MIRAMAR

BEAUTY AND PROGRESS
EST 1955

City of Miramar, Florida

Wastewater Master Plan

Final Report

June 2024



Hazen





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List of Abbreviations

Abbreviation	Definition
AACE	Advancement of Cost Engineering International
AADF	annual average daily flow
AC	asbestos cement
BCWWS	Broward County Water and Wastewater Services
BEBR	Bureau of Economic and Business Research
BFP	belt filter press
BPS	Booster Pump Station
BSF	base sanitary flow
$CBOD_5$	5-day carbonaceous biochemical oxygen demand
CEI	compliance evaluation inspection
CIP	Capital Improvement Program
COF	consequence of failure
DMR	Discharge Monitoring Report
DWF	dry weather flow
EPS	extended period simulation
EUL	Estimated Useful Life
FAC	Florida Administrative Code
FDEP	Florida Department of Environmental Protection

Abbreviation	Definition
FDOT	Florida Department of Transportation
FP&L	Florida Power and Light
fps	feet per second
GBT	gravity belt thickener
GIS	Geographic Information System
gpd	gallons per day
gpdim	gallons per day/diameter-inch/mile
gpm	gallons per minute
GWI	groundwater infiltration
HMII	Historic Miramar Infrastructure Improvements
hp	horsepower
HSPS	High Service Pumping Station
I/I	inflow and infiltration
ISE	integral square error
IWPS	Injection Well Pump Station
kW	kilowatt
LEC Update	Lower East Coast Water Supply Plan Update
LMZ	Lower Monitoring Zone
MADF	monthly average daily flow
mgd	million gallons per day
MIT	mechanical integrity testing
MMADF	maximum month average daily flow
MOR	Monthly Operating Report
MPS	Master Pump Station
MTMADF	maximum three-month average daily flow
NAPOT	Nominal Daily Average Pump Operating Time
NCRS	National Resources Conservation Service

Abbreviation	Definition
O&M	Operation and Maintenance
OPPC	Opinion of Probable Project Cost
PFAM	Population Forecast Allocation Model
POF	probability of failure
PVC	polyvinyl chloride
psig	pounds per square inch gauge
R/R	renewal and replacement
RAS	return activated sludge
RDII	rain-dependent inflow and infiltration
RUL	Remaining Useful Life
SCADA	Supervisory Control and Data Acquisition
SFWMD	South Florida Water Management District
SLR	solids loading rate
SOR	surface overflow rate
SRWWTP	Southern Regional Wastewater Treatment Plant
SSO	sanitary sewer overflow
TAZ	traffic analysis zone
TKN	total Kjeldahl nitrogen
TP	total phosphorus
TP 93	Treatment Plant No. 93
TSS	total suspended solids
UIC	Underground Injection Control
UMZ	Upper Monitoring Zone
USDA	United States Department of Agriculture
WAS	waste activated sludge
WSP	Water Supply Plan
WWF	wet weather flow

Abbreviation	Definition
WWRF	Wastewater Reclamation Facility







Executive Summary

Executive Summary

ES.1 Introduction

The City of Miramar owns and operates a wastewater collection, transmission, treatment and disposal system to serve its nearly 140,000 residents. As such, the City has the responsibility for planning, regulating, designing, constructing, operating and maintaining the system. The City must comply with regulatory programs at various levels (federal, state, county, and local). Therefore, to most effectively fulfill its responsibilities, provide a high level of service to its residents, promote quality surface waters, practice water conservation, accommodate growth and economic development, and protect public health, safety and the environment, the City has defined the need for a Wastewater Master Plan (Master Plan).

The Master Plan identifies capital improvements to meet the needs of the City's service area through the planning period 2045. The capital improvements are based upon an analysis of the age and condition of the existing wastewater infrastructure and incorporate the results of an updated transmission system hydraulic model in consideration of the forecasted population growth during the planning period. Improvements are analyzed and recommended for the four primary operational components of the City's wastewater utility: the Wastewater Reclamation Facility (WWRF), lift stations, force mains, and gravity sewers.

ES.2 Wastewater Flow and Load Projections

To determine the necessary capacity of the Miramar Wastewater Reclamation Facility (WWRF) for the planning period, current wastewater flows and loads from the service area population were established. It was assumed that per capita base sanitary flows will not change over time, such that future flow increases will result from population growth and additional sewered development in the Miramar service area. Therefore, population projections and historic per capita sanitary flows were used to determine flow projections.

The City's wastewater service area includes all developed land within city limits except for the area known as Country Club Ranches, which is currently served by septic tanks and understood to remain unsewered through the end of the planning period in 2045. It is also noted that part of Broward County District 3BC service area, for which the County provides water service, resides within city limits. This area, located at the northeast corner of the City, receives sewer service from the City.

Population projections were based on those presented in the 2018 Lower East Coast Water Supply Plan Update prepared by the South Florida Water Management District. The LEC Update projections were modified to account for the City's plans to provide water service to the Country Club Ranches area in phases and those residents within District 3BC. Table ES.1 presents the resulting population projections for the wastewater service area. From 2020 to 2045, the population is expected to grow from approximately 131,000 residents to 153,000, which is an increase of 17%. In addition to projected population growth, recent land use amendments passed by the City are expected to result in 1.9 mgd of additional wastewater flow by 2045.

Table ES-1: Wastewater Service Area Population Projections

Service Area	2020	2025	2030	2035	2040	2045
Water Service Area	128,715	137,714	141,519	143,845	145,581	147,328
Deduction for Country Club Ranches[1]:	0	-1,500	-3,500	-3,500	-3,500	-3,500
District 3BC Service Area in Miramar	3,208[2]	6,182	6,934	7,375	7,711	8,096
Wastewater Service Area	**131,923**	**143,327**	**146,593**	**149,222**	**151,172**	**153,163**

Influent flowrates to the WWRF have averaged 10 mgd over the past several years. The dry weather flowrate was determined to be 9.1 mgd, consisting of a base sewer flow of 6.7 mgd and groundwater infiltration rate of 2.7 mgd or approximately 27% of average annual daily (AADF). Peak influent flowrates were determined at 24.5 mgd. By 2045, influent flows are anticipated to increase 138%, yielding AADF and peak hourly flowrates of 13.4 mgd and 29.6 mgd respectively.

The projected AADF of 13.4 mgd exceeds the current permitted treatment capacity of 12.7 mgd established by Florida Department of Environmental Protection (FDEP) and Broward County permits. Recommended improvements to increase the treatment capacity of the WWRF include the addition of a third anaerobic digester and a sixth aeration basin, as well as additional blowers and upgrades to the RAS pumps. These improvements are discussed in Section 4.5.

The projected peak hourly flow of 29.6 mgd is nearly equal to the rated capacity of the Underground Injection Well System of 29.8 mgd, which is based on the discharge capability of the effluent pump station. The wells themselves are permitted for a maximum total discharge of 37 mgd. Additional disposal capacity is provided by the reuse system, which has a pumping capacity of 7.9 mgd with one pump out of service. Therefore, an upgrade of the effluent pump station is not recommended at this time. However, the City should continue to monitor peak flowrates and consider an upgrade in the future if necessary.

In accordance with the WWRF facility permit issued by the FDEP, the primary treatment requirements concern the removal of carbonaceous biochemical oxygen demand ($CBOD_5$) and total suspended solids (TSS). From 2011 to 2021, the influent concentrations of $CBOD_5$ and TSS were 162 mg/L and 182 mg/L, respectively. While $CBOD_5$ concentrations were relatively consistent throughout the period, it was noted that TSS concentrations increased to over 200 mg/L after 2017. Effluent $CBOD_5$ and TSS concentrations throughout the period were 3.2 and 4.5 mg/L respectively, which is well below the permit limit of 20 mg/L for each parameter.

ES.3 Collection and Transmission System

In addition to the WWRF, the City owns and operates a wastewater collection and transmission system. Wastewater is conveyed by gravity from the collection system to the transmission system. The lift stations, master pump station (MPS), and in-line booster pump station (BPS) transmit wastewater through a force main network to the WWRF. A detailed evaluation of the collection and transmission system was conducted using two methods: a transmission system hydraulic model to evaluate capacity needs and a

1 Based on the anticipated number of residents receiving water service from the City of Miramar, per the 2020 WSP.
2 Portion sewered before 2021.

desktop condition assessment to evaluate renewal and replacement (R/R) needs. The main objective of this evaluation was to identify capital improvement projects to address capacity and R/R needs.

The City's existing wastewater transmission system model was converted from WaterCAD hydraulic modeling software from Bentley Systems and imported to InfoWorks ICM by Innovyze. The model was updated to include current infrastructure and calibrated to simulate actual operating conditions. Extended period simulations were performed for four flow scenarios: current dry weather flow, current peak (wet weather) flow, 2045 dry weather flow, and 2045 peak (wet weather) flow. All simulations were performed assuming that no flow was diverted to the City of Hollywood. Results of the simulations were used to determine the adequacy of the existing wastewater and collection system by evaluating the following criteria: wet well levels, force main flow velocity, force main head loss, and lift station runtime. Extended period simulations as they relate to lift station capacity identified those stations impacted by surcharge or overflows from a 2-yr storm event. The number of lift stations identified under each scenario is presented in Table ES.2:

Table ES-2: Simulated Lift Station Wet Well Conditions for Existing System

Lift Station Wet Well Condition	2022		2045	
	Dry Weather Flows	Wet Weather Flows	Dry Weather Flows	Wet Weather Flows
Surcharge	2	19	4	30
Overflow	0	10	0	10
Total	**2**	**29**	**4**	**40**

A significant number of force mains downstream of the lift station predicted to surcharge or overflow indicate that force main velocities and head losses exceeded recommended values. Improvements were identified to address both lift station and force main capacity issues. These improvements, their recommended implementation timeframes, and their anticipated costs are summarized in Table ES.3.

Table ES-3: Summary of Recommended Transmission System Capacity Improvements

Implementation Timeframe	Force Main Improvements		Lift Station Capacity Upgrades	
	No. of Projects	Total Estimated Cost	No. of Projects	Total Estimated Cost
0-5 Years	12	$36,540,000	8	$16,882,000
5-10 Years	2	$2,020,000	0	-
10-15 Years	0	-	0	-
15-20 Years	0	-	1*	$862,000
20+ Years	3	$10,360,000	6	$4,716,000
Total	**17**	**$48,920,000**	**15**	**$22,460,000**

*LS-113 is anticipated to need rehabilitation in 15-20 years based on its age. For practical reasons, it is recommended that the capacity upgrade be done at this time.

To identify areas of elevated risk and evaluate infrastructure rehabilitation and/or replacement needs, desktop condition assessments were conducted for the gravity system, force main network and lift stations. Results of the condition assessments were used to develop a capital improvement plan that addresses infrastructure approaching the end of its useful life. A review of the City's Geographic

Information System (GIS) database provided some information on asset age or date of previous rehabilitation efforts.

For the gravity sewer system, identifying pipe age and quantifying the amount of infiltration and inflow (I/I) into the collection system are typically good indicators of the condition of the underground infrastructure. Information on age of gravity sewers is limited, although 20% of the existing collection system is comprised of vitrified clay pipe. Vitrified clay pipe was typically installed in South Florida prior to the 1980's. City-wide, the collection system is not experiencing excessive I/I. However, there may be pockets of the system with excessive I/I. It is recommended that the City establish a program for gravity sewer main assessment and subsequent rehabilitation. This program should include inspection tasks such as smoke testing, field inspections, and video inspections of mains and laterals. Rehabilitation efforts are anticipated to include such activities as sewer main lining, lateral lining, point repairs, and manhole repairs. A cost of $26,475,000 over the planning period is estimated, with an annual cost of $1,059,000.

The force main condition assessment assigns risk scores to pipe sections to assist the City with a prioritized approach to address R/R of existing underground infrastructure. Each force main segment was assigned a Probability of Failure (POF) score based on physical attributes such as pipe age, pipe material, presence of corrosive soils, and peak operating pressure. A Consequence of Failure (COF) score was determined based on pipe diameter, proximity to potable water wells, proximity to land uses and businesses, and proximity to roadways. Each force main segment was categorized by risk category based on these scores. Approximately 12% of the force mains within the City of Miramar were classified as High Risk. Recommended R/R projects for force mains were developed as an overall Force Main Rehabilitation Program. This program is anticipated to include a combination of field assessments, point repairs, lining, and full replacements. Program costs were developed with the intention of establishing minimum capital improvement funds dedicated to force main rehabilitation. A summary of these program projects is provided in Table ES.4.

Table ES-4: Summary of Program Projects Recommended for Force Main R/R

Project ID Number	Project Name	Planning Period (Years)	Total Estimated Cost
RR-FM-01	Force Main Renewal and Rehabilitation Phase 1	0 to 5	$12,088,000
RR-FM-02	Force Main Renewal and Rehabilitation Phase 2	5 to 10	$19,462,000
RR-FM-03	Force Main Renewal and Rehabilitation Phase 3	10 to 15	$18,888,000
RR-FM-04	Force Main Renewal and Rehabilitation Phase 4	15 to 20	$18,111,000
RR-FM-05	Force Main Renewal and Rehabilitation Phase 5	20+	$17,110,000

Lift stations were evaluated for renewal and replacements projects based primarily upon age or time since previous rehabilitation. The condition assessment included a review of lift station assets compared to industry standards for typical estimated useful service. Based upon experience for utilities in South Florida, a composite average useful life of 20 years was assumed to assess overall timeframe when major R/R of lift stations would be needed. Results indicated that 58% of the lift station are greater than 20 years old and 75% are greater than 15 years old.

A capital improvement program was then developed based on lift station age and size. Lift stations were categorized by size in accordance with the rated horsepower of the pumps. The MPS and BPS were

considered a separate category. The total estimated R/R costs by five-year planning periods are presented in Table ES.5.

Table ES-5: Total R/R Costs by Planning Period

Project ID Number	Project Name	Planning Period (Years)	Total Estimated Cost
RR-LS-01	Lift Station Rehabilitation Phase 1	0 to 5	$58,508,000
RR-LS-02	Lift Station Rehabilitation Phase 2	5 to 10	$23,031,000
RR-LS-03	Lift Station Rehabilitation Phase 3	10 to 15	$8,620,000
RR-LS-04	Lift Station Rehabilitation Phase 4	15 to 20	$3,246,000
RR-LS-05	Lift Station Rehabilitation Phase 5	20+	$11,260,000

ES.4 Wastewater Reclamation Facility

The City of Miramar WWRF is a secondary activated sludge treatment facility that receives domestic wastewater generated within the City's service area. Placed into operation in 1997, the WWRF is currently permitted for a rated capacity of 12.7 million gallons per day (mgd) on an Annual Average Daily Flow (AADF) basis and 14.4 mgd on a Three Month Average Daily Flow (TMADF) basis. Major process components are detailed in Table ES.6. The WWRF was evaluated for both capacity and condition to identify capital improvement projects within the planning period.

Table ES-6: Major Process Components

Process Area	Components
Pretreatment	• Two (2) Mechanical self-cleaning screens • Two (2) Forced vortex type grit chambers
Secondary Treatment	• Five (5) aeration basins • Four (4) circular secondary clarifiers • RAS/WAS pumping station with six (6) RAS pumps and two (2) WAS pumps
Solids Treatment	• Two (2) gravity belt thickeners • Two (2) anaerobic digesters • Two (2) belt filter presses
Effluent Disposal	• Effluent pump station with four (4) pumps • Two (2) deep injection wells
Reuse Facilities	• Two (2) filter feed pumps • Six (6) reuse filters • Three (3) chlorine contact basins • Three (3) reuse storage tanks • Four (4) high service pumps

The capacity evaluation for the WWRF was conducted on both a flow and load basis. To determine if the WWRF could accommodate the predicted 2045 flows, a hydraulic model of the facility was developed. On a load basis, a biological process model was developed. Extensive field data were collected and used

to calibrate the models. Hydraulic and process capacity was determined for each unit process and compared to industry design standards as well as typical South Florida municipal treatment operations.

On a capacity basis, it is recommended that the City initiate design and construction of an additional digester within the next five years. The cost of an additional digester and ancillary equipment is estimated at $19 million. In addition, to accommodate proposed development, a sixth aeration basin is needed within five to ten years. The aeration basin will need to be accompanied by additional blowers and upgrades to the RAS pumps, at an estimated total cost of $17 million. All other treatment components have sufficient capacity for projected flows through the year 2045.

A renewal and replacement evaluation of major process areas of the WWRF was conducted to identify capital improvement projects considered necessary to maintain operation of the facilities through the planning year 2045. Review of each process area commenced with staff interviews followed by visual inspections of assets to identify areas of deficiency and/or infrastructure approaching the end of its useful life. Probability of Failure (POF) scores based on physical attributes of an asset's mechanical, structural, and electrical components were assigned. Consequence of Failure (COF) scores considered how the potential failure of an asset would impact regulatory compliance, criticality, safety, and impacts to overall operation and maintenance. Risk scores were assigned based on POF scores, COF scores, and estimated useful remaining service life. Assets were then prioritized by timeframe for renewal and replacement. The total estimated R/R costs by five-year planning period are summarized in Table ES.7. These costs do not include the capacity improvements noted above.

Table ES-7: WWRF Renewal and Replacement Costs by Planning Period

Project ID Number	Project Name	Planning Period (Years)	Total Estimated Cost
RR-WWRF-01 to RR-WWRF-14	WWRF Rehabilitation Phase 1	0 to 5	$34,496,000
RR-WWRF-15 to RR-WWRF-26	WWRF Rehabilitation Phase 2	5 to 10	$14,713,000
RR-WWRF-27 to RR-WWRF-32	WWRF Rehabilitation Phase 3	10 to 15	$1,186,000
RR-WWRF-33 to RR-WWRF-40	WWRF Rehabilitation Phase 4	15 to 20	$12,506,000
RR-WWRF-41	WWRF Rehabilitation Phase 5	20+	$828,000

ES.5 Regulatory Considerations

Although the requirements for the collection, transmission, treatment and disposal of domestic wastewater and biosolids at the WWRF have not drastically changed over the last two facility permit cycles, ongoing regulatory actions and discussions have prompted uncertainty with respect to some future utility practices. Recent rule revisions as they pertain to wastewater systems, rules currently in development, and likely and/or possible regulatory changes and their potential impacts were explored. Selected regulations anticipated to impact the Miramar wastewater system include the following:

FAC 62-600 Domestic Wastewater Facilities: revisions are likely to have a modest impact to the City by requiring the development of a Power Outage Contingency Plan and the Collection System Action Plan for the next WWRF facility permit renewal in 2028. Although details for the anticipated complexity of these plans are not known at this time, budget estimates for these items have been included in the Capital Improvements Plan.

FAC 62-604 Collection Systems and Transmission Facilities: the revisions are likely to have a minor impact to the wastewater utility in the form of revising notification procedures during wastewater spills to include use of the Department's Business Portal and more frequent updating of the Collection and Transmission System Operations and Maintenance Manual. Budget estimates for these items are included in the Capital Improvement Program.

FAC 62-640 Biosolids: amendments include two key provisions related to biosolids land application. As the WWRF produces a Class B biosolids and uses a contract hauler for its management, these revisions may indirectly impact the cost of biosolids operations at the WWRF. As bids were recently received (August 2, 2022) for WWRF biosolids hauling services, such costs should already be reflected in the newly contracted services.

FS 403.928 (Chapter 2021-194) (House Bill 53 Needs Analysis): this bill has been approved by the Governor and requires each municipality to perform and submit a 20-yr needs analysis to the county. Each county will compile all analyses and file the compiled document with the Office of Economic & Demographic Research no later than July 31, 2022, and every five years thereafter. Because the state did not provide timely guidance for the initial submittal, subsequent submittals are anticipated to be more closely scrutinized beginning in 2027. A budget estimate for the updates required has been included in the Capital Improvement Program.

ES.6 Wastewater System Capital Improvement Program

The Capital Improvement Program (CIP) summarizes probable project costs for recommended wastewater improvements identified for the Wastewater Master Plan. These improvements are required to address future growth, renewal and replacement needs, and regulatory requirements. The CIP includes wastewater capital improvements through the planning year 2045 and provides a suggested implementation schedule based on the capacity, compliance, or condition concerns underlying each recommendation. Table ES-8 summarizes recommended improvements by asset type. Based on system conditions and needs, capital improvement needs are approximately $37 million per year for the first five years. Table ES-9 presents all capital improvement projects organized by asset type.

