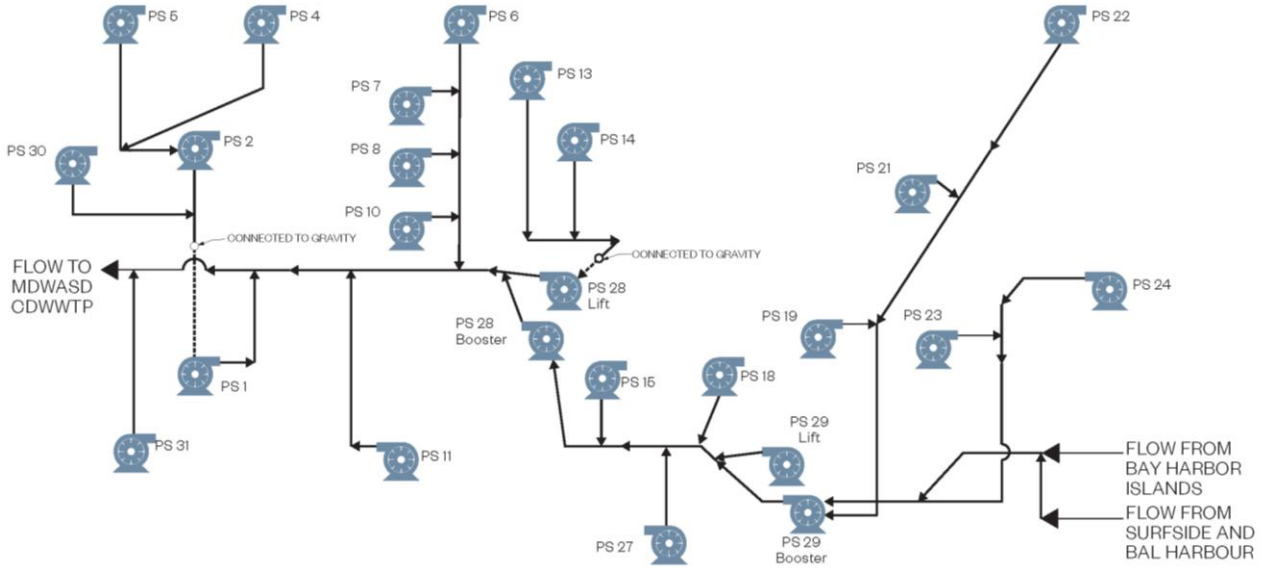
Force Main Hydraulic Model



Hydraulic Model (InfoWorks ICM)

The hydraulic model was used to perform extended period simulations to predict the following:

- Sanitary flow through all infrastructure components in network
- Hydraulic pressures at any point in the force main system
- Pumping capacity of each pump station
- Pumping capacity with standby pump out of service
- Pump station operating wet well levels
- Likelihood and location of SSOs



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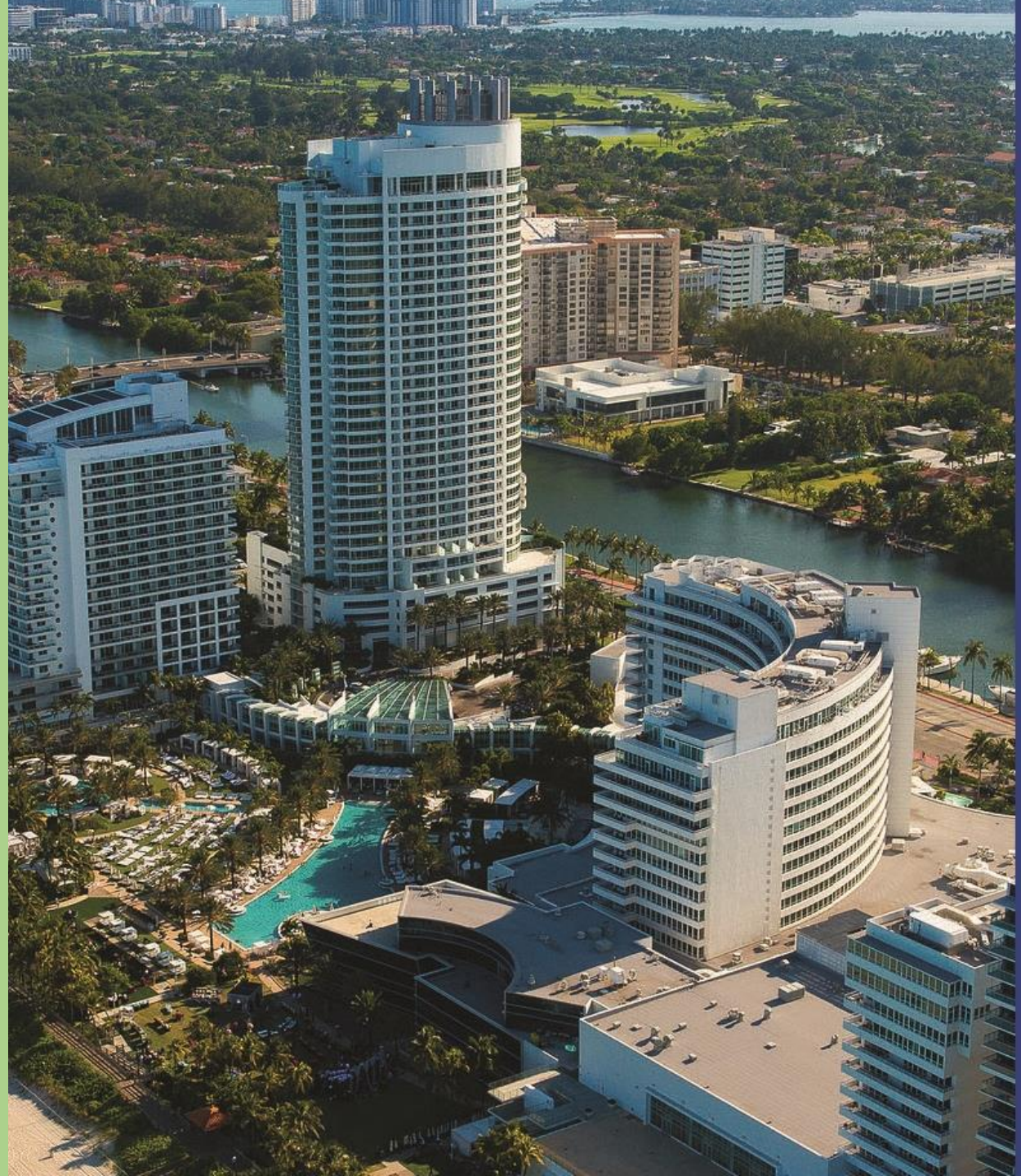
Evaluation of Sewer System Improvement Needs