Table ES-8: Summarized CIP Project Costs

Wastewater System Component	Years 0-5	Years 5-10	Years 10-15	Years 15-20	Years 20+	Total Estimated Cost
Force Mains	$48,628,000	$21,482,000	$18,888,000	$18,111,000	$27,470,000	$134,579,000
Gravity System	$5,311,000	$5,311,000	$5,311,000	$5,311,000	$5,311,000	$26,555,000
Lift Stations	$76,820,000	$23,471,000	$9,060,000	$4,548,000	$17,296,000	$131,195,000
WWRF	$53,323,000	$31,441,000	$1,226,000	$12,546,000	$868,000	$99,404,000
Total Estimated Cost	**$184,082,000**	**$81,705,000**	**$34,485,000**	**$40,516,000**	**$50,945,000**	**$391,733,000**

Table ES-9: Capital Improvement Program

Planning Period	Project ID Number	Project Name	OPPC
Force Mains			
0 to 5	RR-FM-01	Force Main Renewal and Rehabilitation Phase 1	$12,088,000
0 to 5	CAP-FM-01A	Upgrade 18” MPS Discharge Force Main to 24”	$8,180,000
0 to 5	CAP-FM-01B	Force Main for Second Master Pump Station	$8,760,000
0 to 5	CAP-FM-02A	Redirections to 30” Force Main on Red Road	$90,000
0 to 5	CAP-FM-02B	Redirections to 30” Force Main on Red Road	$220,000
0 to 5	CAP-FM-03	Redirect LS-024 and LS-027 Discharge to Miramar Boulevard	$130,000
0 to 5	CAP-FM-04	Upgrade Force Main Along Miramar Parkway from Flamingo Road to SW 136th Avenue	$4,480,000
0 to 5	CAP-FM-05	Upgrade Force Main Along Miramar Parkway from SW 184th Avenue to SW 160th Avenue	$7,520,000
0 to 5	CAP-FM-06	Upgrade Force Main from LS-060 Tie-in to Miramar Parkway	$1,080,000
0 to 5	CAP-FM-07	Proposed 12” Force Main Along Bass Creek Road from Sunrise Avenue to 172nd Avenue	$2,500,000
0 to 5	CAP-FM-08	Upgrade Force Main Along Sunrise Avenue from LS-083 Tie-in to SW 40th Street	$1,800,000
0 to 5	CAP-FM-09	Upgrade Force Main Along SW 40th Street from LS-080 Tie-in to Sunrise Avenue	$1,710,000
0 to 5	CAP-FM-10	Redirect LS-047 Discharge to 30-Inch Force Main	$70,000
		Force Main (0 to 5) Subtotal	**$48,628,000**
5 to 10	RR-FM-02	Force Main Renewal and Rehabilitation Phase 2	$19,462,000
5 to 10	CAP-FM-11	Upgrade Force Main on 172nd Avenue and New 6” Force Main on 37th Court	$1,360,000
5 to 10	CAP-FM-12	Proposed 8” Force Main from LS-076 to 172nd Avenue	$660,000
		Force Main (5 to 10) Subtotal	**$21,482,000**
10 to 15	RR-FM-03	Force Main Renewal and Rehabilitation Phase 3	$18,888,000
		Force Main (10 to 15) Subtotal	**$18,888,000**
15 to 20	RR-FM-04	Force Main Renewal and Rehabilitation Phase 4	$18,111,000
		Force Main (15 to 20) Subtotal	**$18,111,000**
20+	RR-FM-05	Force Main Renewal and Rehabilitation Phase 5	$17,110,000
20+	CAP-FM-13	Upgrade Force Main Along SW 160th Avenue and SW 25th Street	$8,530,000
20+	CAP-FM-14	Upgrade Force Main Along SW 25th Street from SW 130th Avenue to SW 136th Avenue	$1,450,000

Planning Period	Project ID Number	Project Name	OPPC
20+	CAP-FM-15	Upgrade Force Main from LS-049 to SW 148th Avenue	$380,000
		Force Main (20+) Subtotal	**$27,470,000**
		Force Main Total	**$134,579,000**
		Gravity System	
0 to 5	RR-GS-01	Gravity System Rehabilitation Phase 1	$5,311,000
		Gravity System (0 to 5) Subtotal	**$5,311,000**
5 to 10	RR-GS-02	Gravity System Rehabilitation Phase 2	$5,311,000
		Gravity System (5 to 10) Subtotal	**$5,311,000**
10 to 15	RR-GS-03	Gravity System Rehabilitation Phase 3	$5,311,000
		Gravity System (10 to 15) Subtotal	**$5,311,000**
15 to 20	RR-GS-04	Gravity System Rehabilitation Phase 4	$5,311,000
		Gravity System (15 to 20) Subtotal	**$5,311,000**
20+	RR-GS-05	Gravity System Rehabilitation Phase 5	$5,311,000
		Gravity System (20+) Subtotal	**$5,311,000**
		Gravity System Total	**$26,555,000**
		Lift Stations	
0 to 5	RR-LS-01	Lift Station Rehabilitation Phase 1	$58,508,000
0 to 5	RR-PG-01	Portable Generator Rehabilitation Phase 1	$440,000
0 to 5	CAP-LS-01	Second MPS	$10,800,000
0 to 5	CAP-LS-02	LS-056 Capacity Upgrade	$660,000
0 to 5	CAP-LS-03	LS-011 Capacity Upgrade	$912,000
0 to 5	CAP-LS-04	LS-020 Capacity Upgrade	$912,000
0 to 5	CAP-LS-05	LS-044 Capacity Upgrade	$912,000
0 to 5	CAP-LS-06	LS-061 Capacity Upgrade	$912,000
0 to 5	CAP-LS-07	LS-065 Capacity Upgrade	$862,000
0 to 5	CAP-LS-08	LS-076 Capacity Upgrade	$912,000
0 to 5	FI-PG-01	Purchase of Additional Portable Generators	$990,000
		Lift Stations (0 to 5) Subtotal	**$76,820,000**

Planning Period	Project ID Number	Project Name	OPPC
5 to 10	RR-LS-02	Lift Station Rehabilitation Phase 2	$23,031,000
5 to 10	RR-PG-02	Portable Generator Rehabilitation Phase 2	$440,000
		Lift Stations (5 to 10) Subtotal	**$23,471,000**
10 to 15	RR-LS-03	Lift Station Rehabilitation Phase 3	$8,620,000
10 to 15	RR-PG-03	Portable Generator Rehabilitation Phase 3	$440,000
		Lift Stations (10 to 15) Subtotal	**$9,060,000**
15 to 20	RR-LS-04	Lift Station Rehabilitation Phase 4	$3,246,000
15 to 20	RR-PG-04	Portable Generator Rehabilitation Phase 4	$440,000
15 to 20	CAP-LS-09	LS-113 Capacity Upgrade	$862,000
		Lift Stations (15 to 20) Subtotal	**$4,548,000**
20+	RR-LS-05	Lift Station Rehabilitation Phase 5	$11,260,000
20+	RR-PG-05	Portable Generator Rehabilitation Phase 5	$1,320,000
20+	CAP-LS-10	LS-038 Capacity Upgrade	$660,000
20+	CAP-LS-11	LS-049 Capacity Upgrade	$912,000
20+	CAP-LS-12	LS-052 Capacity Upgrade	$912,000
20+	CAP-LS-13	LS-053 Capacity Upgrade	$660,000
20+	CAP-LS-14	LS-057 Capacity Upgrade	$660,000
20+	CAP-LS-15	LS-090 Capacity Upgrade	$912,000
		Lift Stations (20+) Subtotal	**$17,296,000**
		Lift Stations Total	**$131,195,000**
		WWRF	
0 to 5	RR-WWRF-01	Digester Building Phase 1	$7,815,000
0 to 5	RR-WWRF-02	Hypochlorite Building Phase 1	$698,000
0 to 5	RR-WWRF-03	Generator Building Phase 1	$1,836,000
0 to 5	RR-WWRF-04	Aeration Basins Phase 1	$1,448,000
0 to 5	RR-WWRF-05	Blower Building Phase 1	$2,743,000
0 to 5	RR-WWRF-06	IWPS Phase 1	$2,158,000
0 to 5	RR-WWRF-07	Monitoring Well Phase 1	$1,550,000

Planning Period	Project ID Number	Project Name	OPPC
0 to 5	RR-WWRF-08	Reuse Modules Phase 1	$551,000
0 to 5	RR-WWRF-09	Reuse High Service Station Phase 1	$798,000
0 to 5	RR-WWRF-10	RAS/WAS Phase 1	$960,000
0 to 5	RR-WWRF-11	Clarifiers Phase 1	$9,681,000
0 to 5	RR-WWRF-12	Solids Building Phase 1	$2,810,000
0 to 5	RR-WWRF-13	Solids Odor Control Phase 1	$915,000
0 to 5	RR-WWRF-14	Pre-Treatment Odor Control Phase 1	$533,000
0 to 5	CAP-WWRF-01	Anaerobic Digester No. 3	$18,677,000
0 to 5	REG-WWRF-01	WWRF Regulatory Improvement Phase 1	$150,000
		WWRF (0 to 5) Subtotal	**$53,323,000**
5 to 10	RR-WWRF-15	Aeration Basins Phase 2	$399,000
5 to 10	RR-WWRF-16	Blower Building Phase 2	$3,993,000
5 to 10	RR-WWRF-17	Generator Building Phase 2	$3,753,000
5 to 10	RR-WWRF-18	Hypochlorite Building Phase 2	$106,000
5 to 10	RR-WWRF-19	IWPS Phase 2	$1,395,000
5 to 10	RR-WWRF-20	Pre-Treatment Phase 1	$307,000
5 to 10	RR-WWRF-21	Reuse Modules Phase 2	$574,000
5 to 10	RR-WWRF-22	Reuse High Service Station Phase 2	$419,000
5 to 10	RR-WWRF-23	Clarifiers Phase 2	$3,227,000
5 to 10	RR-WWRF-24	Solids Building Phase 2	$78,000
5 to 10	RR-WWRF-25	Digester Building Phase 2	$54,000
5 to 10	RR-WWRF-26	Solids Odor Control Phase 2	$408,000
0 to 5	CAP-WWRF-02	Aeration Basin No. 6	$16,688,000
5 to 10	REG-WWRF-02	WWRF Regulatory Improvement Phase 2	$40,000
		WWRF (5 to 10) Subtotal	**$31,441,000**
10 to 15	RR-WWRF-27	Aeration Basins Phase 3	$133,000
10 to 15	RR-WWRF-28	Hypochlorite Building Phase 3	$387,000
10 to 15	RR-WWRF-29	Pre-Treatment Phase 2	$307,000

Planning Period	Project ID Number	Project Name	OPPC
10 to 15	RR-WWRF-30	Pre-Treatment Odor Control Phase 2	$72,000
10 to 15	RR-WWRF-31	RAS/WAS Phase 2	$234,000
10 to 15	RR-WWRF-32	Digester Building Phase 3	$53,000
10 to 15	REG-WWRF-03	WWRF Regulatory Improvement Phase 3	$40,000
		WWRF (10 to 15) Subtotal	**$1,226,000**
15 to 20	RR-WWRF-33	Generator Building Phase 3	$1,863,000
15 to 20	RR-WWRF-34	IWPS Phase 3	$666,000
15 to 20	RR-WWRF-35	Pre-Treatment Phase 3	$1,228,000
15 to 20	RR-WWRF-36	Pre-Treatment Odor Control Phase 3	$52,000
15 to 20	RR-WWRF-37	Reuse Filters Phase 3	$1,406,000
15 to 20	RR-WWRF-38	Reuse High Service Station Phase 3	$399,000
15 to 20	RR-WWRF-39	Solids Building Phase 3	$3,272,000
15 to 20	RR-WWRF-40	Digester Building Phase 4	$3,620,000
15 to 20	REG-WWRF-04	WWRF Regulatory Improvement Phase 4	$40,000
		WWRF (15 to 20) Subtotal	**$12,546,000**
20+	RR-WWRF-41	Pre-Treatment Phase 4	$828,000
20+	REG-WWRF-05	WWRF Regulatory Improvement Phase 5	$40,000
		WWRF (20+) Subtotal	**$868,000**
		WWRF Total	**$99,404,000**
		CIP Total	**$391,733,000**







1 Introduction

1. Introduction

The City of Miramar has the responsibility for planning, regulating, designing, constructing, operating and maintaining a wastewater collection system within the City's corporate limits. Additionally, the City must comply with regulatory programs at various levels (federal, state, county, and local) relative to the treatment and disposal of wastewater. Therefore, to most effectively fulfill its responsibilities, provide a high level of service to its residents, promote quality surface waters, practice water conservation, accommodate growth and economic development, and protect public health, safety and the environment, the City has defined the need for a Wastewater Master Plan. The Wastewater Master Plan identifies capital improvements that meet the needs of the City's service area through the planning period 2045.

1.1 Background

The original wastewater collection system and wastewater treatment plant for the City of Miramar was constructed in 1955. At the time, Treatment Plant No. 93 (TP 93) consisted of an Imhoff tank and trickling filter. In 1960, the plant was converted to a high-rate trickling filter plant and an additional plant was also constructed. By 1963, a third high-rate trickling filter plant was installed to provide a total plant capacity of 3 million gallons per day (mgd). In the early 1970s, nutrient and dissolved oxygen concentrations indicated that the coastal freshwater canals were failing to meet Broward County water quality standards and a county-wide planning effort commenced. The 1978 Broward County 201 Facilities Plan proposed a regional system wherein large portions of the county would be served by three major secondary sewage treatment plants – the north district by Broward County Utilities District No. 2 (TP 10), the central-Fort Lauderdale area by a new pure oxygen activated sludge plant near Port Everglades (TP 53), and the southern Broward County area by a new 36 mgd pure oxygen activated sludge plant in Hollywood. Funding was received for construction of a 20-in force main from TP 93 to Hollywood for the treatment and disposal of raw wastewater and the Miramar plant was taken out of service.

By the early 1990s, Miramar was quickly approaching its reserve capacity of 5.5 mgd at the Hollywood Southern Regional Wastewater Treatment Plant (SRWWTP) and vacant land in the western area of the City prompted considerable interest on the part of developers. Such development would require water and sewer services beyond capacities that existed at the time. Therefore, in 1993, the City evaluated alternatives for short- and long-term wastewater treatment and disposal. Based on the results of that analysis, the City entered into short-term agreements with both the City of Pembroke Pines and the City of Hollywood (second amendment to the Large User Agreement) to provide wastewater treatment to newly developed areas of the City until the new Miramar Wastewater Reclamation Facility (WWRF) was constructed and placed into operation in 1997. Subsequent modifications and expansions have resulted in the City being increasingly self-reliant for wastewater collection, transmission, treatment and disposal services through the WWRF. As of January 2011, the City re-routed all wastewater flows to the WWRF and officially reduced its reserve capacity with the SRWWTP to 1.665 mgd. This reserve capacity is maintained for emergency use such as extreme wet weather events when the transmission system is stressed. Through valving at the Miramar Master Pump Station, wastewater can be diverted at a rate of approximately 11 mgd to the SRWWTP. Over the last five years, diversions to the SRWWTP have averaged about 0.12 mgd.

1.2 Key Assumptions

Several assumptions concerning regulatory policy, city policy and biological and hydraulic loading were necessary to estimate the timing and sizing of future improvements. These key assumptions are presented below.

- The area known as Country Club Ranches, which is currently unsewered, will remain unsewered throughout the planning period of 2045.
- The use of deep injection wells will continue to be a viable means of effluent disposal. Further, water quality regulations for effluent disposal at the two existing injection wells will continue as currently permitted (20 mg/L BOD_5, 20 mg/L TSS).
- No effluent limitations beyond high-level disinfection will be required for reclaimed water for public access areas (offsite reuse).
- Dual-distribution of effluent reuse will not be promulgated by local, state, or federal agencies.
- The westward boundary of the wastewater service area will not extend beyond 196th Avenue.
- Costs associated with Capital Improvement Program (CIP) Projects are in 2023 dollar values. No escalation or inflation is included in projections beyond 2023.







2 Wastewater Flow and Load Projections

2. Wastewater Flow and Load Projections

2.1 Introduction

To determine the necessary treatment capacity of the Miramar WWRF for the planning period, anticipated wastewater flows and loads from the service area were established. It was assumed that per capita base sanitary flows would not change, such that future flow increases depend on population growth and additional development in the Miramar service area. Therefore, population projections and historical per capita sanitary flows were used to determine flow projections for the WWRF.

The objectives of this section are as follows:

- Define the Miramar wastewater service area
- Determine the current and future served population
- Review the impact of recent land use amendments on anticipated wastewater flows
- Present historical wastewater flow and loads
- Analyze historical flows to determine per capita sanitary flows, inflow and infiltration (I/I), and peaking factors
- Use population projections and historical flow data to project wastewater flows and loads, as well as future I/I and peaking factors, through the planning year 2045

2.2 Wastewater Service Area

The City's wastewater service area (Figure 2-1) includes all the developed land within city limits except for the area known as Country Club Ranches, which is currently served by septic tanks. It is understood that this area is to remain unsewered through the end of the planning period in 2045.

The wastewater service area differs from the water service area only in the inclusion of the northeast corner of Miramar. This area is part of Broward County's District 3BC service area and receives water service from the County. This area received sewer service from the City under the phased Historic Miramar Infrastructure Improvements (HMII) program. Phases 1 and 2 of the HMII were completed in 2007 and 2012, respectively. Phase 3 was completed in 2021 (see Figure 2-1). All areas in District 3BC within Miramar are now connected to the City's sewer system.

Legend

- Miramar City Limits
- Country Club Ranches (septic)
- Water and Wastewater Service Area

District 3BC (BCWWS Water Service Area)

- Sewered by 2012 (HMII-1 & HMII-2)
- Sewered in 2021 (HMII-3)

0 7,000 14,000 Feet

Wastewater Master Plan

Wastewater Service Area

Figure 2-1

Hazen

45024-007

Service Layer Credits: Esri, NASA, NGA, USGS, FDEP, Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, USDA, USFWS

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2.3 Population

This section presents the projected population of the City of Miramar wastewater service area through 2045. These projections were developed by modifying the City's water service area population projections and were then used to project wastewater influent flows to the WWRF through 2045 (see Section 2.6).

2.3.1 Water Service Area Population

As part of its 2020 Water Supply Plan (WSP), the City prepared population projections of its water service area through 2045. These were based on the projections in the 2018 Lower East Coast Water Supply Plan Update (LEC Update) prepared by the South Florida Water Management District (SFWMD). The LEC Update projections were modified to account for the City's plans to provide water service to the Country Club Ranches area in phases. Of the estimated 3,500 residents, 1,500 will receive water service by 2025 and the remaining by 2030[3]. The modified projections are presented in Table 2-1.

Table 2-1: 2020 WSP Water Service Area Population Projections

Planning Year	2018 LEC Water Supply Population Projection	Additional Service Area – Country Club Ranches	City Water Service Area Population
2020	128,105		128,105
2025	134,007	1,500	135,507
2030	138,662	2,000	140,352
2035	142,425		142,425
2040	145,576		145,756
2045	No Data		148,766

In 2023, Brown and Caldwell used Census data to prepare updated population projections, which the City submitted to the SFMWD (Table 2-2). These projections assume that half of the Country Club Ranches residents will receive water service by 2025 and the remaining by 2030.

3 The LEC projections assumed that the area would be included by 2045 but used a different timeline for its inclusion.

Table 2-2: Updated Water Service Area Population Projections

Planning Year	City Water Service Area Population
2020	128,715
2025	137,714
2030	141,519
2035	143,845
2040	145,581
2045	147,328

To confirm the City's population projections, a third set was compiled based on the Broward County 2017 Municipal Population Forecast Allocation Model (PFAM). The PFAM itself is based on countywide forecasts developed by the University of Florida's Bureau of Economic and Business Research (BEBR) and considers development patterns within the county to assign population projections to smaller areas known as Traffic Analysis Zones (TAZs).

Figure 2-2 presents the TAZs within the boundaries of the City of Miramar. The map was used along with aerial imagery to estimate the portion of the population of each TAZ applicable to the Miramar water service area. The 2017 PFAM projections for each TAZ in the water service area were used to predict the total service area population through 2045 (Table 2-3). Separate projections were calculated by the same method for the additional future service area in Country Club Ranches, shown in gray.

Table 2-3 presents the projected population of the current water service area by TAZ. Table 2-4 presents the projected number of residents in Country Club Ranches receiving water service from the City, assuming that half of the Country Club Ranches residents will receive water service by 2025 and the remaining by 2030. In Table 2-5, these tables were summed and compared to the City's updated projections presented in Table 2-2. The projections differed by less than two percent in any year, with the City's projections being slightly higher. Therefore, the City's projections were considered valid. Because the City's projections represent a more conservative estimate of population, they were used to forecast wastewater volumes.

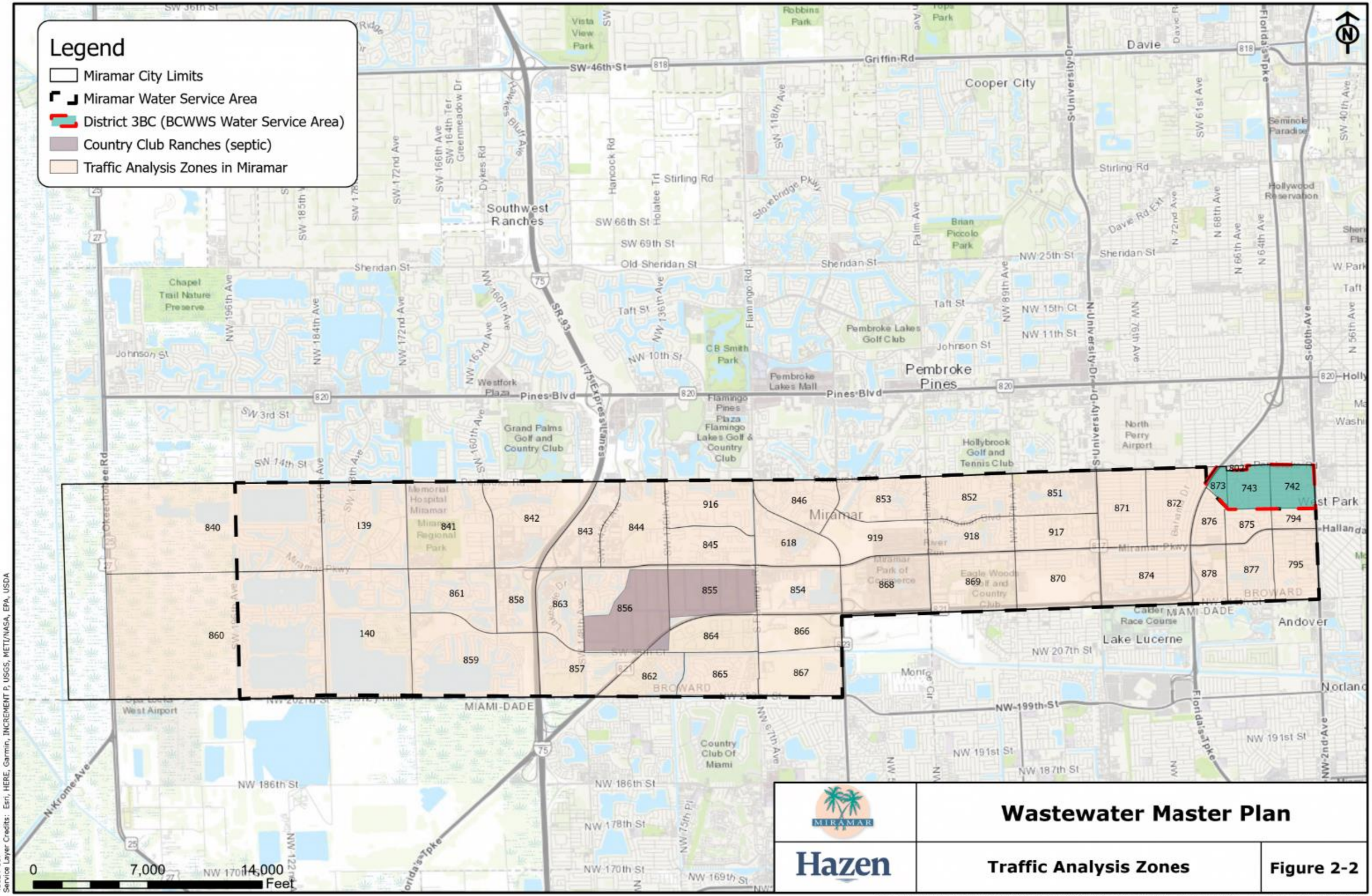

Legend
Miramar City Limits
Miramar Water Service Area
District 3BC (BCWWS Water Service Area)
Country Club Ranches (septic)
Traffic Analysis Zones in Miramar
840
841
842
843
844
845
846
853
852
851
871
872
873
743
742
794
795
877
878
875
876
618
916
919
918
917
870
874
869
868
855
854
856
863
858
861
859
857
862
865
867
864
866
860
140
139
Southwest Ranches
Davie
Cooper City
Pembroke Pines
Miramar
Griffin Rd
SW 46th St
Stirling Rd
Sheridan St
Old Sheridan St
SW 69th St
SW 66th St
Taft St
Johnson St
Pines Blvd
SW 3rd St
SW 14th St
NW 186th St
NW 178th St
NW 170th St
NW 169th St
NW 199th St
NW 191st St
NW 187th St
NW 207th St
Miramar Pkwy
Hancock Rd
Holatee Trl
Flamingo Rd
Palm Ave
Dykes Rd
Hawkes Bluff Ave
SW 172nd Ave
SW 166th Ave
SW 164th Ter
Greenmeadow Dr
SW 185th Way
SW 118th Ave
Shorebridge Pkwy
University Dr
Florida's Tpke
SR 93
I-75 (Express Lanes)
Vista View Park
Robbins Park
Brian Piccolo Park
Chapel Trail Nature Preserve
CB Smith Park
Pembroke Lakes Golf Club
Pembroke Lakes Mall
Flamingo Pines Plaza
Flamingo Lakes Golf & Country Club
Grand Palms Golf and Country Club
Hollybrook Golf and Tennis Club
Memorial Hospital Miramar
Miramar Regional Park
Miramar Park of Commerce
Eagle Woods Golf and Country Club
Country Club Of Miami
Seminole Paradise
Hollywood Reservation
Lake Lucerne
Andover
North Perry Airport
Opa-Locka West Airport
Calder Race Course
Westfork Plaza
BROWARD
MIAMI-DADE
0
7,000
14,000
Feet
45024-007
Service Layer Credits: Esri, HERE, Garmin, INCREMENT P, USGS, METI/NASA, EPA, USDA
MIRAMAR
Hazen
Wastewater Master Plan
Traffic Analysis Zones
Figure 2-2
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Table 2-3: TAZ Population Forecast in Current Water Service Area

TAZ ID	% of TAZ Population within Current Water Service Area	2020	2025	2030	2035	2040	2045
139	100%	6,166	6,109	6,062	6,021	5,981	5,939
140	100%	3,899	4,850	4,846	4,807	4,772	4,735
618	100%	4,700	4,864	5,055	5,187	5,292	5,397
794	100%	904	1,122	1,267	1,378	1,482	1,601
795	100%	2,737	2,967	3,125	3,235	3,329	3,452
840	100%	3,240	3,197	3,171	3,144	3,122	3,088
841	100%	3,762	3,720	3,685	3,661	3,632	3,608
842	100%	2,996	2,974	2,956	2,938	3,049	3,211
843	100%	0	0	0	0	0	0
844	100%	2,035	2,005	2,100	2,145	2,172	2,198
845	100%	3,331	3,283	3,245	3,309	3,347	3,312
846	100%	4,114	4,287	4,463	4,596	4,700	4,808
851	100%	6,085	5,987	6,189	6,306	6,368	6,366
852	100%	3,660	4,568	4,757	4,920	5,055	5,201
853	100%	4,175	4,372	4,555	4,698	4,805	4,919
854	100%	880	1,073	1,198	1,300	1,390	1,482
855	0%[4]	0	0	0	0	0	0
856	66%[5]	1,523	1,504	1,491	1,484	1,477	1,465
857	100%	2,367	2,333	2,315	2,293	2,281	2,261
858	100%	2,536	2,489	2,455	2,430	2,405	2,387
859	100%	4,547	4,496	4,453	4,417	4,382	4,347
860	100%	4,197	4,153	4,115	4,087	4,064	4,029
861	100%	3,676	3,621	3,573	3,541	3,511	3,489
862	100%	2,165	2,131	2,103	2,089	2,066	2,055
863	100%	1,203	1,193	1,185	1,178	1,171	1,164
864	100%	2,931	3,197	3,375	3,525	3,639	3,782
865	100%	4,709	4,646	4,599	4,592	4,547	4,514
866	100%	852	1,042	1,171	1,273	1,369	1,461
867	100%	1,991	2,239	2,406	2,540	2,659	2,784
868	100%	153	340	463	559	646	745
869	100%	6,031	6,519	6,728	6,883	7,011	7,132
870	100%	1,578	2,976	3,022	3,064	3,072	3,043
871	100%	4,815	4,829	4,778	4,740	4,702	4,656

4 TAZ 855 is within Country Club Ranches.

5 TAZ 856 is located mostly within Country Club Ranches. However, the population is concentrated in the northwest portion of the TAZ, outside of Country Club Ranches.

Table 2-3: TAZ Population Forecast in Current Water Service Area

TAZ ID	% of TAZ Population within Current Water Service Area	2020	2025	2030	2035	2040	2045
872	95%[6]	5,363	5,318	5,258	5,234	5,190	5,143
874	100%	4,562	4,927	4,887	4,890	4,866	4,826
875	100%	1,319	1,564	1,741	1,865	1,979	2,114
875	100%	1,744	2,463	2,507	2,593	2,646	2,700
876	100%	3,491	3,739	3,943	4,085	4,201	4,335
877	100%	1,405	2,220	2,264	2,343	2,386	2,430
878	100%	3,233	3,195	3,172	3,187	3,173	3,152
916	100%	3,992	4,524	4,478	4,544	4,523	4,487
917	100%	2,749	2,996	3,167	3,317	3,452	3,597
918	100%	758	949	1,076	1,180	1,272	1,372
919	100%	6,166	6,109	6,062	6,021	5,981	5,939
	Total:	**126,574**	**134,981**	**137,399**	**139,578**	**141,186**	**142,787**

Table 2-4: TAZ Population Forecast of Water Customers in Country Club Ranches[7]

TAZ ID	% of TAZ Population within Country Club Ranches	2020	2025	2030	2035	2040	2045
855	100%	0	405	1,092	1,234	1,359	1,506
856	34%	0	733	768	765	761	754
864[8]	0%	0	0	0	0	0	0
	Total:	**0**	**1,137**	**1,860**	**1,999**	**2,120**	**2,260**

Table 2-5: Population in Planned Water Service Area

	2020	2025	2030	2035	2040	2045
City Projections	128,715	137,714	141,519	143,845	145,581	147,328
TAZ Projections[9]	126,574	136,118	139,259	141,577	143,306	145,047
Percent Difference	-1.7%	-1.2%	-1.6%	-1.6%	-1.6%	-1.5%

6 TAZ 872 includes some area in District 3BC.
7 Based on the proportion of residents receiving water service from the City of Miramar according to the 2020 WSP.
8 TAZ 864 contains some area within Country Club Ranches, but this area is uninhabited.
9 Sum of totals of Table 2-3 and Table 2-4.

2.3.2 Wastewater Service Area Population

To project the City's wastewater service area population, the City's water service area population projections were modified by adding the population of District 3BC in Miramar (Table 2-6) and subtracting that of Country Club Ranches. Table 2-7 presents the resulting population projections for the wastewater service area. From 2020 to 2045, the population is expected to grow from about 132,000 to 153,000, a growth of about 16%.

Table 2-6: TAZ Population Forecast in District 3BC

TAZ ID	% of TAZ Population within District 3BC	2020	2025	2030	2035	2040	2045
742	100%	2,420	2,664	3,251	3,574	3,808	4,069
743	100%	2,161	2,417	2,585	2,716	2,826	2,960
802	100%	107	107	107	107	107	107
872	5%	282	280	277	275	273	271
873	100%	723	714	714	703	697	689
Previously Sewered (HMII Phases 1 and 2):[10]		3,208	3,444	4,028	4,342	4,569	4,822
Recently Sewered (HMII Phase 3):[11]		2,485	2,738	2,906	3,034	3,142	3,274
Total:		**5,693**	**6,182**	**6,934**	**7,375**	**7,711**	**8,096**

Table 2-7: Wastewater Service Area Population Projections

Service Area	2020	2025	2030	2035	2040	2045
Water Service Area	128,715	137,714	141,519	143,845	145,581	147,328
Deduction for Country Club Ranches[12]:	0	-569	-1,860	-1,999	-2,120	-2,260
District 3BC Service Area in Miramar	3,208[13]	6,182	6,934	7,375	7,711	8,096
Wastewater Service Area	**131,923**	**143,327**	**146,593**	**149,222**	**151,172**	**153,163**

2.4 Recent Land Use Amendments

The City has recently passed amendments to its Land Use Plan allowing for higher land use densities in three designated areas: the Regional Activity Center (RAC) in central Miramar as well as the Miramar Innovation and Technology Activity Center (MITAC) and Transit Oriented Corridor (TOC) in eastern Miramar. Because the changes were not captured by the latest population projections, the City anticipates that future development, as well as accompanying increases in water demand and wastewater flows, will outpace the projections presented above in Table 2-7. Therefore, to project future wastewater flows, the flows associated with anticipated development in these areas were calculated directly and added to the increase in flows due to projected population growth.

10 This includes all of TAZ 742, 5% of TAZ 872, and 70% of TAZ 873.
11 This includes all of TAZs 743 and 802 and 30% of TAZ 873.
12 Assuming half the residents receive water service by 2025 and the remainder by 2030.
13 Portion sewered before 2021.

Estimates for additional wastewater flows are summarized in Table 2-8. These estimates were provided by the City and are the result of a collaboration between the Utilities, Engineering & Strategic Development, and Building, Planning & Zoning Departments.

Table 2-8: Estimated Additional Wastewater Flows Due to Proposed Developments

Development	Anticipated Completion Date	Impacted Lift Station Basin(s)	Average Daily Wastewater Flow (gpd)
Regional Activity Center (RAC)			
Miramar Station Phase II (332 Apartment Units)	2024 (Under Construction)	LS 121	49,800
Miramar Town Center (897 Apartment Units; 473,917 sq ft Commercial Space; 295,062 sq ft Institutional Space)	2024 (Under Construction)	LS 100	261,810[14]
MPV VI - The Park at Miramar (Mixed Use Development)	2024-2028 (Under Design/Permitting)	Three New Lift Stations	597,575
WSVN Channel 7 (71,212 sq ft Office)	2024-2028 (Under Design/Permitting)	LS 085	14,250
Hotel (160 Rooms)	2024-2028 (Under Design/Permitting)	LS 085	15,360
Memorial Free Standing Emergency Department (16,000 sq ft Building)	2024-2028 (Under Design/Permitting)	LS 034	3,200
Vacant Land (26 acres) (Assuming 10,000 sq ft Commercial/Office/Industrial Use per Acre)	2025-2035	LS 016, LS 026, LS 034, LS 085	52,000
RAC Total			**993,995**
Miramar Innovation and Technology Activity Center (MITAC)			
Residential Development (450 Apartment/Townhome Units)	2025-2040	MPS, LS C	71,500
Commercial/Office Development (81,000 sq ft Commercial Space; 200,000 sq ft Office Space)	2025-2040	LS A, LS 003	56,200
City Municipal Use (58,000 sq ft Community Centers or Other)	2025-2040	MPS, LS 002	11,600
MITAC Total			**139,300**
Transit Oriented Corridor (TOC)			
Residential Development (125 Single Family Units and 1,776 Multifamily Scattered Throughout the TOC)	2025-2040	LS B, LS F, LS G, LS I, LS J, LS M, LS 10	270,780
Non-Residential Development (1.6M sq ft Commercial Space, 1.8M sq ft Office Space, and 236 Hotel Rooms Mostly Along SR-7, Miramar Pkwy, and Pembroke Rd)	2025-2040	LS F, LS I, LS J, LS M, LS 10	702,656
TOC Total			**973,436**

[14] The City provided an estimate of 350,000 gpd for Miramar Town Center. Based on population projections alone, the estimated 2045 average flow would be 88,190 gpd. Therefore, the proposed development accounts for an additional 261,810 gpd.

Location maps of proposed development in the RAC, MITAC, and TOC are provided in Figure 2-3, Figure 2-4, and Figure 2-5 respectively.

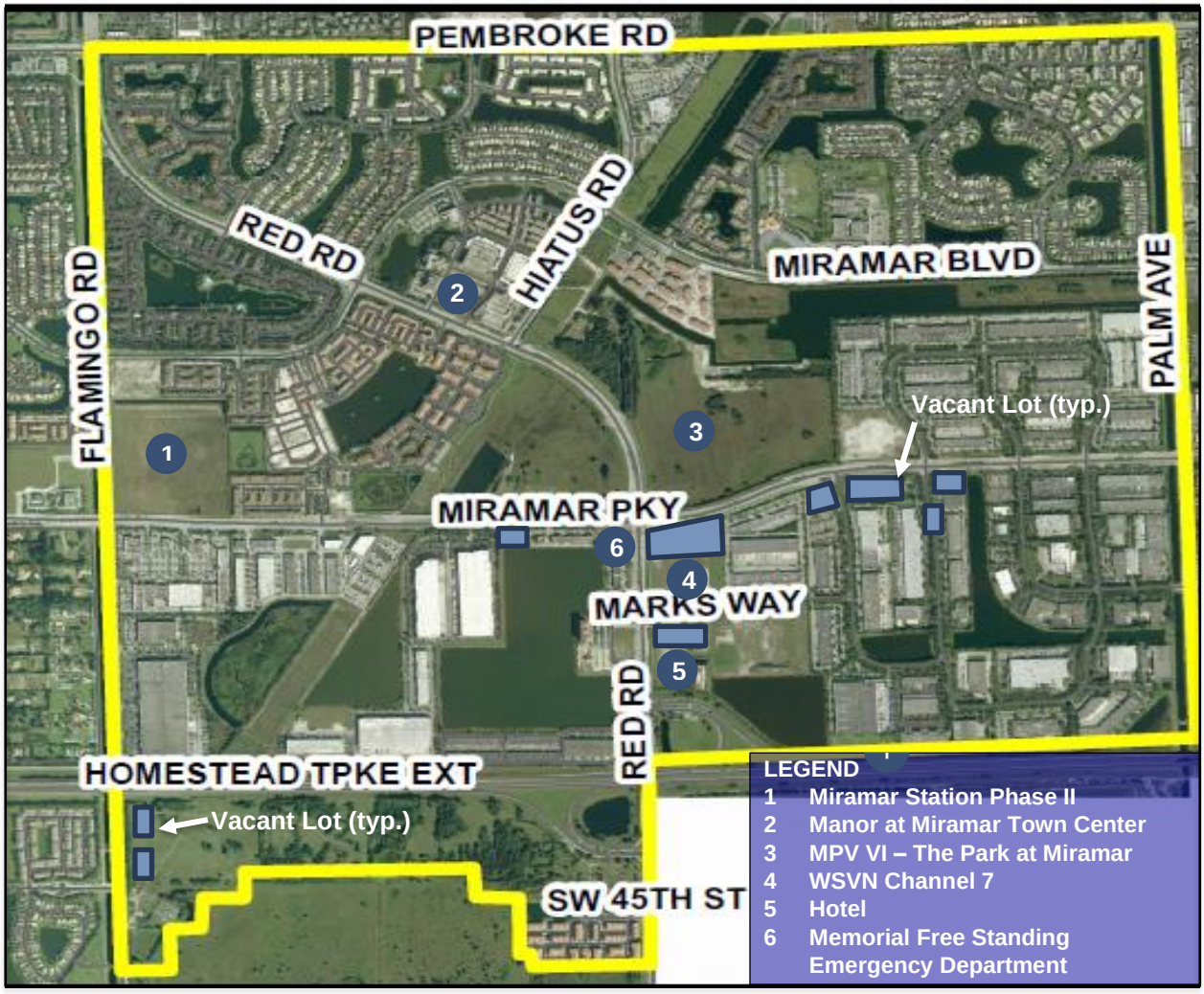


Figure 2-3: Proposed Developments in the Regional Activity Center



Figure 2-4: Proposed Developments in the Miramar Innovation and Technology Activity Center



Figure 2-5: Proposed Development in the Transit Oriented Corridor

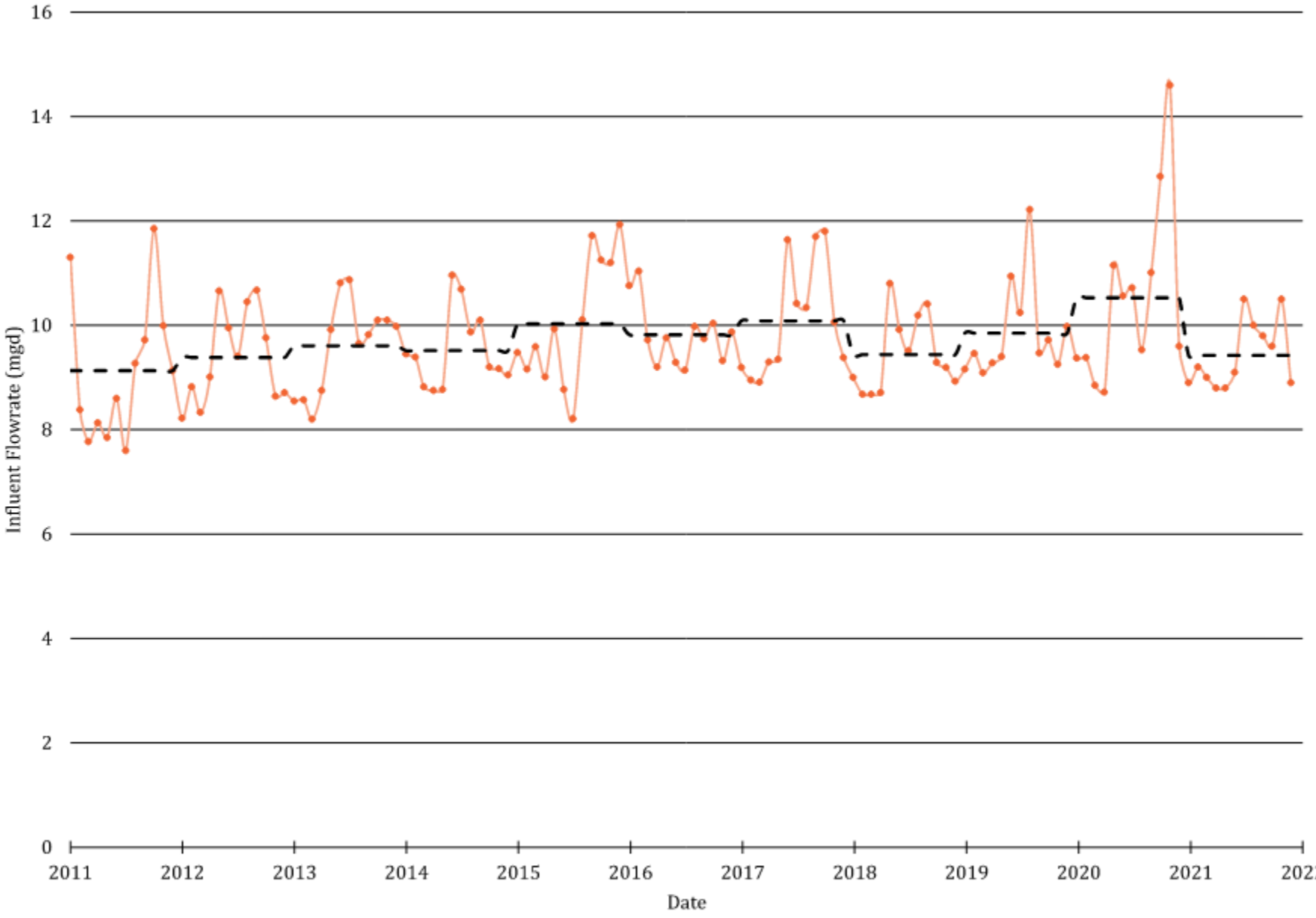
2.5 Historical Wastewater Flows and Loads

2.5.1 Historical Wastewater Flows

Table 2-9 presents monthly average daily flow (MADF) and annual average daily flow (AADF) received at the WWRF from 2011 through 2021. Figure 2-6 shows the same information graphically. The average flowrate during this period was 9.7 mgd. Influent flows have increased slightly since 2011, but this increase of about 0.5 mgd is within the range of normal year-to-year variation during this period.