Force Mains / Transmission - Capacity Based Improvement Projects

Recommended Capacity Improvement Projects		
ID	**Project Name**	**Timeframe**
4	Pump Station 2 parallel force main	2020 - 2024
5	Pump Station 4 parallel force main	2020 - 2024
6	Pump Stations 4 and 5 parallel force main	2020 - 2024
7	Pump Station 14 parallel force main	2020 - 2024
8	Pump Station 18 parallel force main	2020 - 2024
9	Pump Station 23 parallel force main	2020 - 2024
10	Pump Station 27 parallel force main	2020 - 2024
11	North Beach parallel force main and interconnect	2030-2034
12	Pump Stations 6, 7, and 8 flow rerouting	2020 - 2024

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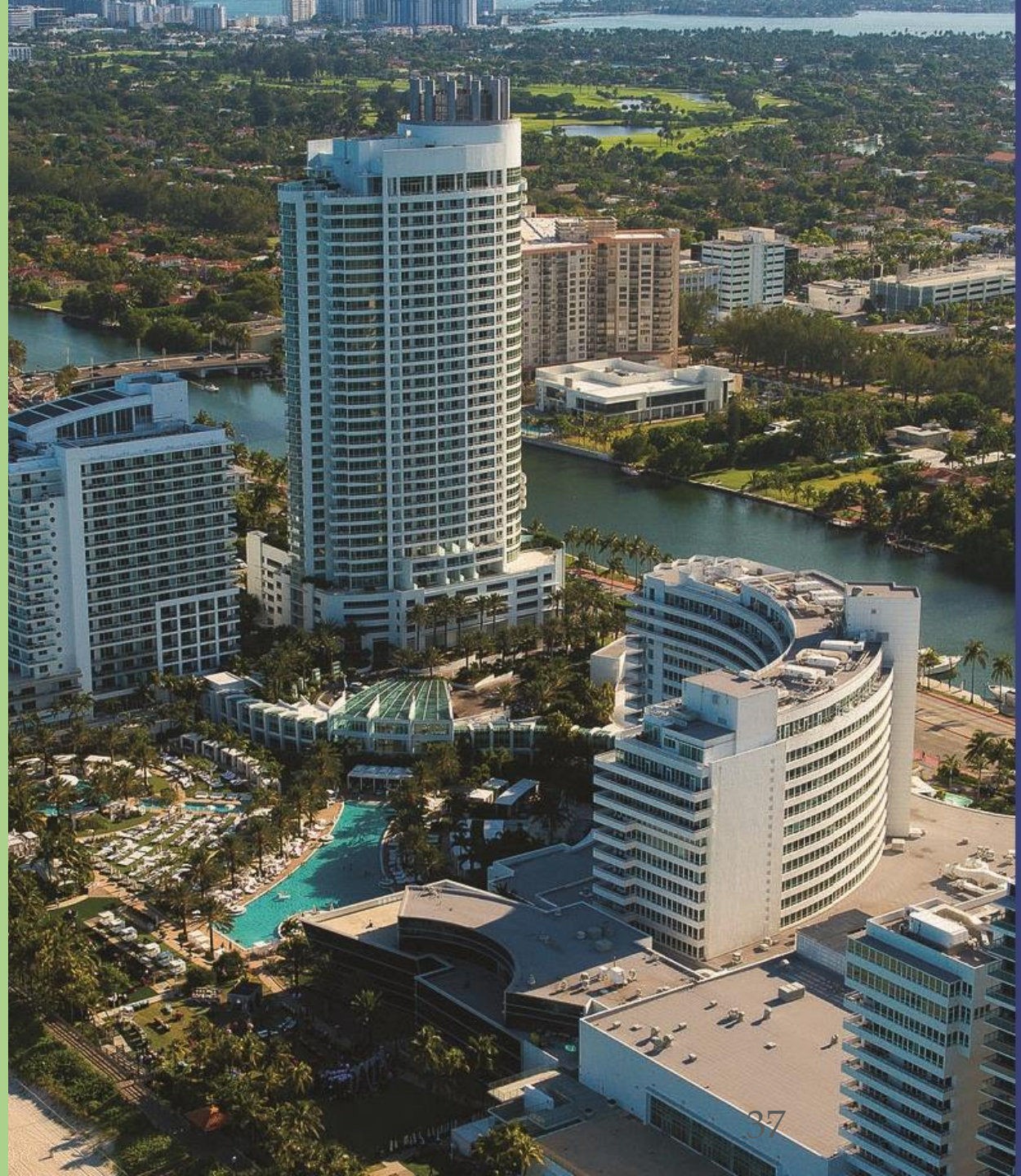
Risk Assessment and Renewal and Replacement (R&R) Projects for Sewer Aboveground Assets