Table 2-9: Monthly Average Daily Flow (mgd)

Month	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
January	8.0	8.2	8.6	9.5	9.5	10.8	9.2	9.0	9.2	9.4	8.9
February	8.4	8.8	8.6	9.4	9.2	11.0	9.0	8.7	9.5	9.4	9.2
March	7.8	8.3	8.2	8.8	9.6	9.7	8.9	8.7	9.1	8.9	9.0
April	8.1	9.0	8.8	8.8	9.0	9.2	9.3	8.7	9.3	8.7	8.8
May	7.9	10.7	9.9	8.8	9.9	9.8	9.4	10.8	9.4	11.2	8.8
June	8.6	10.0	10.8	11.0	8.8	9.3	11.6	9.9	10.9	10.6	9.1
July	7.6	9.4	10.9	10.7	8.2	9.1	10.4	9.5	10.2	10.7	10.5
August	9.3	10.5	9.7	9.9	10.1	10.0	10.3	10.2	12.2	9.5	10.0
September	9.7	10.7	9.8	10.1	11.7	9.7	11.7	10.4	9.5	11.0	9.8
October	11.9	9.8	10.1	9.2	11.3	10.0	11.8	9.3	9.7	12.9	9.6
November	10.0	8.6	10.1	9.2	11.2	9.3	10.1	9.2	9.3	14.6	10.5
December	9.1	8.7	10.0	9.1	11.9	9.9	9.4	8.9	10.0	9.6	8.9
AADF	**8.9**	**9.4**	**9.6**	**9.5**	**10.0**	**9.8**	**10.1**	**9.4**	**9.9**	**10.5**	**9.4**



MIRAMAR	**Wastewater Master Plan**	
Hazen	**Historical WWRF Influent Flowrate**	**Figure 2-6**

45024-007

2.5.2 Historical Wastewater Loads

Proper sizing and operation of treatment units within a wastewater treatment plant facility require an evaluation of wastewater influent characteristics, including 5-day carbonaceous biochemical oxygen demand ($CBOD_5$) and total suspended solids (TSS), which are the primary compliance parameters. Nitrogen and phosphorus concentrations were also evaluated given the City's extensive reuse system. The following sections summarize historical influent and effluent quality at the WWRF.

2.5.2.1 Carbonaceous Biochemical Oxygen Demand ($CBOD_5$) and Total Suspended Solids (TSS)

In accordance with the WWRF facility permit (No. FLA017025) issued by the Florida Department of Environmental Protection (FDEP), influent and effluent samples of $CBOD_5$ and TSS are taken five times a week and reported in Discharge Monitoring Reports (DMRs). This data was compiled and plotted in Figure 2-7.

From 2011 to 2021, the average recorded influent $CBOD_5$ concentration was 162 mg/L, and the average recorded influent TSS concentration was 182 mg/L. Average $CBOD_5$ and TSS mass loadings were 13,000 lbs/day and 14,600 lbs/day, respectively. $CBOD_5$ concentration was relatively consistent throughout the period, but TSS concentration increased from about 150 mg/L to over 200 mg/L after 2017. A similar pattern was observed in TSS mass loading.

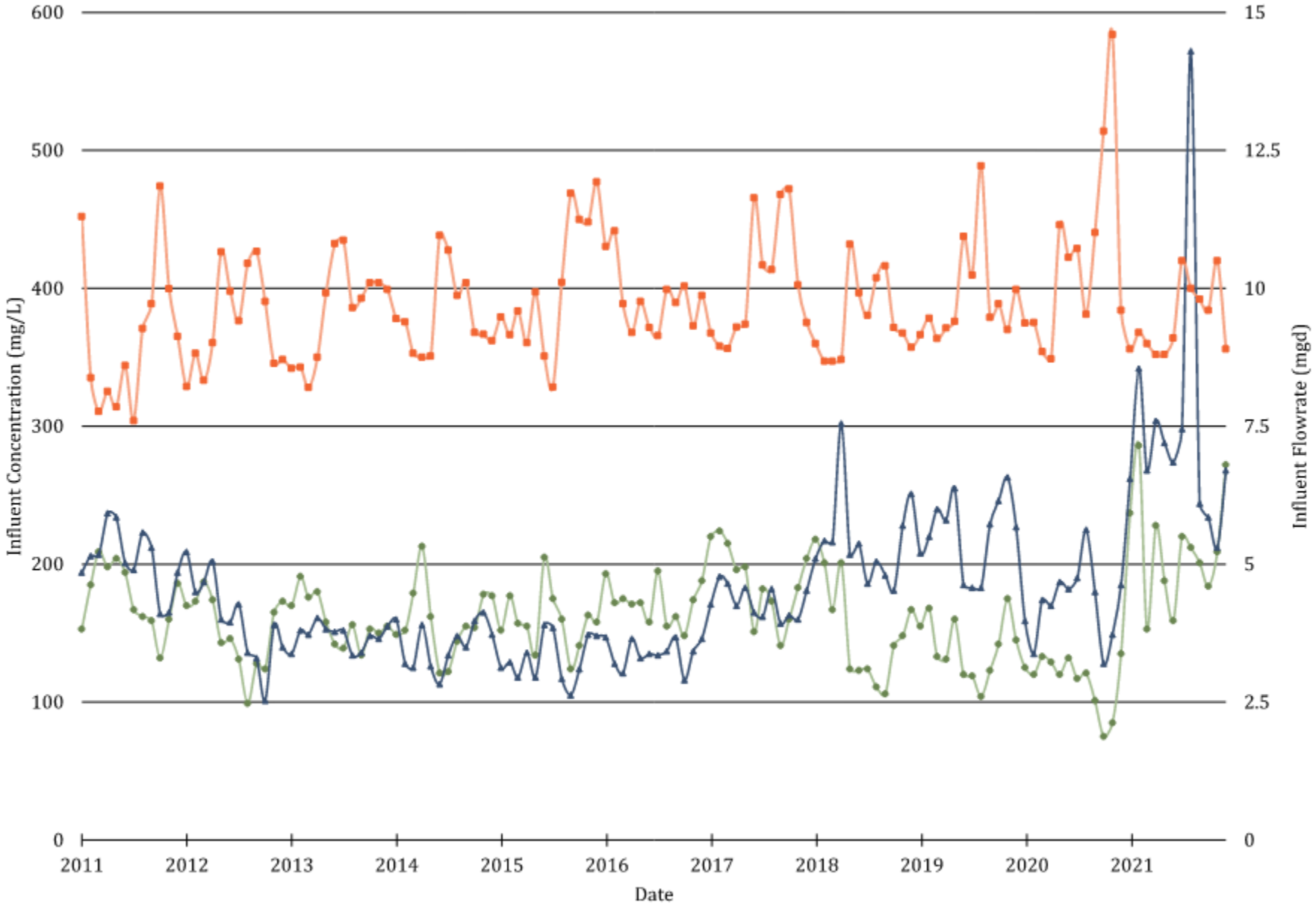
Effluent $CBOD_5$ and TSS concentrations at the injection well pump station in the same period were 3.2 and 4.5 mg/L respectively, corresponding to a removal efficiency of 98% for both (see Figure 2-8). The permitted annual average concentration limit for both $CBOD_5$ and TSS is 20 mg/L. There is also a single sample maximum of 5 mg/L TSS downstream of the reuse filters. For more details on permit requirements, see Section 4.4.

As part of the 2021 WWRF BioWin™ process model update, daily influent loading data from 2018 through 2020 was analyzed and corrected for outliers and potential analytical errors. The resulting average concentrations and mass loadings are presented in Table 2-10. These values were selected in favor of the recorded values to represent existing conditions. This ensures a more accurate assessment of plant performance and capacity needs.

Table 2-10: $CBOD_5$ and TSS Influent Loads

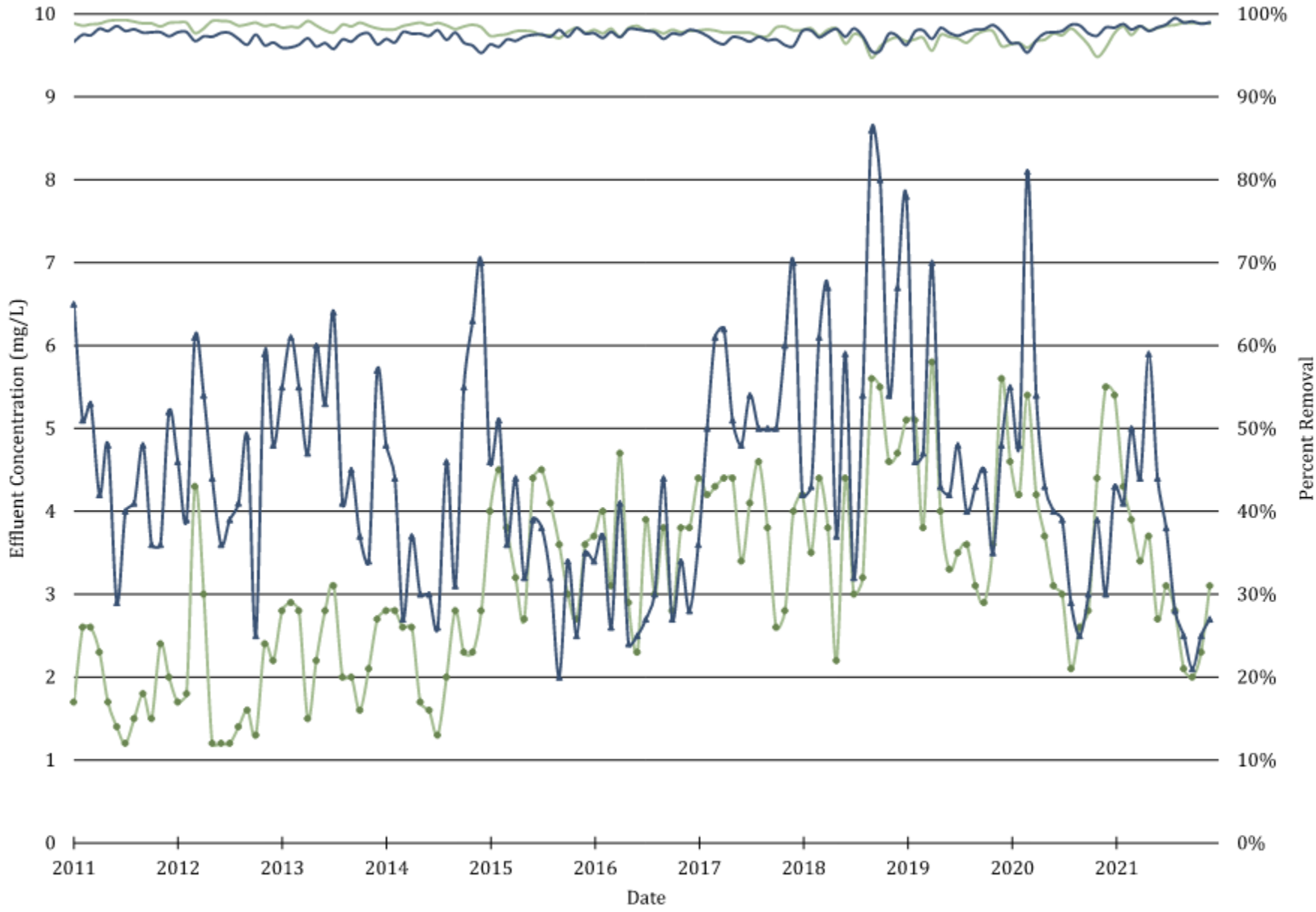
	Average Recorded Concentration, 2011-2021 (mg/L)	Average Recorded Mass Loading, 2011-2021 (lbs/day)	Selected Design Concentration for Existing Conditions (mg/L)[15]	Selected Mass Loading for Existing Conditions (lbs/day)[15]
$CBOD_5$	162	13,000	154	12,700
TSS	182	14,600	196	16,100

15 The selected TSS concentration and loading are notably higher than the values based on the recorded data. This is mostly due to the increase in TSS concentrations after 2017.



	Wastewater Master Plan	
Hazen	**Historical WWRF Influent CBOD5 and TSS Concentrations**	**Figure 2-7**

45024-007



Wastewater Master Plan

Historical WWRF Effluent CBOD5 and TSS Concentrations

Figure 2-8

45024-007

2.5.2.2 Nitrogen and Phosphorus

The WWRF does not have effluent permit limits for nitrogen or phosphorus. As such, influent concentrations of nitrogen and phosphorus at the WWRF are not regularly monitored. However, because Miramar has an extensive reuse program with irrigation as the primary use, an assessment of influent and effluent loads of these nutrients is of value.

Special sampling was conducted in August 2021 to update the BioWin™ process model of the WWRF. Total Kjeldahl nitrogen (TKN) and total phosphorus (TP) influent concentrations were determined to be 31 mg/L and 4 mg/L respectively. These values correspond to respective mass loadings of 2,600 lbs/day and 300 lbs/day.

Effluent concentrations of nitrogen are sampled monthly at the injection wells. Phosphorus was also monitored until May 2015, when it was discontinued due to its removal from the permit requirements. These parameters are reported to FDEP in Monthly Operating Reports (MORs) as required by the operating permit for the two deep injection wells. Available data from 2011 through 2021 is summarized in Table 2-11. Effluent concentrations of nitrogen were variable, but averaged 4.7 mg/L for ammonia, 7.7 mg/L for combined nitrate and nitrite, and 7.2 mg/L for TKN. Effluent concentration of phosphorus averaged 0.6 mg/L between 2011 and 2013 and increased to 2.5 mg/L between 2014 and May 2015.

Table 2-11: Historical WWRF Effluent Nitrogen and Phosphorus Concentrations

	Ammonia (mg/L as N)	Nitrate (mg/L as N)	Nitrate + Nitrite (mg/L as N)	TKN (mg/L as N)	Phosphorus (mg/L as P)
2011	1.8	7.0	Not monitored	3.5	0.7
2012	1.2	6.6	Not monitored	5.1	0.6
2013	6.2	2.1	Not monitored	9.4	0.6
2014	3.1	8.0	Not monitored	5.1	2.5
2015	4.3	6.5	6.2	7.5	2.4
2016	9.4	Not monitored	5.5	14.4	Not monitored
2017	3.5	Not monitored	11.9	6.0	Not monitored
2018	4.2	Not monitored	7.8	5.9	Not monitored
2019	8.6	Not monitored	3.1	10.2	Not monitored
2020	4.5	Not monitored	9.0	5.7	Not monitored
2021	4.2	Not monitored	10.4	5.6	Not monitored
Average	**4.7**	**6.0**	**7.7**	**7.2**	**1.4**

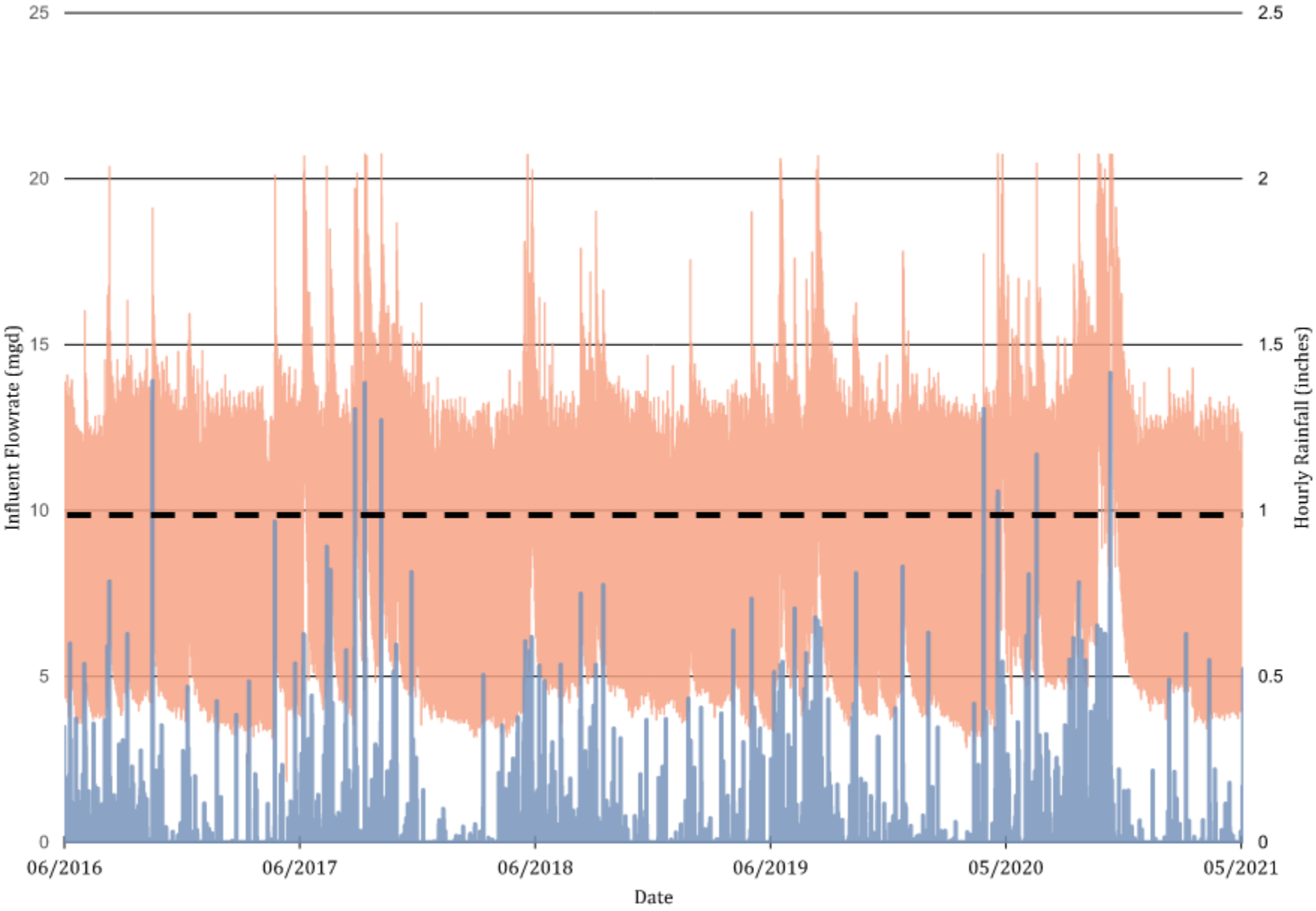
2.5.3 Historical Inflow and Infiltration

Influent wastewater flow can be separated into three components: base sanitary flow (BSF), groundwater infiltration (GWI), and rainfall-dependent inflow and infiltration (RDII). These components are defined as follows:

- Base sanitary flow (BSF): population-based sanitary flow that enters the collection system from residential and commercial areas
- Groundwater infiltration (GWI): extraneous water entering the sewer system through defects in pipes and manholes, which can occur in dry and wet weather
- Rainfall-dependent inflow and infiltration (RDII): flow which enters the collection system in response to the intensity and duration of rain events

Inflow and infiltration (I/I) is the sum of GWI and RDII. Because wastewater flow is influenced by weather, dry weather flow (DWF) and wet weather flow (WWF) are analyzed separately. DWF is the sum of BSF and GWI. WWF includes these components as well as RDII. The highest flowrates experienced by the WWRF occur during wet weather events, so it is important to understand how influent flowrates are impacted during such events.

To quantify I/I in the collection system in both dry and wet weather, hourly WWRF influent data was compiled for a five-year period (June 2016 through May 2021). The average flowrate during this period was about 10 mgd. SFWMD radar rainfall data was used to determine the average hourly rainfall in the WWRF service area for the period. The influent flowrate and rainfall are plotted alongside each other in Figure 2-9. The compiled data was then analyzed as described in the following sections in order to identify the BSF, GWI and RDII components of the influent flow.



MIRAMAR / Hazen	**Wastewater Master Plan**	
	Hourly WWRF Influent Flowrate and Rainfall	**Figure 2-9**

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2.5.3.1 Dry Weather Infiltration

Historical DWF was determined by filtering the influent flow data to exclude days on which flows were influenced by rain events and calculating the average flow for each hour of the remaining data. This enabled development of a composite DWF pattern, which is presented in Figure 2-10.

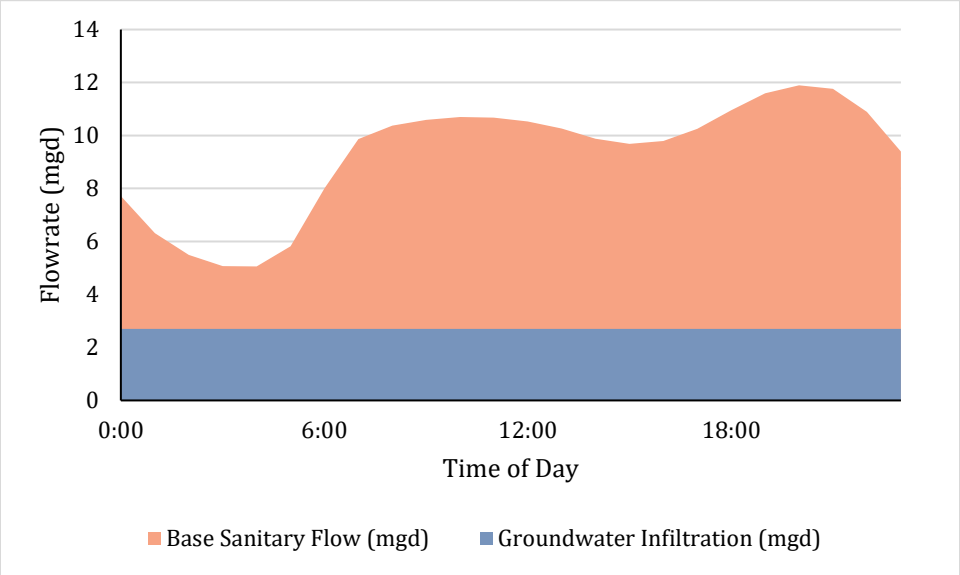


Figure 2-10: Dry Weather Flow Diurnal Pattern

Typical dry weather hourly flowrates ranged from 4.4 mgd in the early morning to 12.0 mgd in the evening, with an average daily flow of 9.1 mgd. GWI was estimated by comparing the average DWF to the minimum hourly flowrate, which occurs when BSF is close to zero. The average was taken from several commonly used methods[16] of conducting this comparison, resulting in an estimate of 2.7 mgd of GWI, which is about 30% of wastewater flows during dry weather. Subtracting this from the average DWF yields a BSF of 6.4 mgd, or about 50 gallons per capita per day. The DWF diurnal pattern is summarized in Table 2-12.

Table 2-12: Dry Weather Flow Diurnal Pattern Summary

Parameter	Average Hourly Flow
Wastewater Flow	9.1 mgd
Groundwater Infiltration	2.7 mgd
Base Sanitary Flow	6.4 mgd

16 Wastewater Production, Minimum Flow Factor, Stevens-Schutzbach, WASD, and Humphrey-Eagle. Each method uses different equations to calculate GWI based on average flow and the average minimum hourly flow.

2.5.3.2 Wet Weather Inflow and Infiltration

The total amount of RDII throughout the year can be estimated by subtracting the calculated DWF from the AADF. For the five-year period, this was 10 mgd minus 9.1 mgd, or 0.9 mgd. The annual average I/I, including GWI and RDII, was therefore 3.6 mgd (2.7 mgd + 0.9 mgd), or 36% of total wastewater volume. However, the most important impact of RDII on treatment plant capacity needs is not its contribution to average flows, but its contribution to peak wet weather flows.

To characterize WWF, the RTK unit hydrograph method was used to quantify the RDII in the wastewater system. Rather than quantifying total or average RDII, this method calculates RDII during a storm event to determine peak flows.

The RTK methodology computes three parameters (R, T, and K) related to a unit hydrograph (Figure 2-11), which is a representation of the sewer flow corresponding to each inch of rainfall.

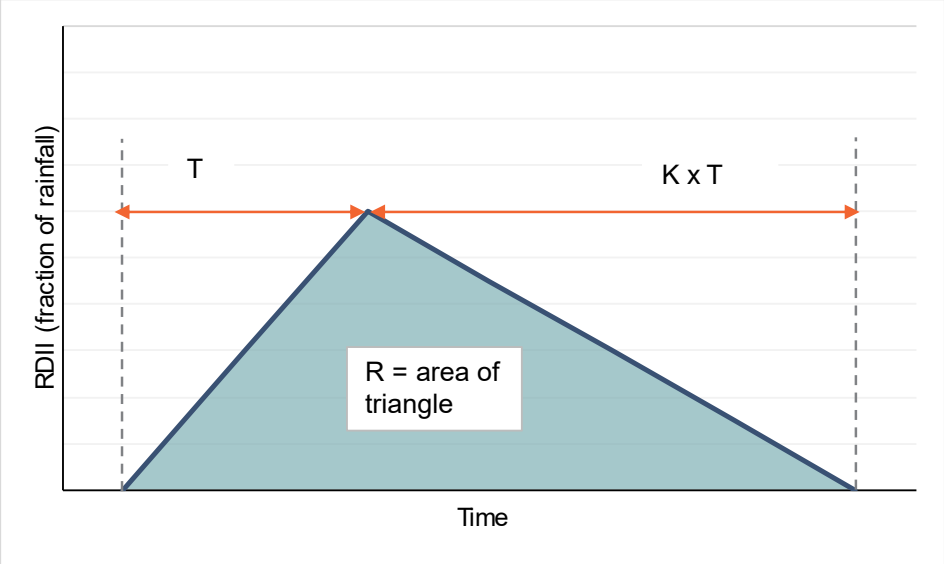


Figure 2-11: RTK Unit Hydrograph

R is the fraction of rain volume entering the sewer system as RDII during and immediately after the rain event or the area of the triangular unit hydrograph. T is the time to peak of the triangular unit hydrograph. K is the ratio of the time of recession to T.

To represent a more complex and more realistic response to a rain event, three unit hydrographs with different R, T and K values are added together to account for various observed stages in RDII (Figure 2-12). The “short term” stage represents direct inflow into the collection system, the “medium term” represents delayed inflow from indirect sources, and the “long term” represents infiltration due to a rise in the groundwater table following the rain event. The lengths of these stages are not pre-defined and are adjusted to match the observed flows in the sewer basin being analyzed.

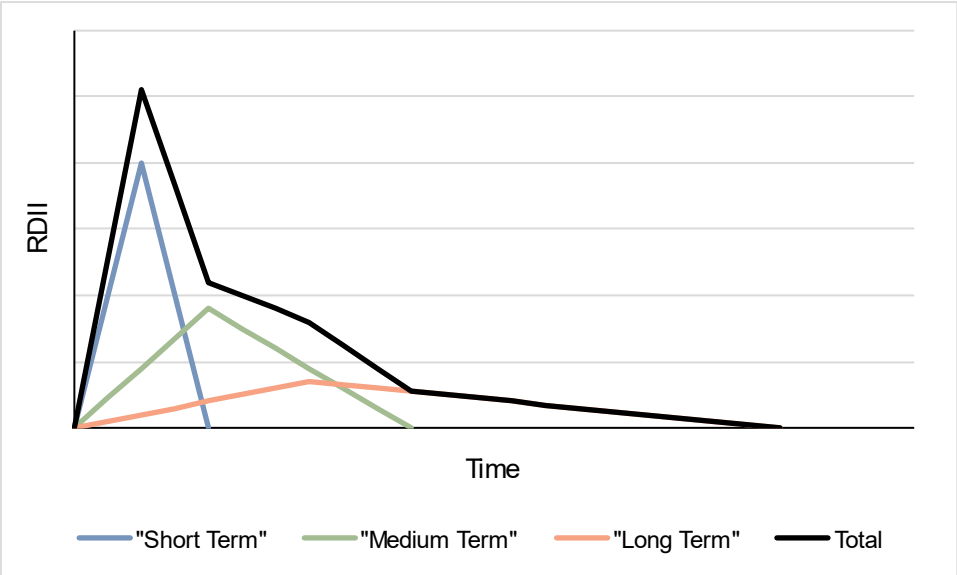


Figure 2-12: Synthetic Unit Hydrograph

This synthetic RTK unit hydrograph represents the proportional RDII response per inch of rainfall. The unit hydrograph is applied to rainfall amounts in discrete time steps and added together to calculate the total RDII hydrograph (Figure 2-13).

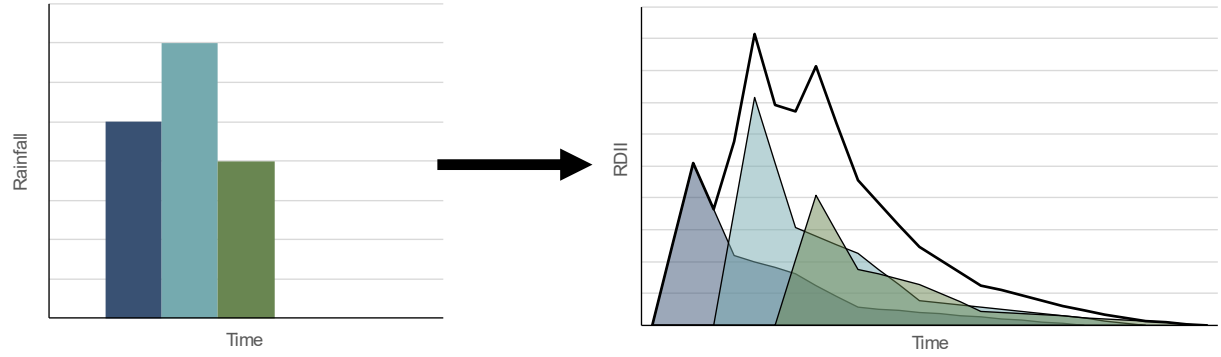


Figure 2-13: Application of RTK Unit Hydrograph

To compute the RTK parameters for the WWRF wastewater system, actual storm events in the five-year period between 2016 and 2021 were used to compare observed RDII volume and peak flow to calculated values, iterating the calculated values until they aligned. It is noted that during heavy rain events, recorded influent flowrates plateaued at about 21 mgd. Effluent flowrates measured at the injection wells exceeded this value (Figure 2-14), indicating that recorded influent flowrates were limited by the influent flow meter capability. This limitation was resolved by the end of 2021; however, it was necessary to exclude heavy rain events in the five-year period to prevent artificial flow readings from distorting the calculated RTK parameters.

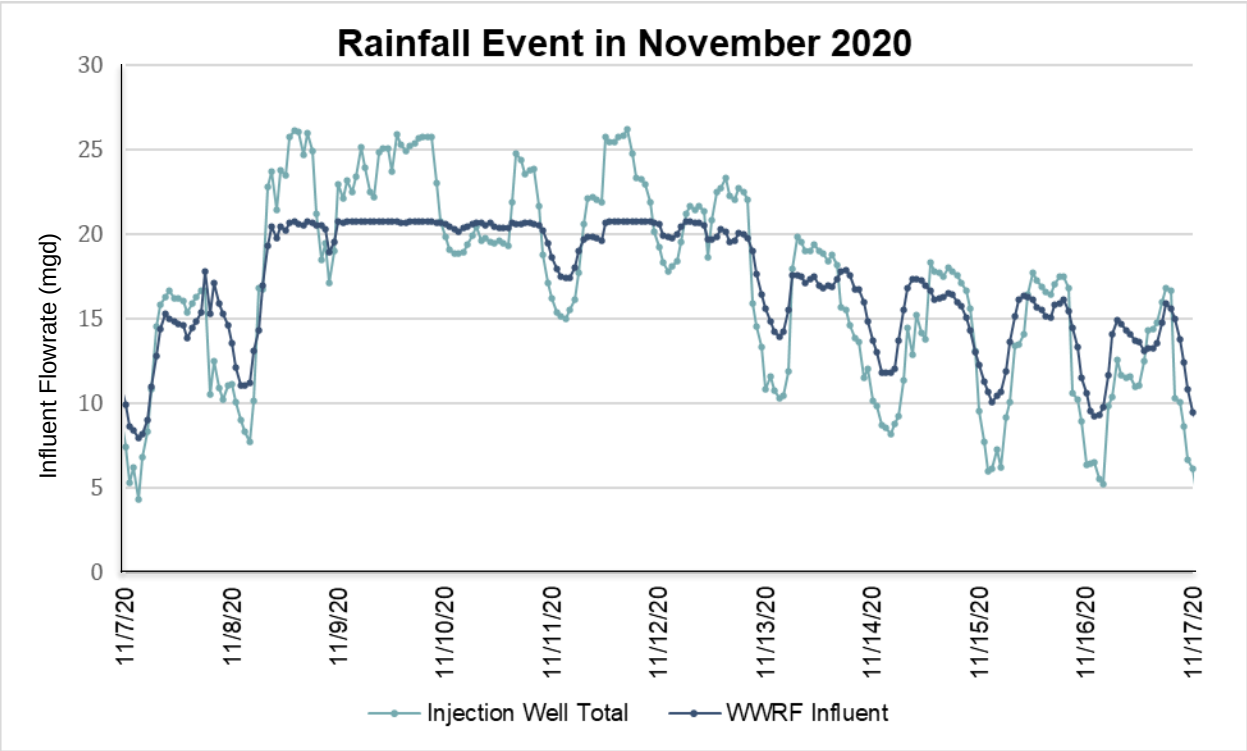


Figure 2-14: Influent-Effluent Flow Meter Comparison

Once the RTK parameters were determined, the unit hydrograph method was used to mathematically model the RDII response to a design storm. FDEP has recognized a 2-year storm event for the determination of peak flowrates. Therefore a 4.5", 24-hour rainfall event using the SFWMD 24-hour storm event distribution (Figure 2-15) provided the basis for determination of WWF. Although the rainfall event ends after 24 hours, the RDII response lasts for several days. The calculated RDII over 72 hours is illustrated in Figure 2-16.

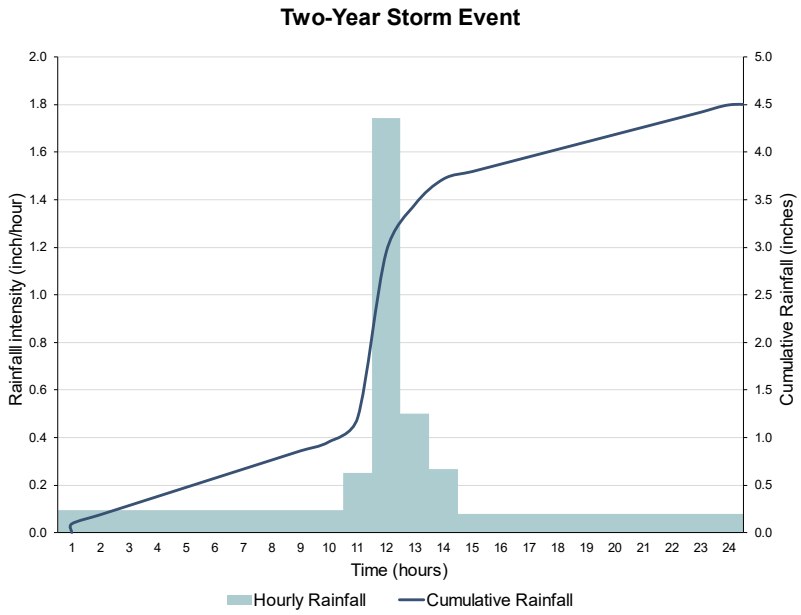


Figure 2-15: SFWMD 4.5", 24-Hour Rainfall Event

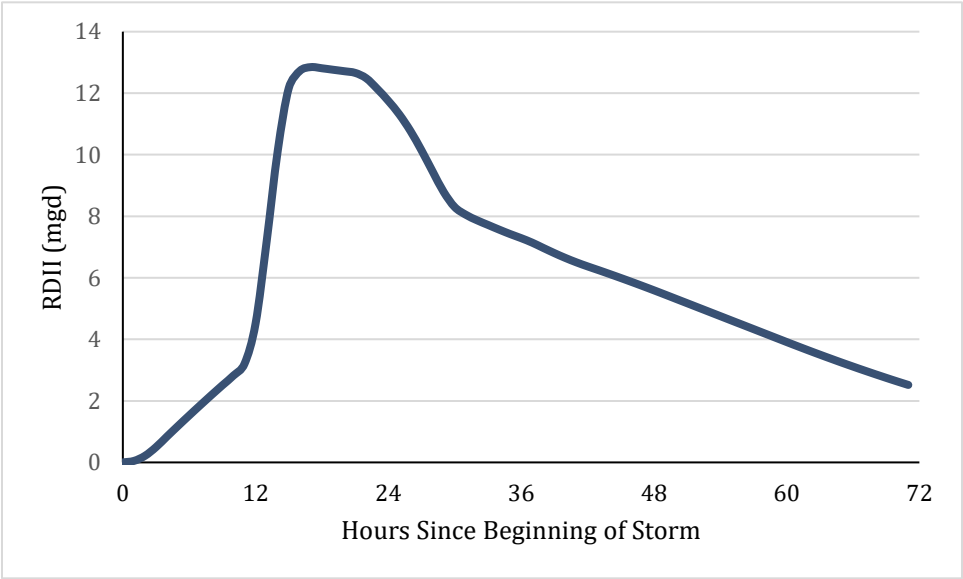


Figure 2-16: RDII Response to a Two-Year Storm Event

To predict peak flowrates, this curve was superimposed on the projected DWF pattern. The peak hourly flow of the resulting WWF hydrograph is considered the peak wet weather flow. Figure 2-17 shows the hydrographs for DWF and WWF based on this approach. The peak wet weather flow, which occurs 20 hours after the beginning of the theoretical storm event, is about 24.5 mgd.

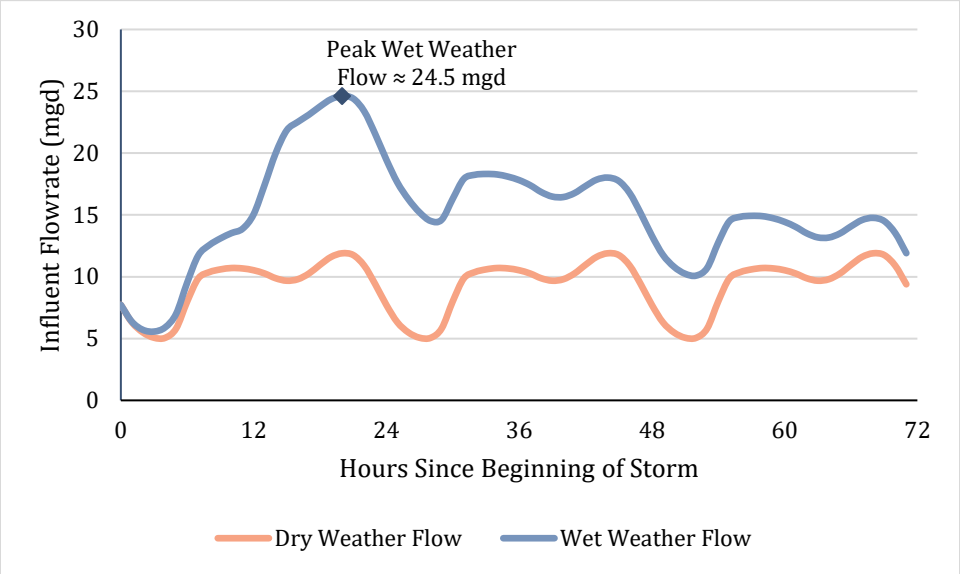


Figure 2-17: Two-Year Rain Event WWRF Hydrographs

2.5.4 Historical Peaking Factors

The peak hour factor represents the ratio between the peak wet weather flowrate and the average dry weather flowrate. As discussed above, the peak wet weather flowrate was calculated to be 24.5 mgd based on a theoretical two-year rainfall event. The average DWF was determined to be 9.1 mgd. Thus, the peak hour factor was determined to be 2.7. As the wastewater customer base expands and sewer flowrates increase over time, some dampening of influent flow variability will occur such that this ratio can be expected to decrease.

The maximum month average daily flow (MMADF) is defined as the highest monthly flowrate in a given year. The maximum three-month average daily flow (MTMADF) is the maximum average flowrate across any three months in a year. These values were calculated based on influent flow data from 2017 through 2021 (see Table 2-9 for more detailed information on monthly influent flows). Because monthly average flows contain a mix of dry and wet weather flows, it is more meaningful to compare these values to AADF rather than average DWF. Thus, peaking factors were determined from the ratio of the average MMADF and MTMADF across this period to the AADF of 10 mgd.

Historical peaking factors are presented in Table 2-13.

Table 2-13: Historical Influent Flow Peaking Factors

Parameter	Flow (mgd)	Peaking Factor
Maximum Three-Month	11.3	1.1
Maximum Month	12.0	1.2
Peak Hour	24.5[17]	2.7

It is assumed that the maximum month and maximum three-month peaking factors will not change in the planning period. Therefore, future maximum month and maximum three-month flows were calculated from projected AADF using these factors. However, as mentioned above, the hourly peaking factor is expected to decrease slightly as sanitary flows increase and the relative impact of RDII decreases. Projected peak hour flow was calculated directly using the RTK unit hydrograph method outlined in Section 2.5.3.2.

2.5.5 Impact of Rainfall on AADF

A comparison of annual average daily influent flows to the WWRF and annual rainfall within the wastewater service area shows that flowrates are impacted by rainfall (see Figure 2-9). Between 2017 and 2021, the AADF varied from a minimum of 9.4 mgd to a maximum of 10.5 mgd with no clear trend. Although long-term changes in influent flow are driven by increasing sanitary flow due to population growth and/or sewer expansion, the variability in yearly WWRF influent flowrates is the result of sensitivity to rainfall within the wastewater service area. Influent flowrates increase with greater rainfall due to more RDII as well as GWI, which increases as a result of a higher groundwater table that persists on dry days following rain. As presented in Table 2-14, over the last five years, the population in the service area has increased slightly each year, although influent flow varied.

Table 2-14: Annual Average WWRF Influent Flow and Rainfall, 2017-2021

Year	AADF (mgd)	AADF Percent Difference from Average	Annual Rainfall (inches)	Rainfall Percent Difference from Average	Wastewater Service Area Population
2017	10.1	2%	72	16%	126,432
2018	9.4	-5%	48	-23%	127,597
2019	9.8	-1%	63	2%	128,773
2020	10.5	6%	81	31%	131,313
2021	9.4	-5%	47	-24%	132,541

Rainfall varied from year to year, without any discernable trend. Variation in WWRF AADF correlated strongly with rainfall. In particular, the year of highest rainfall and highest flow, 2020, was followed by the year with the lowest rainfall and lowest flow in 2021, despite an estimated increase in population of over 1,000 residents.

17 This flowrate is a calculated value based on a two-year rainfall event.

Despite increased variability over the last five years, on average rainfall has not increased or decreased. As presented in Figure 2-18, influent AADF has increased slightly over the last decade, corresponding with the increase in population. However, the magnitude of this increase is negligible compared to the year-to-year variation which coincides with annual rainfall.