CIP Projects Identified as part of Condition Assessment of Sewer System Aboveground Assets

The *Water and Sewer Renewal and Replacement Report* (Hazen, 2018) evaluated the aboveground assets (pump stations and aerial crossings) based on criticality

- Six (6) High Criticality Projects identified
- Eight (8) Medium Criticality Projects identified

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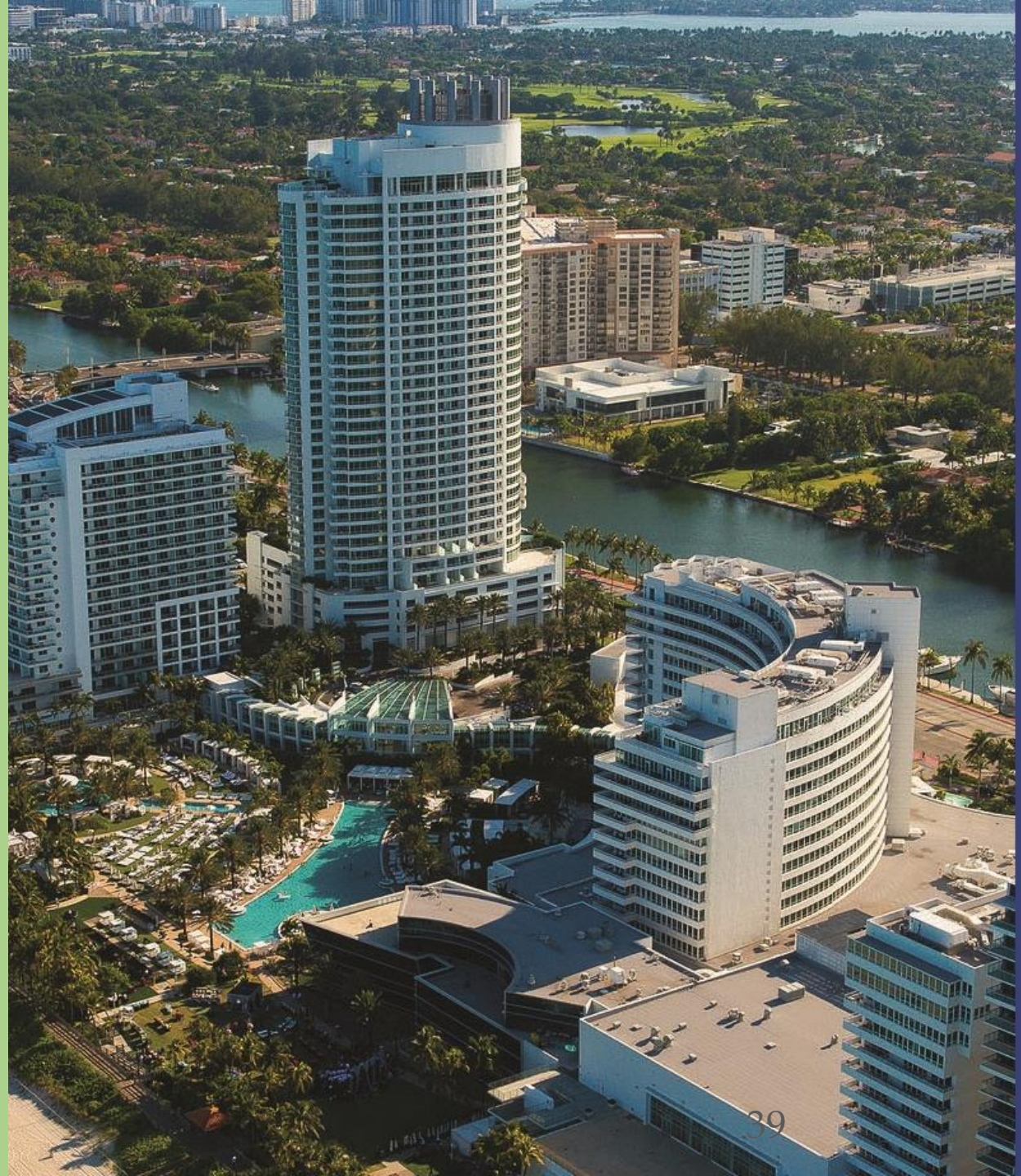
Risk Assessment and Renewal and Replacement (R&R) Projects for Sewer Underground Assets



Gravity Collection System Improvements Prioritization

a) Basins selected based on GPDIM

+

b) Basins selected based on RUL

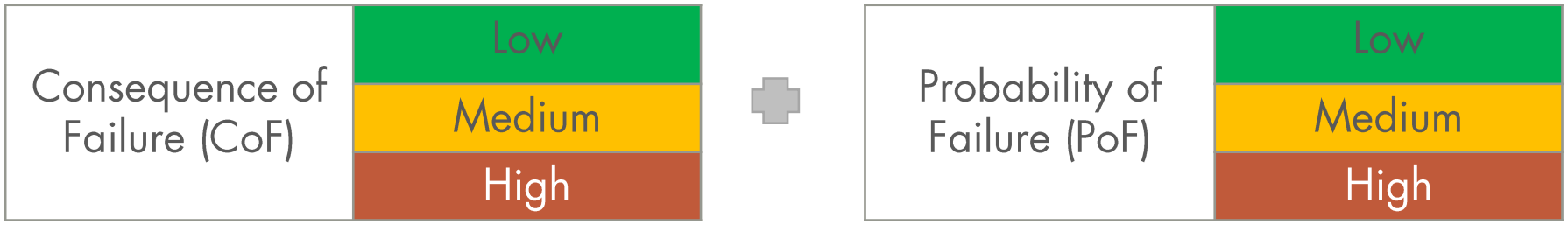
=

c) Basins selected for I/I improvements in the Master Plan

- The Collection System was evaluated using GIS and historical flow data available.
- Basins selected based on Gallons per Day per Inch-Mile (GPDIM) greater than 5,000 were combined with basins selected based on the remaining useful life (RUL) to obtain the recommended basin prioritization in the Master Plan.