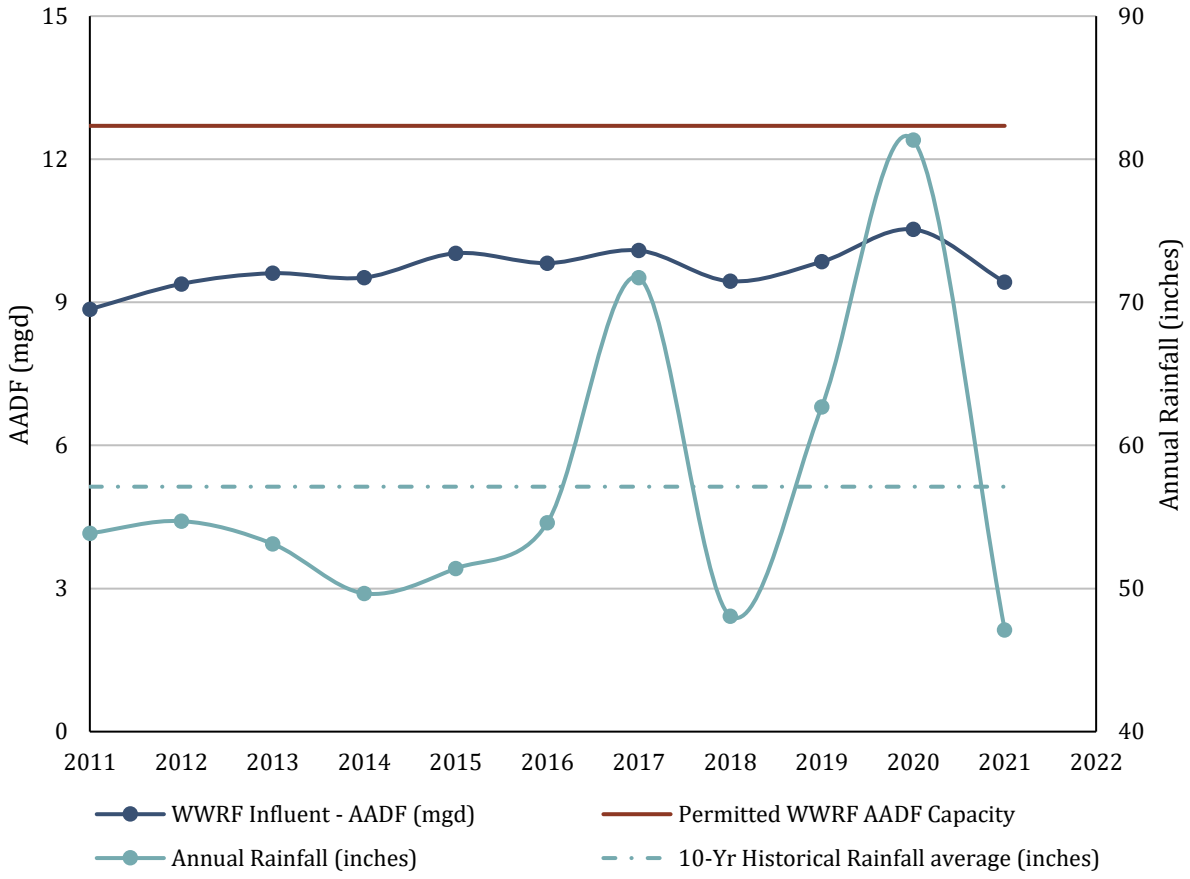


Figure 2-18: WWRF AADF Influent and Rainfall

2.6 Projected Wastewater Flows and Loads

2.6.1 Projected Wastewater Flows

Future wastewater flows were projected based on population growth, assuming that per capita sanitary flows will remain constant at 50 gallons per capita per day. As discussed in Section 2.4, because the City has made several amendments to its Land Use Plan since the latest population projections were developed, the wastewater flows associated with planned future developments were estimated separately and added to the population-based projections.

It was further assumed that inflow and infiltration relative to the sewered area would remain constant through the end of the planning period in 2045. Although the volume of infiltration can be expected to increase slightly with an increased service area due to the HMII Phase 3 and the development of currently

vacant land in the RAC, this additional flow is expected to be minor for new infrastructure. For the purposes of this study, GWI in these areas was conservatively assumed to be half of that for previously existing infrastructure. Based on this assumption, by 2025 the new sewered areas would contribute an additional 0.02 mgd, increasing the GWI slightly from 2.68 mgd to 2.7 mgd. Therefore, increases in sewer flows will be primarily driven by an increasing BSF.

The resulting flow projections throughout the planning period are summarized in Table 2-15. By 2045, based sanitary flow is expected to increase to approximately 53% greater than current conditions. This will translate to an increase of approximately 38% in annual average influent flow to the WWRF. Peak WWF, defined as the peak hourly flowrate expected to occur during a two-year, 24-hour rain event of 4.5 inches, is expected to increase about 20% from about 24.5 mgd to about 29.6 mgd in 2045. Due to increasing dry weather flowrates, the WWF peak factor (peak WWF divided by average DWF) will decrease slightly, from 2.7 currently to 2.4 in 2045.

Table 2-15: Projected Wastewater Flows

	2025	2030	2035	2040	2045
Service Area Population[18]	143,327	146,593	149,222	151,172	153,163
Base Sanitary Flow (mgd) – Based on Population Projections	7.0	7.2	7.3	7.5	7.7
Additional Wastewater Flows Due to Proposed Developments (mgd)	0.3	1.3	1.7	2.1	2.1
Base Sanitary Flow (mgd) – Revised to Account for Recent Land Use Amendments	7.3	8.5	9.0	9.6	9.8
Groundwater Infiltration (mgd)	2.7	2.7	2.7	2.7	2.7
Average Dry Weather Flow (mgd)	10.0	11.2	11.7	12.3	12.5
Annual Average Daily Flow (mgd)	10.9	12.1	12.6	13.2	13.4
Maximum Three-Month Average Daily Flow (mgd)	12.6	14.0	14.6	15.3	15.5
Peak Wet Weather Flow (mgd)	25.9	27.7	28.4	29.3	29.6
Wet Weather Flow Peak Factor	2.6	2.5	2.4	2.4	2.4

2.6.2 Projected Wastewater Loads

Future wastewater loads through 2045 were projected by assuming that average influent quality will remain the same. Therefore, increases in loads will be proportional to the projected increase in influent flowrate. Projected loads through 2045 are presented in Table 2-16.

[18] Based on the latest official population projections, which do not account for recent land use amendments.

Table 2-16: Projected Wastewater Loads

		Projected Mass Loading (lbs/day)				
Parameter	Concentration (mg/L)	2025	2030	2035	2040	2045
$CBOD_5$	154	14,000	15,600	16,200	17,000	17,200
TSS	196	17,700	19,700	20,500	21,500	21,800
TKN	31	2,800	3,100	3,300	3,400	3,500
TP	4	330	360	380	400	400

2.7 Summary of Historical and Projected Wastewater Flows and Loads

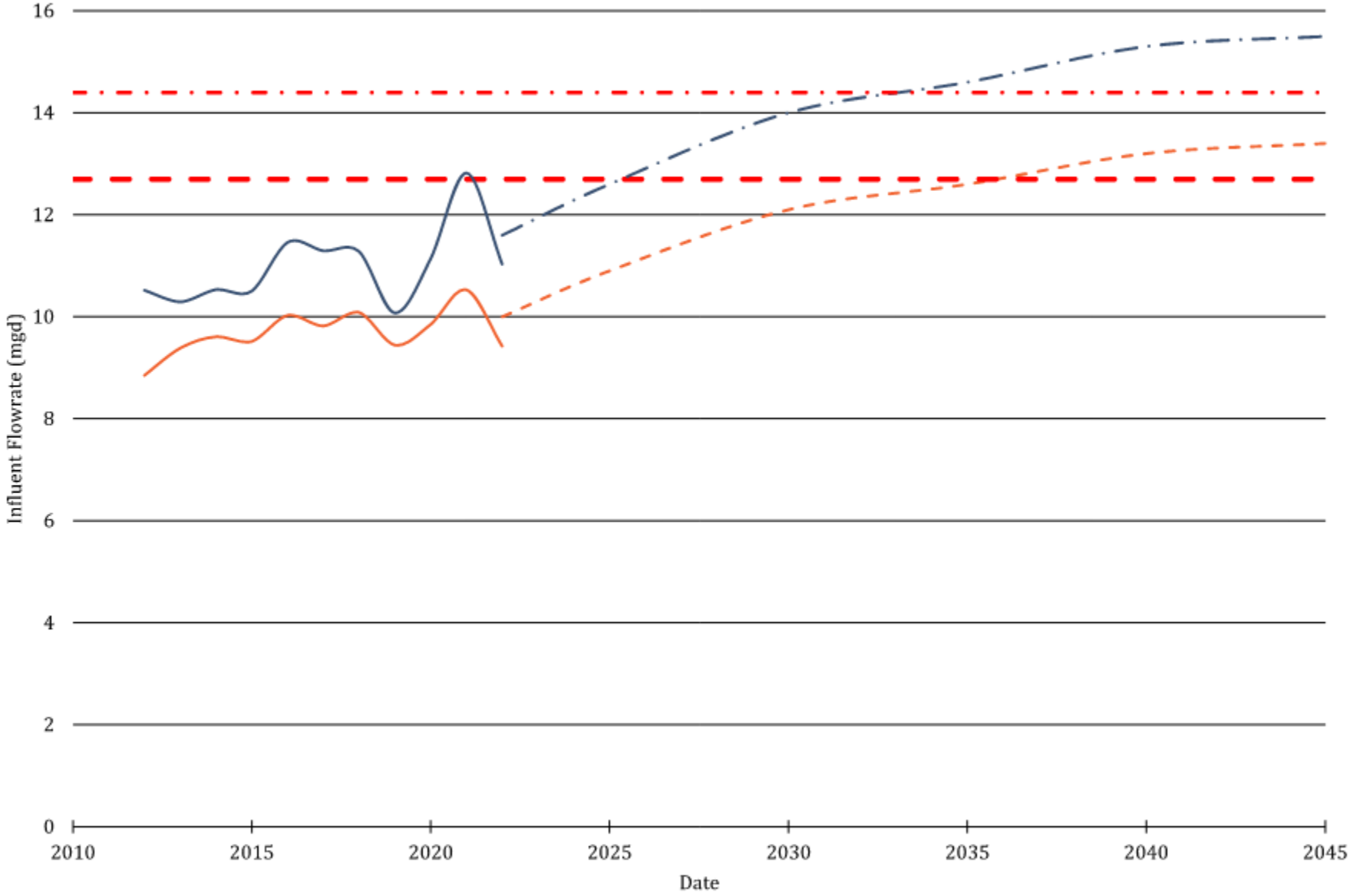
The annual average daily flow experienced at the WWRF has been approximately 10 mgd over the past several years. The dry weather flowrate was determined to be 9.1 mgd, consisting of a base sewer flow of 6.4 mgd and groundwater infiltration rate of 2.7 mgd or about 27% of AADF. As discussed in Section 2.5, recorded WWRF influent peak flow data was artificially limited to about 20 mgd through 2021. Based on rainfall data and observed system response times, the RTK method was used to estimate the actual peak flowrate associated with a 2-year storm event to be 24.5 mgd. Plant staff have noted that during a more extreme storm event, a peak flowrate of approximately 27 mgd was observed.

Due to expansion of the sewer service area under the HMII program, anticipated population growth as projected by the 2017 PFAM, and proposed development intensification in specified areas of Miramar, influent flows to the WWRF are expected to increase throughout the planning period. By 2045, AADF, MTMADF, and peak hourly flowrates are estimated to be 13.4 mgd, 15.5 mgd, and 29.6 mgd, respectively. This represents an approximate increase of 38% in average flow. Wastewater loads are expected to increase at the same rate, resulting in projected $CBOD_5$ and TSS mass loadings of 17,200 lbs/day and 21,800 lbs/day, respectively.

The projected AADF of 13.4 mgd exceeds the current permitted treatment capacity of 12.7 mgd according to FDEP and Broward County permits, and the projected MTMADF of 15.5 mgd exceeds the 14.4 mgd referenced by the Broward County permit. Improvements will therefore be necessary to increase the treatment capacity of the WWRF. The capacity evaluation of the WWRF and recommendation improvements are discussed in Section 4.5.

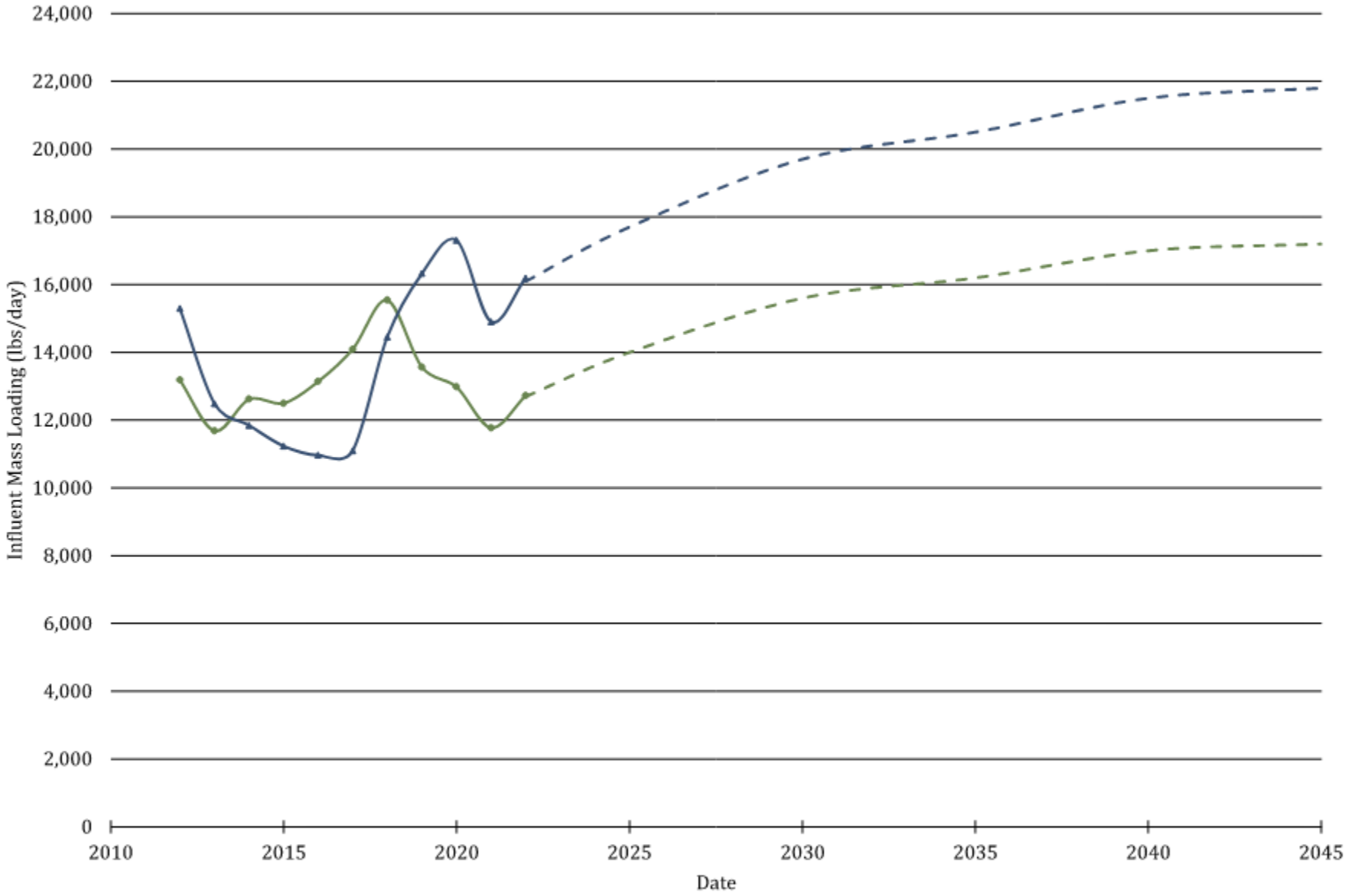
The projected peak hourly flow of 29.6 mgd is nearly equal to the rated capacity of the Underground Injection Well System of 29.8 mgd, which is based on the discharge capability of the effluent pump station. The wells themselves are permitted for a maximum total discharge of 37 mgd. Although dependent upon demand, particularly during wet weather, additional disposal capacity is provided by the reuse system, which has a pumping capacity of 7.9 mgd with one pump out of service. Therefore, an upgrade of the effluent pump station is not recommended at this time. However, the City should continue to monitor peak flowrates and consider an upgrade in the future if necessary.

Projected annual average daily flowrates and maximum three-month average daily flowrates throughout the planning period are presented in Figure 2-19. Projected $CBOD_5$ and TSS mass loadings are presented in Figure 2-20.



MIRAMAR	**Wastewater Master Plan**	
Hazen	**Historical and Projected WWRF Influent Flowrate**	**Figure 2-19**

45024-007



MIRAMAR	**Wastewater Master Plan**	
Hazen	**Historical and Projected WWRF Influent Loading**	**Figure 2-20**

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3 Collection and Transmission System

3. Collection and Transmission System

3.1 Introduction

In addition to the WWRF, the City of Miramar owns and operates a wastewater collection and transmission system within its service area. Wastewater is conveyed by gravity from the collection system to the transmission station. The lift stations, master pump station (MPS), and an in-line booster pump stations (BPS) transmit wastewater through force mains to the WWRF. The City currently provides wastewater service to approximately 97% of its more than 131,000 residents.

A detailed evaluation of the collection and transmission system was conducted using two methods: a transmission system hydraulic model to evaluate capacity needs and a desktop condition assessment to evaluate infrastructure renewal and replacement (R/R) needs.

The objectives of this section include the following:

- Describe the existing wastewater collection and transmission system
- Review the development and calibration of the transmission system hydraulic model
- Present results of the hydraulic model analysis and identify capacity improvement projects
- Present the results of a desktop condition assessment of the transmission system
- Identify renewal and replacement (R/R) projects necessary through the planning period

3.2 Background

The City of Miramar's wastewater collection system was originally constructed in 1955 and transported wastewater to Treatment Plant No. 93 (TP 93) for primary treatment. As the City developed westward in the 1960's and 1970's, the City expanded the wastewater collection system as well as TP 93. In 1978, Broward County proposed a regional wastewater system to address surface water quality concerns within the County. The City of Miramar subsequently began transporting all wastewater from its MPS east to the Southern Regional Wastewater Treatment Plant (SRWWTP) as part of a Large User Agreement with the City of Hollywood. TP 93 was subsequently decommissioned.

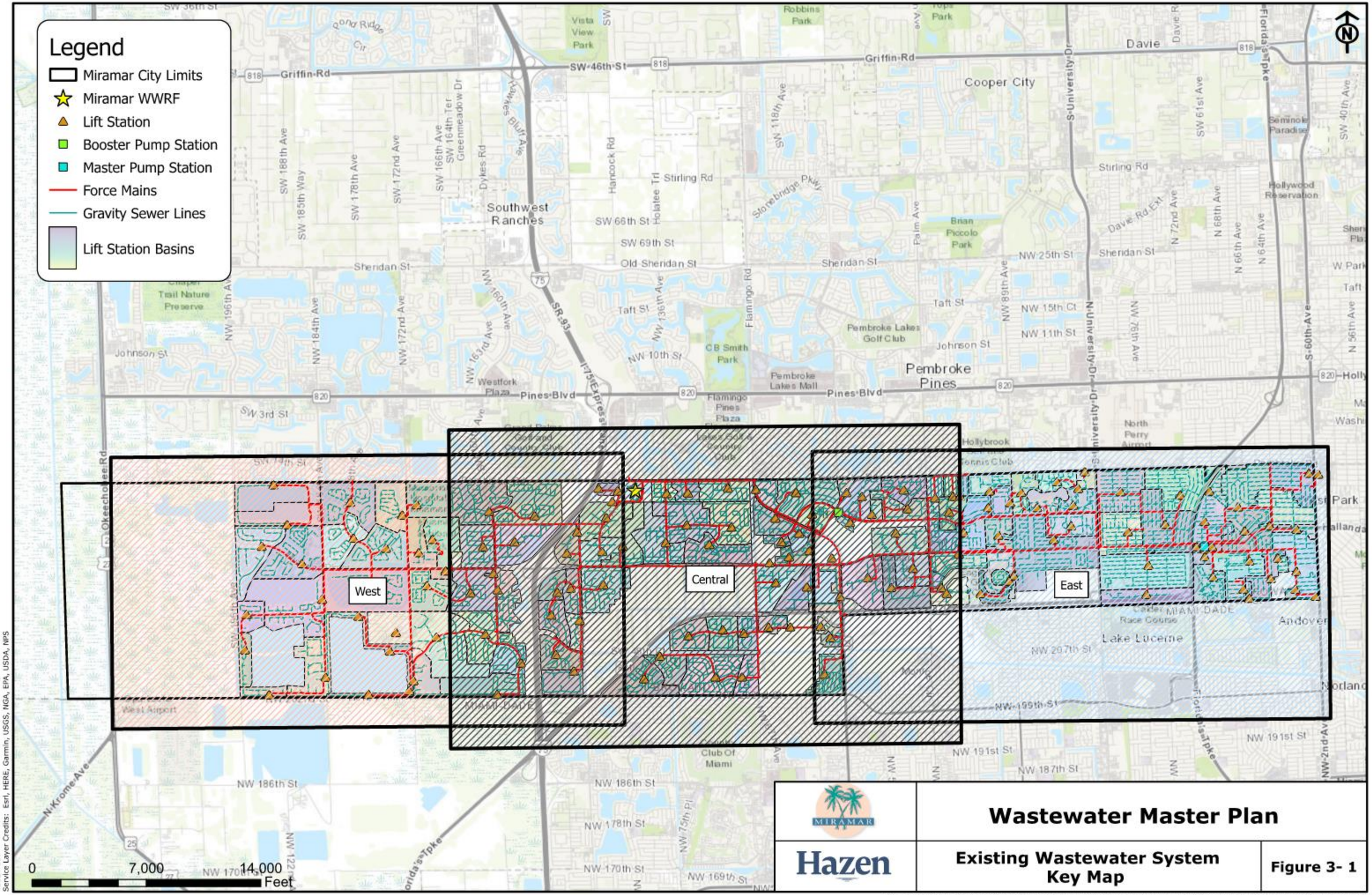
Continual population and land expansion westward through the 1990's was mirrored by expansion of the City's wastewater collection and transmission system. As the City approached its Large User capacity limit, the need for the City's own wastewater treatment plant was realized. The WWRF was constructed and subsequently placed into service in 1997. Initially, wastewater flow from areas west of Palm Avenue were transmitted to the WWRF for treatment, and wastewater collected east of Palm Avenue continued to be conveyed to the SRWWTP for treatment via the MPS. The BPS was commissioned in 2002 to improve hydraulic conditions within the wastewater system and divert a portion of the flow from the MPS to the WWRF. The City's wastewater collection and transmission system continued to expand while the City reduced its reliance on the SRWWTP. Today, wastewater is only transmitted to the SRWWTP during emergencies; the City maintains an emergency capacity allocation of 1.665 mgd (annual average).