Evaluation of Sewer Underground Assets - Risk Analysis Project Prioritization

- R & R Project Prioritization was developed based on a Risk Analysis that combined Consequence of Failure (CoF) and Probability of Failure (PoF) to obtained a combined scored use to rank each project.
- Three levels (Low, Medium and High) were developed for CoF and PoF



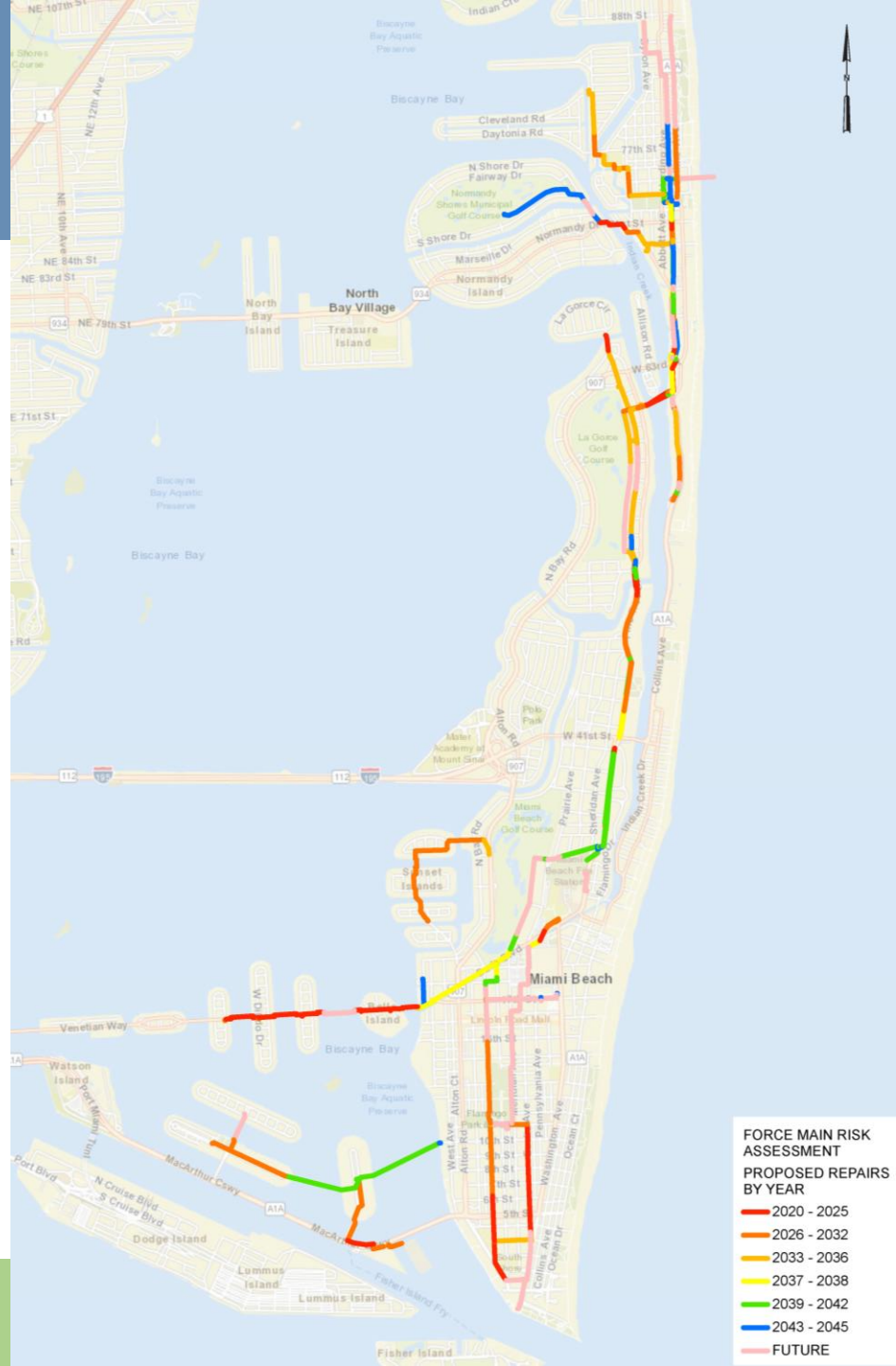
Force Mains' PoF and CoF ratings were combined in 3x3 matrix

Force Mains' Risk Matrix by Length (Feet)

Consequence of Failure (CoF)	Probability of Failure (PoF): Low	Medium	High
High	5,000 (4%)	10,000 (8%)	18,000 (14%)
Medium	12,000 (10%)	18,000 (14%)	28,000 (22%)
Low	10,000 (8%)	9,000 (7%)	16,000 (13%)

Recommended Replacement Timeframe

Consequence of Failure (CoF)	Probability of Failure (PoF): Low	Medium	High
High	Future	2037-2038	2020-2025
Medium	Future	2039-2042	2026-2032
Low	Future	2043-2044	2033-2036