Over the last five years, the average discharge from the City of Miramar to the SRWWTP was approximately 0.12 mgd.

As noted in Section 2, the region known as District 3BC is the most recent area to convert from septic to sewer as part of the City's Historic Miramar Infrastructure Improvements (HMII) Program completed in 2021. The area known as County Club Ranches, which has an estimated 3,500 residents, is the only area that is currently serviced by septic tanks and is anticipated to remain unsewered through the year 2045. The City is expected to continue to grow throughout the planning period.

3.3 Existing System

Data from the City's Geographic Information System (GIS) database and City maintenance records were used to develop an asset inventory of the wastewater collection and transmission system. The City maintains a network of approximately 270 miles of gravity sewer, 81 miles of force main, 136 City-owned lift stations, including the MPS and BPS, and several privately owned and maintained lift stations. Figure 3-1 presents the existing wastewater collection and transmission system. In Figure 3-2 through Figure 3-4, larger scale views are provided for more detail.



Wastewater Master Plan

Existing Wastewater System Key Map

Figure 3- 1

Hazen

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Legend

- Miramar City Limits
- Lift Station
- Booster Pump Station
- Master Pump Station
- Force Mains
- Gravity Sewer Lines
- Lift Station Basins

Key Map

24" Emergency Discharge to Hollywood

Pembroke Pines
Hollybrook Club
North Perry Airport
Miramar Pineland Park
Lake Lucerne
Andover
Ronald Reagan Turnpike
Florida's Turnpike
Miramar Blvd
Miramar Pkwy
Palm Ave
SW 89th Ave
University Dr
Red Rd
Snake Creek Canal
BPS
MPS
PAL

0 2,500 5,000 Feet

Wastewater Master Plan

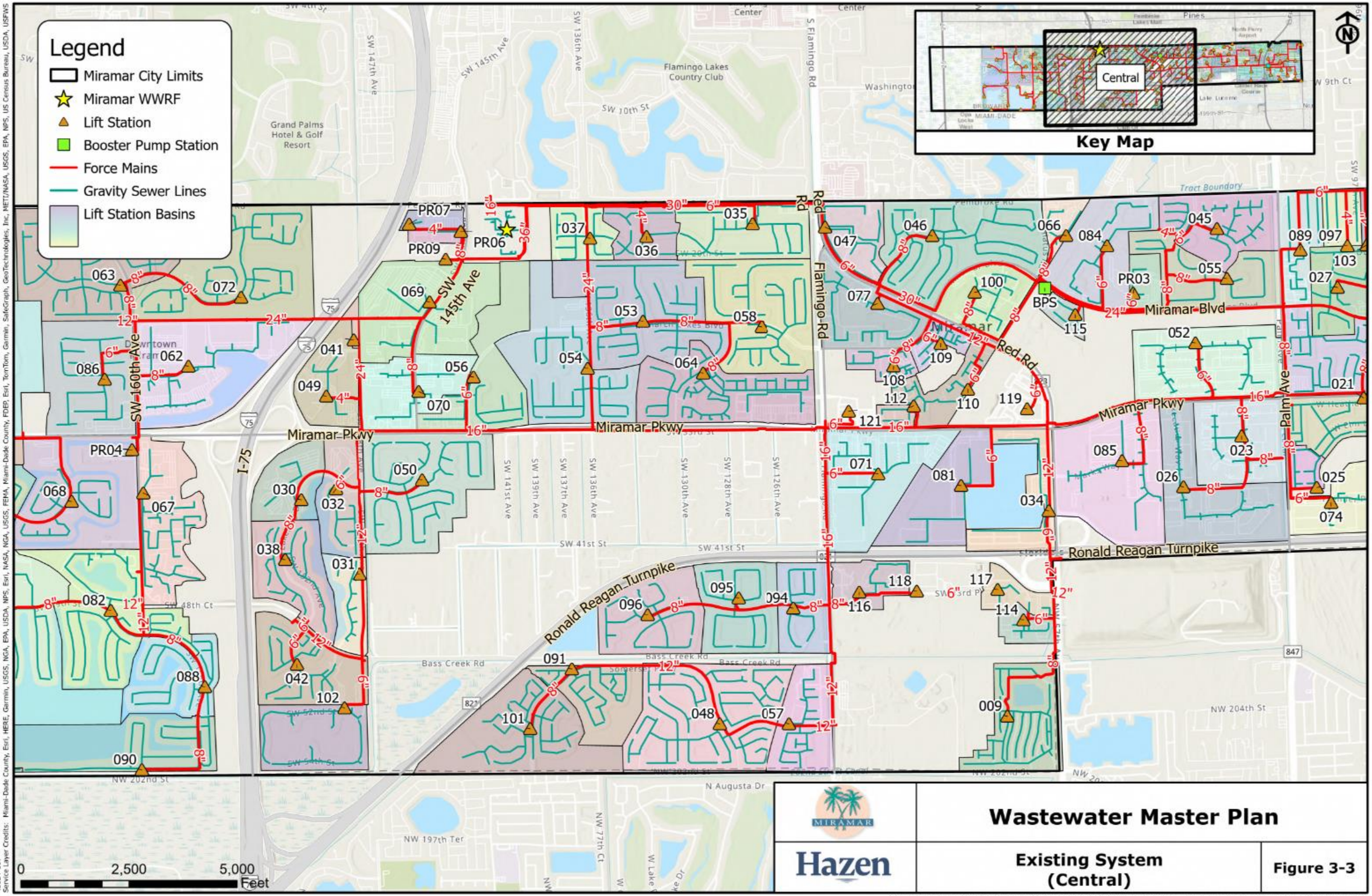
Existing Wastewater System (East)

Figure 3-2

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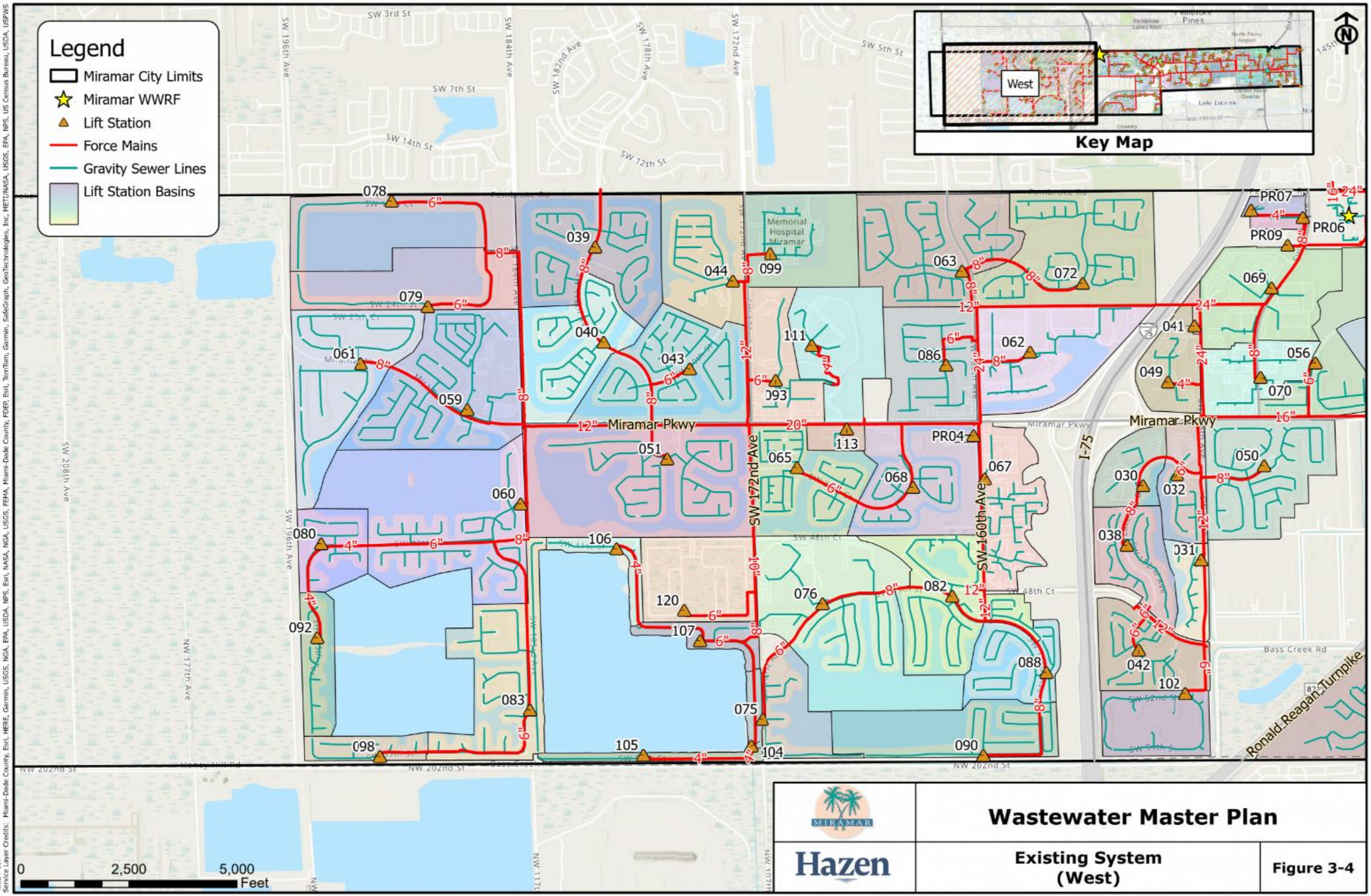


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MIRAMAR / Hazen	**Wastewater Master Plan**	
	Existing System (Central)	**Figure 3-3**

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MIRAMAR

Hazen

Wastewater Master Plan

Existing System (West)

Figure 3-4

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3.3.1 Gravity Sewers

Lift station collection areas, referred to as basins, are comprised of gravity sewers and manholes. The Miramar wastewater collection system consists of approximately 1,424,000 linear feet, or 270 miles, of gravity sewer and 7,062 manholes. Gravity sewers range from 4 inches to 24 inches in diameter. A distribution of the City's gravity sewer inventory by size is presented in Table 3-1. Approximately 99% of the City's gravity sewers are 8 inches in diameter.

Table 3-1: Gravity Sewer Piping Distribution by Size

Diameter (inches)	Length (Linear Feet)	Percentage
4	378	0.0%
6	312	0.0%
8	1,413,926	99.3%
10	4,980	0.3%
12	2,315	0.2%
15	1,603	0.1%
16	60	0.0%
18	440	0.0%
24	25	0.0%

Gravity sewers in the City are classified as polyvinyl chloride (PVC), vitrified clay, ductile iron, or cast iron. Table 3-2 provides a breakdown of the City's gravity sewer inventory by pipe material. PVC is the most common material, accounting for approximately 218 miles of the 270 miles of gravity sewer. Approximately 51 miles of gravity sewers are vitrified clay pipe. The remaining gravity sewer is classified as ductile iron or cast iron.

Table 3-2: Gravity Sewer Piping Distribution by Material

Material	Length (Linear Feet)	Percentage
Cast Iron	161	0.0%
Ductile Iron	1,059	0.1%
PVC	1,151,106	80.8%
Vitrified Clay	270,181	19.0%
Unknown	1,533	0.1%

Table 3-3 presents an inventory of the City's gravity sewers by installation decade. Records of pipe installation dates from the 1960s through the 1990s are not available. Pipe material may provide some indication of age. The use of vitrified clay pipe in sewer systems was phased out by the 1980's in favor of plastic sewer options. In addition, underground infrastructure can be linked to development. Therefore, gravity sewers in western Miramar are anticipated to be newer than piping installed in the eastern or central parts of the City. It is recommended that the City maintain detailed records of pipe installation dates for prioritizing system maintenance and rehabilitation efforts.

Table 3-3: Gravity Sewer Piping Distribution by Installation Decade

Installation Decade	Length (Linear Feet)	Percentage
1950s	130	0.0%
2000s	35,126	2.5%
2010s	29,903	2.1%
2020s	33,986	2.4%
Unknown	1,324,894	93.0%

3.3.2 Force Mains

The Miramar wastewater transmission system includes approximately 429,000 feet, or 81 miles, of active force main, ranging from 2 inches to 36 inches in diameter. Table 3-4 provides a breakdown of the City's force main inventory by diameter. Approximately 50% of the City's force mains are six to eight inches in diameter.

Table 3-4: Force Main Distribution by Size

Diameter (inches)	Length (Linear Feet)	Percentage
2	877	0.2%
4	26,273	6.1%
6	94,609	22.1%
8	120,381	28.1%
10	26,701	6.2%
12	40,139	9.4%
14	6,933	1.6%
16	32,451	7.6%
18	9,488	2.2%
20	7,825	1.8%
24	46,668	10.9%
30	15,273	3.6%
36	1,338	0.3%

Table 3-5 provides the distribution of the City's force main inventory by pipe material. More than half of the City's force main network is constructed of PVC. It is noted that 5% of the City's force mains are not categorized by pipe material within the City's GIS database.

Table 3-5: Force Main Distribution by Material

Material	Length (Linear Feet)	Percentage
Asbestos Cement	470	0.1%
Cast Iron	54,446	12.7%
Ductile Iron	118,212	27.6%
HDPE	468	0.1%
PVC	233,889	54.5%
Unknown	21,472	5.0%

Table 3-6 provides the distribution of the City's force main inventory by installation date. At least 65% of the force mains are less than 40 years old. Approximately 21% of the City's force mains have not been identified by age. In order to prioritize system maintenance and rehabilitation efforts, it is recommended that the City work to identify the age of these pipes.

Table 3-6: Force Main Distribution by Installation Decade

Installation Decade	Length (Linear Feet)	Percentage
1960s	44,963	10.5%
1970s	11,729	2.7%
1980s	78,055	18.2%
1990s	112,251	26.2%
2000s	91,431	21.3%
Unknown	90,527	21.1%

3.3.3 Lift Stations

Lift station information from the City's GIS database was inventoried and compared with maintenance records to determine the number the following:

- Number and location of lift stations within the transmission system
- Commission date for each lift station
- Number and size of pumps
- Lift station type

Records of commission dates for many lift stations were not available. For some of these lift stations, the Broward County Property Appraiser website was utilized to estimate the year of construction based on the construction year of surrounding developments. Four lift stations (LS-118, LS-119, LS-120, and LS-121) were not included as part of the City's GIS database and were located using City maintenance records. A total of 145 lift stations were identified within the transmission system. Eight of these stations are owned and maintained by private developments. The majority of the City's lift stations are duplex submersible stations. There are three triplex stations, including the master pump station (MPS). The in-line booster

pump station (BPS) has four pumps. It is recommended that the City update the GIS database to accurately reflect the existing lift station inventory.

The MPS receives flow from over two dozen upstream lift stations and directs this flow towards the WWRF. Typically, this flow from the MPS bypasses the BPS. When the wastewater system experiences significant wet weather events, the BPS automatically engages to boost flow from the MPS as well as 20 additional lift stations to the WWRF via a 30" force main.

During extreme wet weather events, flow from the MPS is re-routed to the City of Hollywood by changing positions of discharge valves. Over the last five years, this emergency discharge has averaged 0.12 mgd. In 2021, to prevent backwards flow in the force main along Miramar Parkway and to reduce pressure downstream of the MPS, a valve was closed at Tara Road downstream of the LS-007 tie-in. In addition, the BPS suction pressure setpoint was decreased so that the station would engage sooner during peak flow events. These changes have improved conditions at the MPS and reduced reliance on the City of Hollywood's system. However, during heavy rain events, it has still been necessary to divert flow to the City of Hollywood to prevent extreme wet well surcharging and overflows.

Lift station attributes are presented in Table 3-7. Figure 3-5 provides a flow schematic of the wastewater transmission system for the City of Miramar. Re-pumping relationships between lift stations, the MPS, and the BPS are evident in this figure.

Table 3-7: Lift Station Inventory

Lift Station ID	Address	Commission Year	Rehabilitation Year	Number of Pumps	Pump Size, horsepower (hp)
LS-001*	3413 Island Drive	1965	1999	2	20
LS-002	2726 SW 66 Terrace	1968	2017	2	20
LS-003	7021 SW 27 Street	1969	2019	2	15
LS-004	2200 SW 68 Terrace	1959		2	2.4
LS-005	7231 W. Orleans Street	1969	1998	2	30
LS-006*	2654 W. Desoto Drive	1965	1999	3	30
LS-007*	8517 Beekman Drive	1970	2000	3	47
LS-008	1955 S. State Route 7	1971		2	3
LS-009	11201 SW 55 Street	1985		2	20
LS-010	3651 SW 62 Avenue	1974		2	3
LS-011	2801 W. Nassau Drive	1959	1997	2	15
LS-012	7501 Riviera Boulevard	1997		2	2.3
LS-013	2105 W. Oleander Drive	1970	2000	2	30
LS-014	3550 S. Douglas Road	1975	2014	2	40
LS-015	6900 SW 36 Street	1978	2017	2	10
LS-016	2100 Sherman Circle	1980	2021	2	47
LS-017	8530 S. Sherman Circle	1980	2018	2	47
LS-018	8200 W. Sherman Circle	1991	2018	2	10
LS-019	8300 N. Sherman Circle	1980		2	10
LS-020	2747 Buttonwood Avenue	1983	2016	2	7.5

Lift Station ID	Address	Commission Year	Rehabilitation Year	Number of Pumps	Pump Size, horsepower (hp)
LS-021	9700 Miramar Parkway	1983	2015	2	29
LS-022	2350 Dunhill Avenue	1983		2	5
LS-023	3302 Commerce Parkway	1985	2017	2	20
LS-024	2731 Fairmont Avenue	1987	2015	2	20
LS-025	9998 W.Daffodil Lane	1988		2	10
LS-026	3651 Executive Way	1989		2	10
LS-027	2401 N. Riverdale Drive	1989		2	10
LS-028	1900 University Drive	1990		2	2
LS-029	2321 Lake Miramar Way	1992		2	3
LS-030	3451 Lakeside Drive	1991		2	20
LS-031	4150 SW 148 Avenue	1991		2	20
LS-032	3505 SW 149 Terrace	1991		2	20
LS-033	9208 SW 20 Street	1991		2	3
LS-034	4000 SW 112 Avenue	1991		2	20
LS-035	12701 SW 18 Street	1993		2	20
LS-036	13250 SW 19 Drive	1993		2	10
LS-037	1900 SW 135 Way	1993		2	7.5
LS-038	4121 Lakeside Drive	1994		2	15
LS-039	2001 SW 178 Avenue	1994		2	25
LS-040	2801 SW 178 Avenue	1994		2	25
LS-041	14801 SW 27 Street	1995		2	2
LS-042	15181 SW 49 Court	1995		2	20
LS-043	17500 SW 30 Court	1995		2	25
LS-044	17250 SW 23 Street	1995		2	15
LS-045	10271 E. Avalon Boulevard	1996		2	10
LS-046	11801 Renaissance Boulevard	1996		2	15
LS-047	12156 St. Andrews	1996		2	10
LS-048	5300 Somerset Parkway	1996	2020	2	25
LS-049	15051 SW 30 Street	1996		2	10
LS-050	14510 SW 36 Street	1996		2	10
LS-051	17700 SW 34 Street	1996		2	15.4
LS-052	2900 Executive Way	1997		2	15
LS-053	13299 SW 25 Street	1997		2	10
LS-054	2800 SW 136 Avenue	1997		2	7.5
LS-055	2361 E. Avalon Boulevard	1998	2020	2	10
LS-056	2899 SW 143 Avenue	1998		2	10
LS-057	12667 Somerset Boulevard	1998		2	7.5
LS-058	12800 SW 25 Street	1997		2	15.4
LS-059	18592 Miramar Parkway	1998		2	25
LS-060	3801 Sunrise Avenue	1998		2	25

Lift Station ID	Address	Commission Year	Rehabilitation Year	Number of Pumps	Pump Size, horsepower (hp)
LS-061	2999 SW 192 Terrace	1998	2021	2	25
LS-062	15731 SW 29 Street	1998		2	25
LS-063	16102 Silver Shores Boulevard	1999		2	25
LS-064	2899 SW 130 Avenue	1998		2	15.4
LS-065	3651 SW 164 Avenue	1998		2	20
LS-066	11000 Pembroke Road	1999		2	7.5
LS-067	15740 SW 41 Street	1999		2	25
LS-068	16951 SW 37 Court	1999		2	20
LS-069	2300 SW 145 Avenue	1999		2	10
LS-070	3000 SW 145 Avenue	1999		2	10
LS-071	3701 S Flamingo Road	1999		2	15
LS-072	15202 Silver Shores Boulevard	1999		2	25
LS-073	Shirley Branca Park	1989		2	2
LS-074	9890 Premier Parkway	1999		2	7.5
LS-075	5250 SW 171 Street	2000		2	3
LS-076	16855 SW 49 Street	2000		2	15
LS-077	2435 Centergate Drive	2001		2	30
LS-078	18800 SW 24 Street	2001		2	15
LS-079	19001 SW 17 Court	2001		2	15
LS-080	4004 SW 195 Terrace	2001		2	30
LS-081	11600 Miramar Parkway	2001		2	15
LS-082	16210 SW 49 Street	2001		2	20
LS-083	5201 Sunrise Avenue	2001	2018	2	47
LS-084	10796 N. Preserve Way	2001		2	47
LS-085	10901 Marks Way	2002		2	15
LS-086	163th Ave & 29th Street	2002		2	15
LS-087	6301 County Line Road	2003		2	3
LS-088	SW 49th Street Riviera Isles	2001		2	15
LS-089	Tropical Valley #1	2002		2	15
LS-090	SW 54th Street	2002		2	15
LS-091	SW 137 Ave & SW 49 Street	2003		2	50
LS-092	4707 SW 195 Terrace	2006		2	50
LS-093	17051 Miramar Parkway	2004		2	15
LS-094	Silver Falls Blvd & SW 125 Lane	2004		2	20
LS-095	SW 128 Ave & SW 44 Street	2004		2	30
LS-096	13231 Silver Falls Boulevard	2004		2	30
LS-097	2099 SW 97th Terrace	2002		2	15
LS-098	19142 SW 55 Street	2006		2	47
LS-099	1901 SW 172 Avenue	2004		2	20
LS-100	2150 Civic Center Place	2004		2	47