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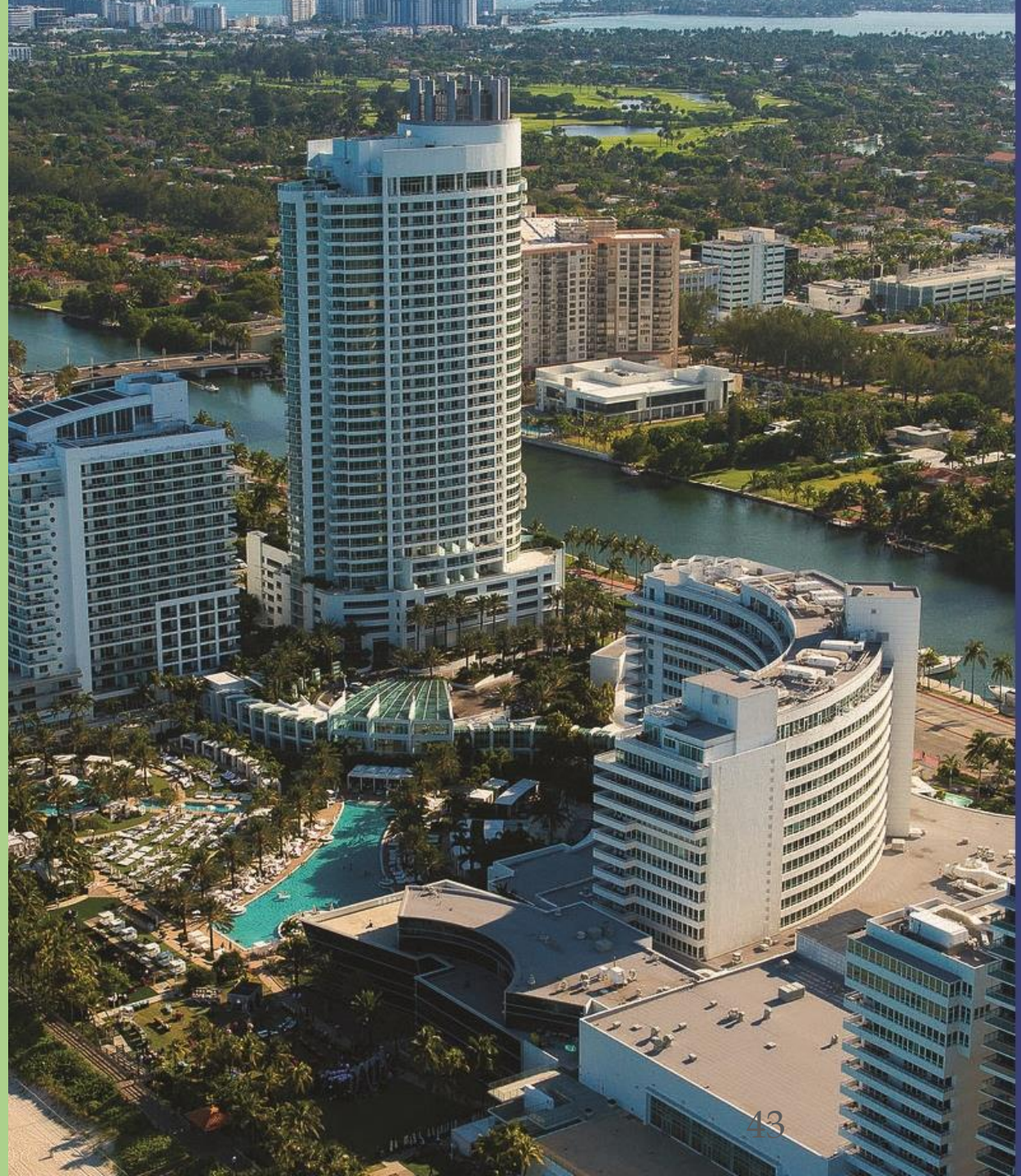
RISING
ABOVE

Sewer System Capital Improvement Program



Summary of Sewer System Recommended Improvements

64 CIP Projects Identified

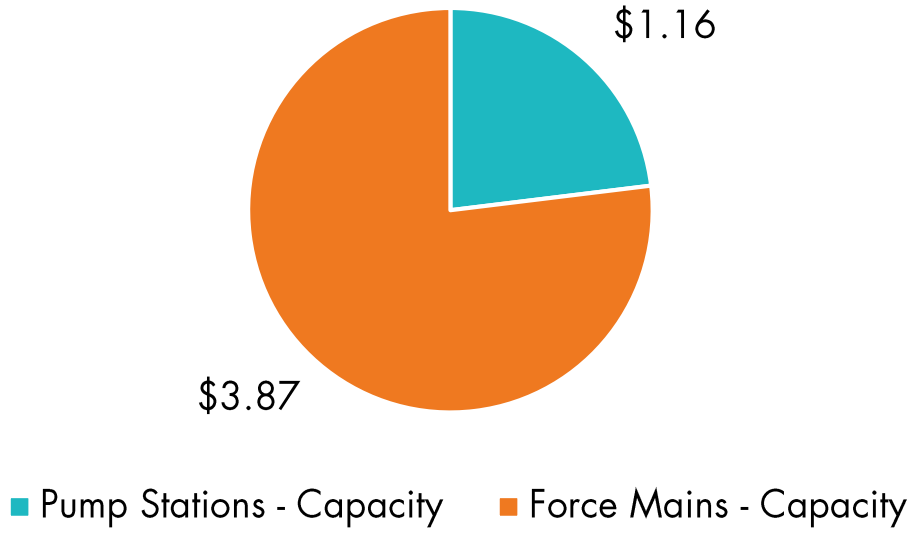
9 Capacity Based Improvements Identified

55 R&R Based Improvements Identified

Total CIP Cost Through 2045 = **$116 M**

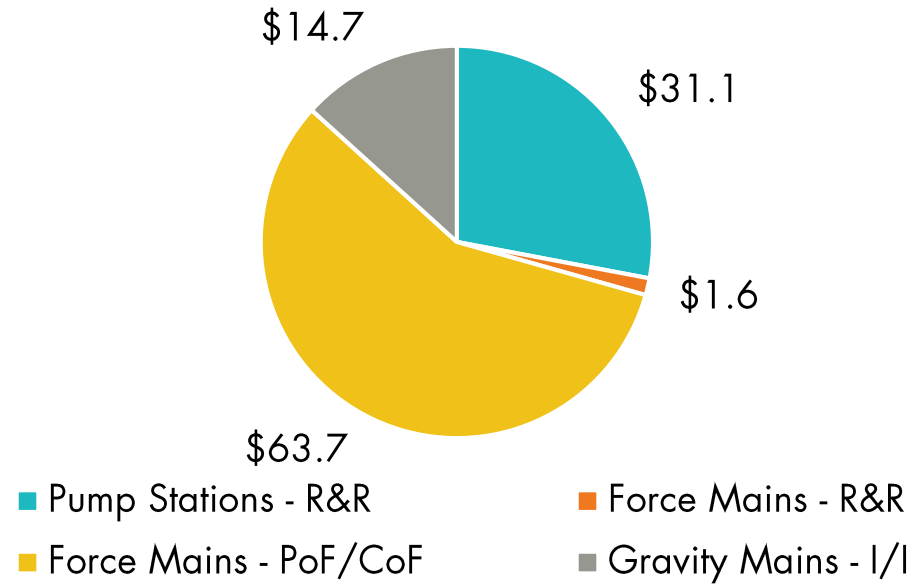
Capacity Based Improvements

(Total Costs = $5 M)



R&R Based Improvement Projects

(Total Costs = $ 111.1 M)



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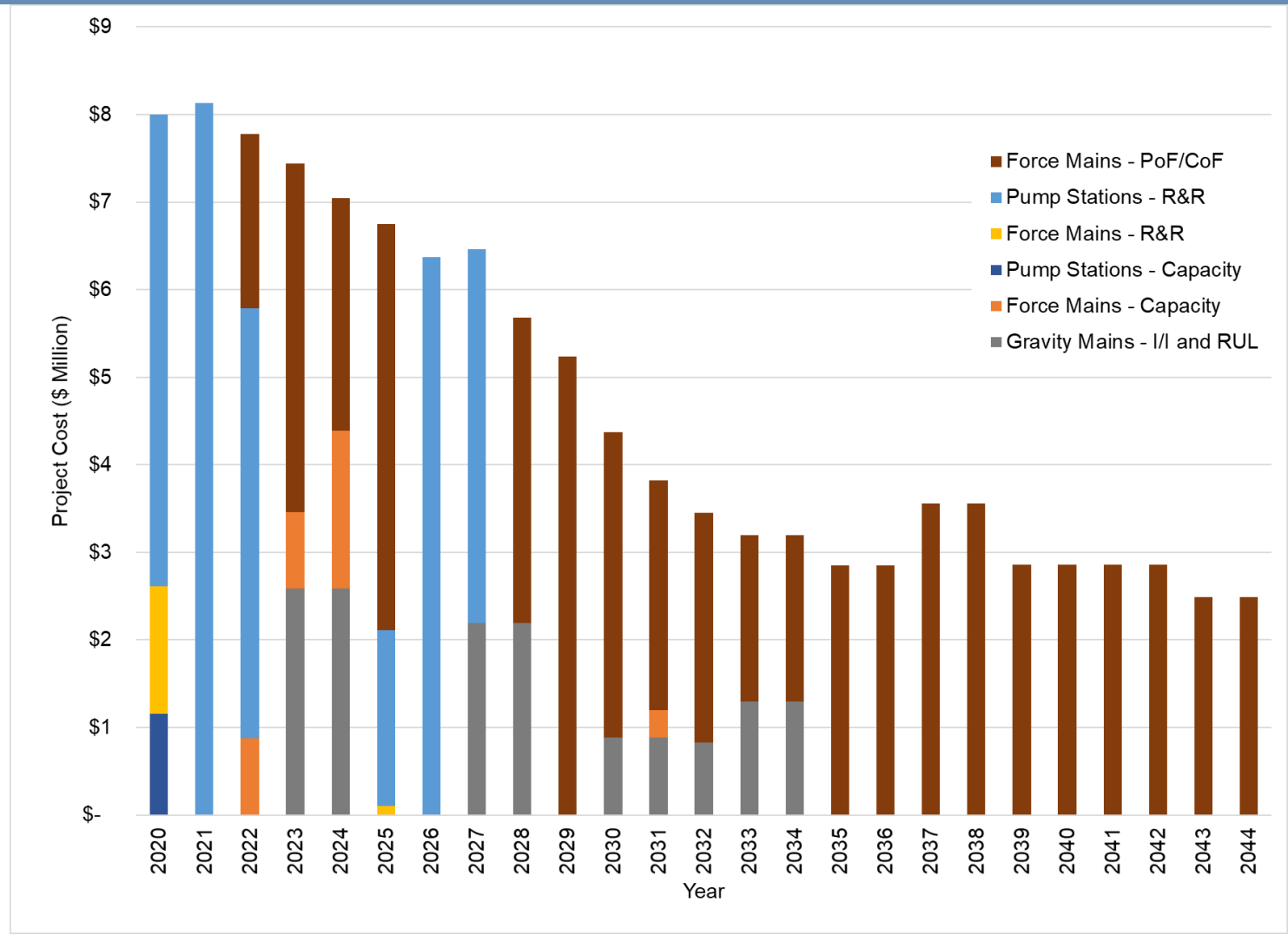
The total cost of the Sewer System recommended projects in the Master Plan is $116 million (2018 dollars):

Sewer System CIP
$116M



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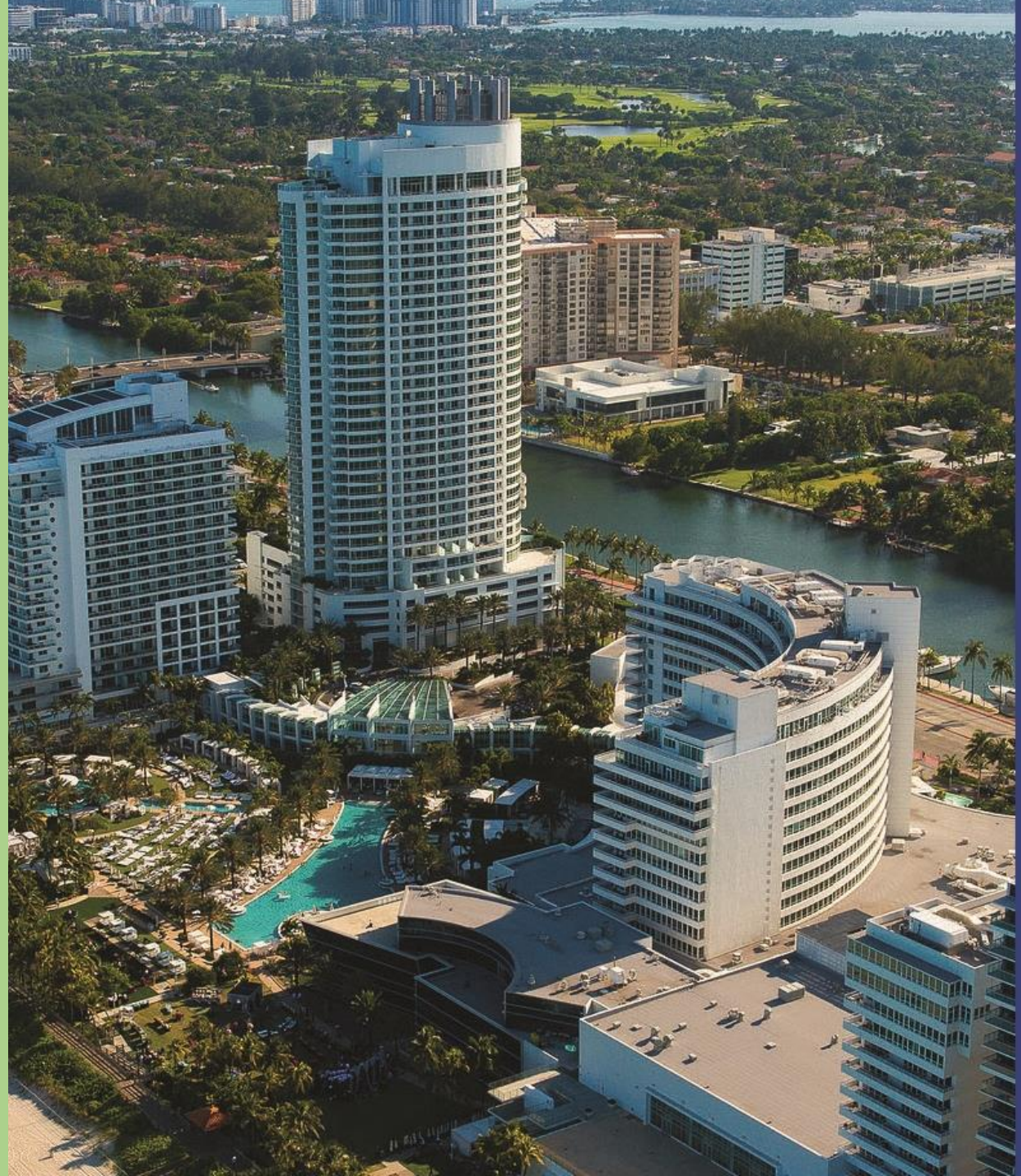
Questions/Comments



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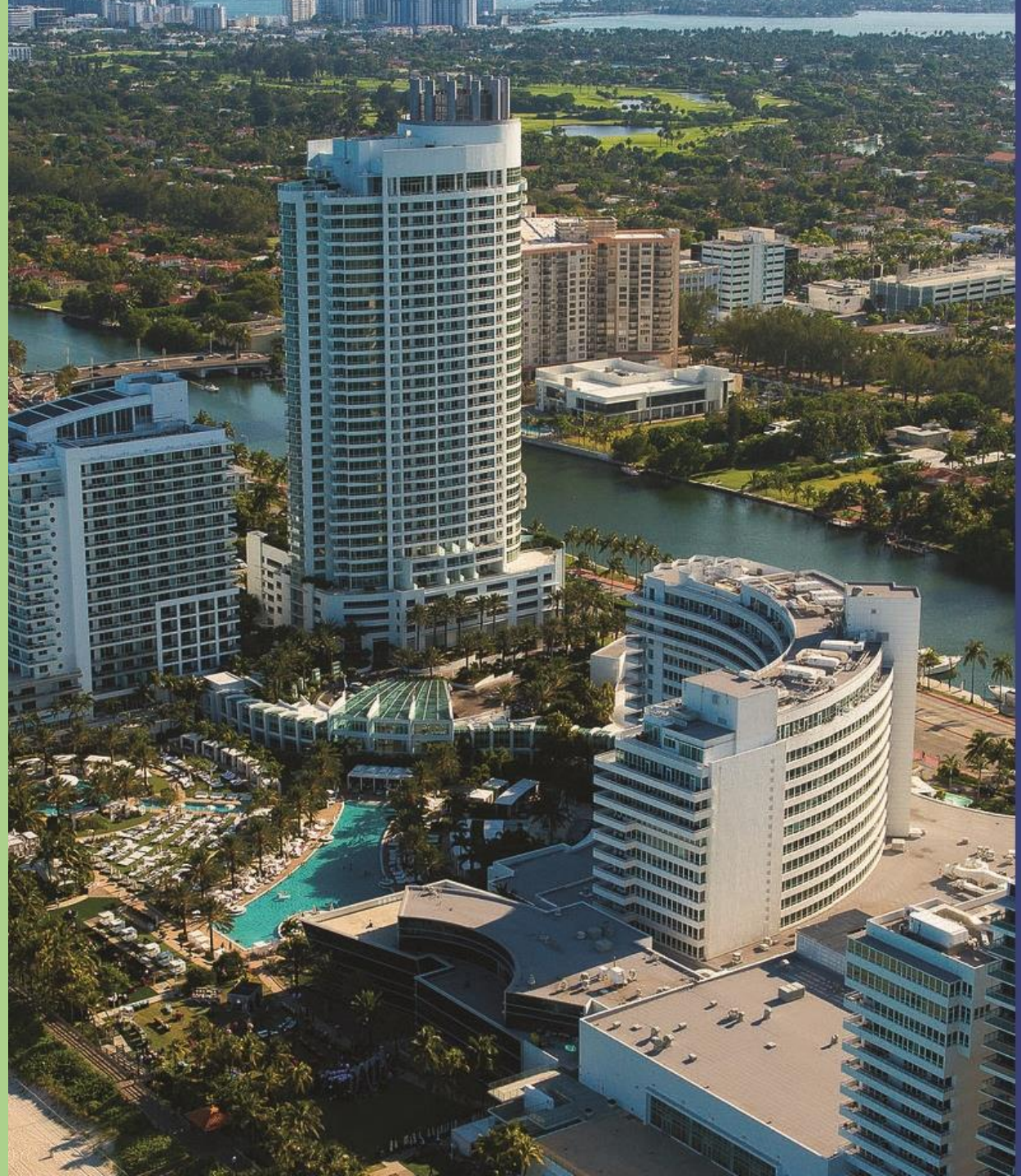
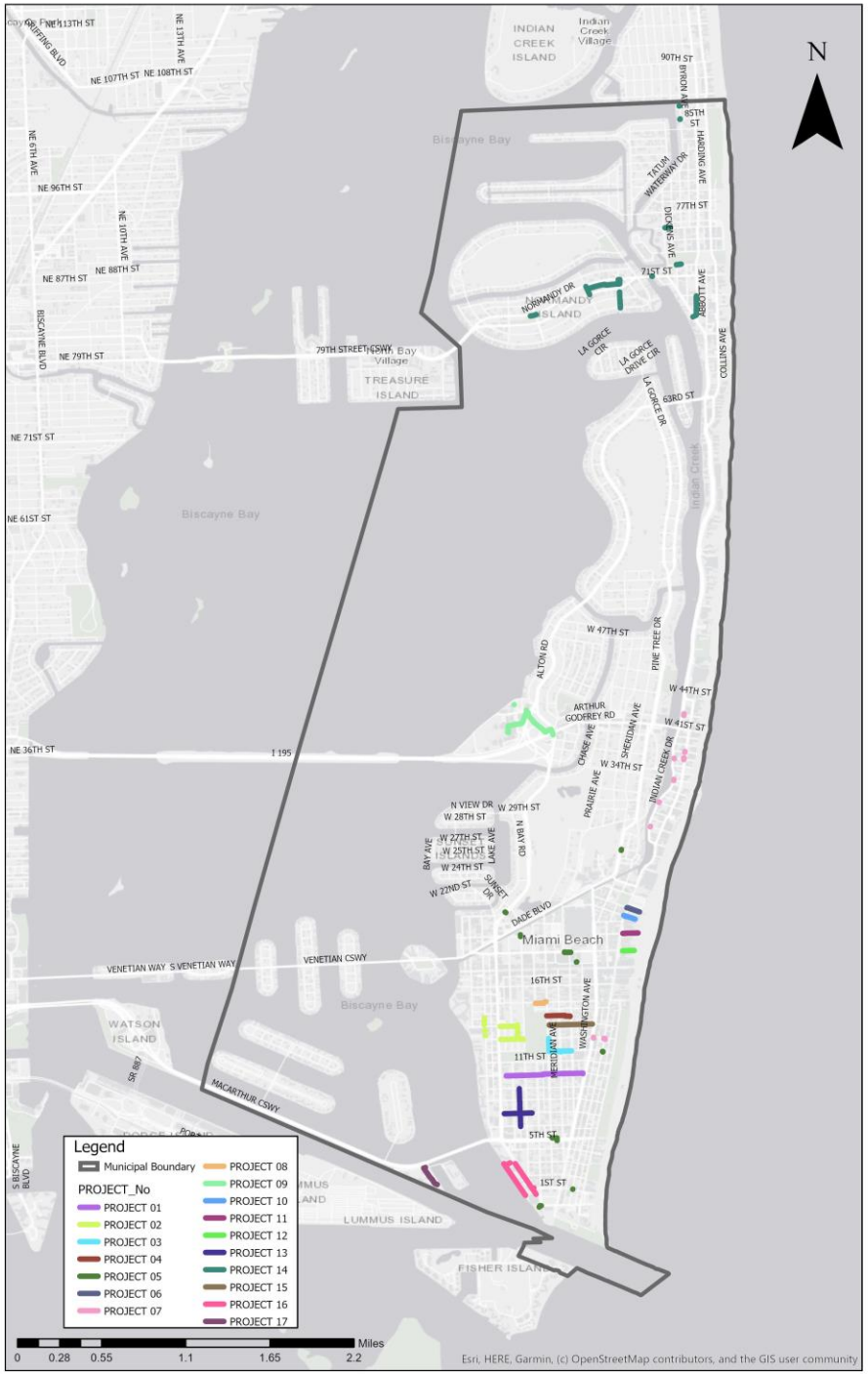


Water System Improvements



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