Lift Station ID	Address	Commission Year	Rehabilitation Year	Number of Pumps	Pump Size, horsepower (hp)
LS-101	5141 SW 139 Avenue	2003		2	30
LS-102	14851 SW 52nd Drive	2003		2	20
LS-103	2099 SW 96 Terrace	2006		2	23
LS-104	5362 SW 173 Avenue	2005		2	50
LS-105	17799 SW 54 Street	2009		2	50
LS-106	17942 SW 41 Street	2009		2	47
LS-107	4771 SW 176 Terrace	2009		2	50
LS-108	2691 SW 120 Terrace	2007		2	20
LS-109	2691 SW 118 Way	2007		2	20
LS-110	11500 SW 29 Street	2007		2	45
LS-111	16801 Miramar Parkway	2003		2	7.5
LS-112	SW 31 Ct & SW 119 Terrace	2009		2	20
LS-113	16800 Miramar Parkway	2013		2	23
LS-114	11338 SW 45 Place	2012		2	23
LS-115	2502 SW 110 Avenue	2012		2	23
LS-116	12219 SW 143 Place	2016		2	17
LS-117	4300 SW 113 Terrace	2012		2	23
LS-118	11740 SW 43 Place	2018		2	23
LS-119	3010 SW 113th Way	2021		2	50
LS-120	17605 SW 46 Street	2021		2	35
LS-121	12355 Miramar Parkway	2023		2	45
LS-PR01	4090 S State Road 7	1969		2	2
LS-PR02	6301 County Line Road	Renamed LS-087			
LS-PR03	10701 Miramar Boulevard	2001		2	2
LS-PR04	3500 Dykes Road	2004		2	2
LS-PR05	1800 S University Drive	2014		2	5
LS-PR06	2030 SW 145 Avenue	2014		2	20
LS-PR07	1930 SW 145 Avenue	2014		2	23
LS-PR08	3400 Wildcat Way	2011		2	2
LS-PR09	2030 SW 145 Avenue	2014		2	2
LS-00A	6999 Miramar Parkway	1962		2	3
LS-00B	6450 SW 38 Street (Ficus)	1969	2002	2	10
LS-00C*	3417 Hibiscus Place	1966	2000	2	20
LS-00D	3861 SW 67 Terrace	1965		2	3
LS-00E	4021 S. Lake Terrace	1969		2	2
LS-00F	6180 Miramar Parkway	1992	1993	2	3
LS-00G	6360 SW 34 Court	1968	1993	2	2.3
LS-00H	2692 SW 83 Avenue	2004		2	47
LS-00I	6421 Miramar Parkway	1997		2	30
LS-00J	6020 SW 19 Street	2007		2	25

Lift Station ID	Address	Commission Year	Rehabilitation Year	Number of Pumps	Pump Size, horsepower (hp)
LS-00K	3822 SW 93rd Lane	2009		2	35
LS-00L	3645 SW 90 Avenue	2009		2	35
LS-00M	6701 SW 25 Street	2003		2	30
LS-PAL	7000 Miramar Parkway	1997		2	2.7
BPS*	11190 Miramar Boulevard	2002		4	125
MPS*	7000 Miramar Parkway	1965	1996	3	250

Notes:
1. Lift stations marked with an asterisk (*) have a permanently installed emergency generator
2. Lift stations in bold type re-pump flow from upstream lift stations.

Legend

- Force Main Discharge
- Gravity Main Discharge
- Closed Valve
- Open Valve
- Emergency Discharge to Hollywood SRWWTP

LS-0090 LS-0088
LS-0075 LS-0076 LS-0082
LS-0067
LS-PR04
LS-0065 LS-0068
LS-0105 LS-0104
LS-0106 LS-0107
LS-0120
LS-0099 LS-0044
LS-0111 LS-0093
LS-0039 LS-0040 LS-0043
LS-0078 LS-0079
LS-0061 LS-0059
LS-0060
LS-0092 LS-0080
LS-0098 LS-0083
LS-0051 LS-0113
LS-0102 LS-0042 LS-0031 LS-0050
LS-0038 LS-0030 LS-0032
LS-0072
LS-0063
LS-0086
LS-0062
LS-0041
LS-0049
LS-0069
LS-0070
LS-0035
LS-0036
LS-0037
LS-0058 LS-0064 LS-0053
LS-0054
LS-0056
LS-0071
LS-0096 LS-0095 LS-0094
LS-0117 LS-0118 LS-0116
LS-0101 LS-0091 LS-0048 LS-0057
LS-PR07
LS-PR06
LS-PR09
WWRF
BPS
LS-0121 LS-0112
LS-0081
LS-0034
LS-0114
LS-0009
LS-0026
LS-0023
LS-0074 LS-0025
LS-00K LS-00L LS-0014
LS-0047
LS-0046
LS-0077
LS-0108
LS-0109
LS-0100
LS-0110
LS-0119
LS-0052
LS-0085
LS-0066
LS-0115
LS-0084 LS-PR03 LS-0045 LS-0055
LS-0089 LS-0097 LS-0103
LS-0027
LS-0024
LS-0022
LS-0020
LS-0021
LS-00H
LS-0007
LS-0013
MPS
LS-0011
LS-0012
LS-0005
LS-0006
LS-0001
LS-0016
LS-0019
LS-0028
LS-PRO5
LS-0017
LS-0018
LS-0029
LS-0033
To Hollywood SRWWTP
LS-0003
LS-0004
LS-00M*
LS-00J*
LS-008
LS-00I
LS-0073
LS-00A
LS-PAL
LS-PR08
LS-0002
LS-00F
LS-0015
LS-00D
LS-00C
LS-00B
LS-0010
LS-0087
LS-PR01
LS-00G
LS-00E

*Note: LS-00J and LS-00M serve portions of the Broward County water service area.

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Wastewater Master Plan

Wastewater Transmission System Flow Schematic

Figure 3-5

3.3.4 Additional Assets

Emergency power for lift stations is provided through a combination of permanently installed on-site generators and portable generators housed at the WWRF. Currently, a total of six on-site stationary generators and 19 portable generators are available for use. The on-site generators are permanently installed at lift stations LS-00C, LS-001, LS-006, LS-007, the MPS and the BPS. The portable generators stored at the WWRF are available for rapid deployment in the event of a lift station power outage.

The MPS and BPS generators have diesel fuel tanks with a capacity of 3,000 gallons and 2,000 gallons, respectively. The generator at LS-007 was installed in 2022 and has a 500-gallon diesel fuel tank. The remaining standby generators are each supplied with a 200-gallon diesel fuel tank. The portable generator diesel fuel tanks range from 50 to 200 gallons. During extended lift station power outages, diesel storage tanks are refilled daily by City operations staff. The generators, their location, and size in kilowatts (kW), are presented in Table 3-8.

Table 3-8: Lift Station Generators

Generator ID	Location	Size, kilowatts (kW)
Stationary Generators		
BG-03	LS-BPS	545
BG-06	MPS	500
no I.D.	LS-00C	100
BG-16	LS-001	125
no I.D.	LS-006	150
no I.D.	LS-007	150
Portable Generators		
PG-02	WWRF	100
PG-04	WWRF	100
PG-05	WWRF	100
PG-07	WWRF	150
PG-08	WWRF	120
PG-09	WWRF	120
PG-10	WWRF	300
PG-12	WWRF	120
PG-13	WWRF	120
PG-14	WWRF	120
PG-20	WWRF	120
PG-21	WWRF	120
PG-22	WWRF	120
PG-23	WWRF	25
PG-25	WWRF	120
PG-26	WWRF	120
PG-27	WWRF	140
PG-28	WWRF	45
PG-29	WWRF	45

Staff reports that the mobile generators are stored in an uncovered lot and exhibit some surface corrosion but are otherwise functional. Overall, staff reports the City's 25 generators are in fair to good condition and are exercised weekly.

An important factor when considering deployment of a mobile generator is how its electrical capacity compares with lift station electrical needs. Known pump sizes within the collection system were organized and converted from horsepower to kilowatt (kW) assuming 480-volt, three phase power. A safety factor was applied to account for ancillary electrical equipment and increased electrical draw during pump startup. The recommended kW needed for running two pumps with non-concurrent and concurrent starting were compared with existing portable generator sizes. Suggested generator sizes for each pump horsepower are presented in Table 3-9.

Table 3-9: Recommended Generator Size by Pump Horsepower

Pump Horsepower	Two Pumps, Non-Concurrent Start (kW)	Two Pumps, Concurrent Start (kW)	Recommended Portable Generator Size (kW)
3	20	20	25
10	36	60	100
15	60	60	100
17	60	60	100
20	60	60	100
23	60	60	100
25	60	60	100
29	120	120	120
30	120	120	120
35	120	120	120
40	120	120	120
45	120	120	120
47	120	120	120
50	120	120	120

There are seven portable generators capable of powering the 32 lift stations with pumps greater than 25 hp (excluding the MPS and BPS). Thirteen generators are available to power the 113 lift stations with pumps less than 25 hp. Staff reports that during mass power outages where the number of lift stations without power are greater than the number of available portable generators, staff drives from lift station to lift station to pump down wet well levels. It is recommended that the City consider adding additional portable generators to their inventory. A capital improvements project for the purchase of nine additional portable generators is estimated to cost $990,000. This project is defined as a "Facility Improvement" project. Facility improvements are projects identified to enhance operational effectiveness. This project is identified as FI-PG-01.

3.4 Transmission System Hydraulic Model

The hydraulic model for the City of Miramar wastewater transmission system was updated to reflect current infrastructure and to identify areas with insufficient capacity. The model was initially developed using the WaterCAD hydraulic modeling software from Bentley Systems and imported to InfoWorks ICM by Innovyze. It was calibrated using recorded pressure and flow data to increase accuracy. The model is intended to serve as a planning tool for the identification of anticipated hydraulic deficiencies within the system, the evaluation of potential impacts by future developments, and the assessment of the efficacy of proposed improvements.

As discussed in Section 1.1, Miramar has the option to divert wastewater flow from the Master Pump Station (MPS) to the City of Hollywood's SRWWTP during emergencies. From 2018 through 2021, the last four fiscal years for which records are available, the City's average cost obligation to Hollywood has been $232,000 per year. Due to cost considerations, the City intends to become increasingly self-reliant on its own infrastructure. For this reason, hydraulic modeling scenarios consider that all flow generated within the City of Miramar will be directed to the WWRF and no flow will be diverted to the City of Hollywood.

The two types of hydraulic model simulations are steady-state simulation and extended period simulation (EPS). Steady-state simulation is a snapshot of system performance at a particular time. Steady-state simulation computes the state of the system (i.e., flows, pressures, lift station operating status, wet well levels) assuming that neither the wastewater generation rate nor the system state change with time. EPS determines the dynamic behavior of the system, computing the state of the system continuously as wastewater generation rate, lift station operating status, wet well level, force main pressure, and other factors vary over time. EPS allows the model to evaluate wet well level, daily pump run time, force main pressures, and force main flow rates throughout the system. The Miramar wastewater transmission system was modeled utilizing the EPS technique.

3.4.1 Model Development

The hydraulic model represents the transmission system from the lift station wet wells to the WWRF influent force main. The gravity collection system was not modeled directly; inflows were applied to each lift station based on the estimated total sewer flow in its collection basin. However, the system includes some force mains that discharge into gravity sewers, which convey the flow to downstream lift stations to be re-pumped. These gravity sewers and manholes were included in the model to completely represent the transmission system. Wastewater flows, both current and projected, were incorporated into the model and serve as drivers for model scenario runs.

The model can be used to simulate the operation of the system over a pre-determined time period, including pump cycles, resulting variations in lift station wet well levels, and force main flowrates and pressures. The results are used to predict the likelihood and location of system stress in different scenarios. Indicators of stress predicted by the model include the following:

- Excessive flow velocity, hydraulic pressure and head loss
- High pump runtime

- Lift station wet well surcharges and sanitary sewer overflows (SSOs)

The model was updated based on the current GIS database, as-built drawings, anecdotal information from operations staff, and other City records. Twenty lift stations were identified as missing in the original WaterCAD model and were added to the new model. For all other lift stations, model parameters were checked to verify that they matched these records. In WaterCAD, pumps are represented as links, while in InfoWorks, they are represented as nodes. Due to this structural difference between the programs, all lift station parameters had to be manually added to the new InfoWorks model, which provided an opportunity to check errors in the original model.

Key model inputs included the following:

- Lift station wet well dimensions and elevations
- Pump control levels
- Pump curve characteristics
    - Pump curves were added to the model as sets of multiple points (flow vs. head). The model uses the curves to compute the flow through the pump based on the total dynamic head conditions.
- BPS operation and pressure setpoints
- Piping layout, diameters, and head loss coefficients
- System boundary conditions (WWRF headworks water level)

3.4.2 Lift Station Inflow Hydrographs

To define planning conditions for the transmission system, hydrographs, or flow time series, were developed for typical dry weather and peak wet weather flows for each lift station basin for both current and 2045 conditions. These hydrographs are similar to the WWRF influent flow hydrographs plotted in Figure 2-17 on page 2-26. Dry weather hydrographs were defined as the sum of BSF and GWI. Wet weather hydrographs were defined as the sum of BSF, GWI, and RDII based on a two-year storm event. See Section 2.5.3 for discussion on these components of wastewater flow.

Because monitoring flowrates for each sewer collection basin in the system was not feasible, lift station inflows could not be measured directly. Instead, hydrographs developed for the WWRF in Section 2 were used as the basis for each collection basin, following the assumption that the pattern of wastewater flow would be the same throughout the service area. Total BSF was distributed from water consumption data, and total GWI and RDII were distributed based on basin land area. This approach allows for a reasonably accurate approximation of flow conditions throughout the wastewater system without the need for flow monitoring. Flow approximations can be further refined in the future through detailed I/I field measurements.

Citywide BSF, calculated at 6.4 mgd, was apportioned among lift station basins based on the distribution of potable water consumption in 2020. Wastewater customers in both the Miramar and the Broward County Water and Wastewater Services (BCWWS) water service areas were assigned to lift station basins

based on their location. Their billed water consumption was aggregated to get the total in each basin. For customers in BCWWS District 3BC, billing data was provided by Broward County. Water billing data was unavailable or did not exist for several small or recently developed lift station basins in the City's service area, so consumption amounts for these basins were assumed based on land use, following the City's level of service standards outline in the 2020 Water Supply Plan (WSP).

Wastewater flow from recently developed or sewered areas was not captured in the WWRF influent flowrates measured during the data period, which ended in May 2021. As such, these areas were not included in the analysis that determined BSF to be 6.4 mgd. Excluding these areas, the total potable water consumption was compared to the total BSF to determine a conversion ratio of about 77%. This ratio was then applied to the water consumption of each basin in the wastewater service area, including the newly sewered areas. The result was that the sum BSF of every lift station basin was approximately 6.8 mgd. To calculate a BSF diurnal pattern for each lift station basin, it was assumed that each basin would follow the same normalized pattern as the WWRF influent flow.

The 2020 WSP projections did not delineate projected growth within Miramar. To account for varying levels of growth across different areas of the city, changes in water consumption were estimated based on the TAZ population projections presented in Section 2.3. Percent population growth (or decline) was estimated for each basin based on an area-weighted average of the projected population growth in TAZs that intersect with the basin.

To ensure that the overall calculated increase in water consumption was consistent with the population projections established from the 2020 WSP and the resulting Citywide flow projections, the estimated 2045 water consumption for each basin was multiplied by a uniform adjustment factor. Some basins have no population according to the TAZ forecast, so population growth could not be calculated. These are all small basins in commercial areas. For these basins, growth was assumed to be zero.

Citywide GWI was previously calculated at 2.7 mgd. The wastewater service area covers approximately 23 square miles; therefore, average GWI is about 0.0068 inches per day. This value was applied to every lift station basin, and GWI was calculated based on the area of each basin. Similarly, RDII was calculated using the same RTK parameters developed for the plant influent flow, so it was proportional to basin area (a larger area means more total rainfall).

Key features of all 140 lift station input hydrographs are tabulated in Appendix B. The booster pump station is not included because it does not have a gravity collection basin. Flows to the booster pump station are calculated within the model based on inflows to upstream lift stations.

3.4.3 Model Verification and Calibration

Model verification was accomplished by comparing model predictions to pressure data collected by portable pressure recording devices located at select lift stations. In addition, metered flow data at the WWRF were obtained from the City's Supervisory Control and Data Acquisition (SCADA) system. During calibration, lift station inflows were input to the model to generate force main flows and pressures. Model input parameters were adjusted and simulations were run in an iterative process until differences between the model output and the monitoring data were small enough to justify confidence in the model

results. Objective criteria were used as described later in this section to determine the point at which these differences were acceptable.

3.4.3.1 Field Data Collection

For model calibration, pressure data were collected at key points in the force main system with the assistance of City staff. Pressure monitoring was conducted in two phases and included a total of 30 lift stations. Phase I occurred during a two-week period in December 2021 and included pressure monitoring of 17 lift stations in eastern (Historic) Miramar. Phase II occurred during a two-week period in July 2022 and included monitoring of 14 lift stations in western Miramar. Monitoring for LS-069 was carried out during both Phase I and Phase II activities due to its central location.

Trimble Telog LPR-31-100 pressure recorders were installed at lift stations on the discharge manifold to continuously record pressures in the force main network. Each LPR-31-100 pressure recorder has an isolated strain gauge pressure sensor that can measure pressure between 0 and 100 pounds per square inch gauge (psig) via a ¼" NPT female threaded port. Units were programmed to record a pressure sample once per second and record the minimum, maximum, and average pressure at one-minute intervals. Figure 3-6 presents an example installation of a pressure recorder at Lift Station LS-080. The pressure recorder was installed on an existing saddle tap on the discharge header of the pumps.



Figure 3-6: Trimble Telog LPR-31-100 Pressure Recorder

In addition to the temporary pressure recorders, data from the City's SCADA system were also compiled. SCADA data from permanent pressure transducers installed at 26 lift stations, recorded every fifteen minutes, and SCADA WWRF influent flow data, recorded every five minutes, were collected during the same time periods. The locations of all pressure monitoring locations are presented in Figure 3-7.

Legend

- Miramar City Limits
- Force Main
- Lift Stations Without Pressure Monitors

Pressure Monitoring Locations

- Phase I Telog
- Phase II Telog
- Phase I & II Telog
- SCADA Pressure Transducer

0 7,000 14,000 Feet

45024-007
Service Layer Credits: Esri, HERE, Garmin, USGS, NGA, EPA, USDA, NPS

Wastewater Master Plan

Hazen

Pressure Monitoring Locations | **Figure 3-7**

3.4.3.2 Calibration Methodology

Calibration was performed using data from both monitoring phases. For locations where SCADA data were compiled during both monitoring periods and recorded pressures were inconsistent, model inputs were adjusted to reduce the overall error as much as possible.

For each phase, a single day during the monitoring period was selected for calibration: December 24th, 2021 for Phase I and July 26th, 2022 for Phase II. These days were selected because rainfall events resulted in a wide range of flowrates. On July 26th in particular, there was a significant rain event which led to a peak WWRF influent flowrate of approximately 20 mgd. This improved results by providing a wide range of conditions on which to calibrate the model.

To simulate observed conditions on the calibration day, lift station inflow hydrographs described in Section 3.4.2 were modified uniformly such that the modeled WWRF influent flow and hourly pattern matched the measured values, while the relative distribution of flow among the lift stations was preserved. To ensure that modeled conditions closely mimicked actual operations, it was verified that no flow was discharged to Hollywood. Booster pump station controls were modified to match recorded pressures.

Modeled WWRF influent flow was compared to observed flow. For lift stations with pressure data, the modeled hydraulic grade on the discharge side was compared to the observed hydraulic grade, which was calculated from the recorded pressure and elevation of the pressure recorder. To align the modeled conditions with the field data, adjustments were made as necessary to friction and minor loss coefficients in the model. The calibration process also provided an opportunity to identify and correct errors in model input data, such as incorrect pump curves, pipe sizes, and connections.

The difference between modeled and observed WWRF influent flow was evaluated by comparing the hourly averages using the criteria presented in Table 3-10. These criteria comply with and are partially based on the standards outlined in the Wastewater Planning Users Group Code of Practice for the Hydraulic Modelling of Sewer Systems (WaPUG) (Version 3.001, Amended December 2002).

Table 3-10: Hydraulic Model Flow Calibration Criteria

Criterion	Dry Weather	Wet Weather
Flow Rate	-10% to 10% of measured or <±0.1 MGD	-15% to 25% of measured or <±0.1 MGD
Flow Volume	-10% to 10% of measured or <±0.1 MG	-15% to 25% of measured or <±0.1 MG
Pattern	Modeled and observed curves should be similar	
Surcharging	Corroborated using City data and other historical records	

The method used to evaluate the model error in pressure depended on the source of pressure data. The fifteen-minute polling frequency of the SCADA pressure transducers resulted in data of insufficient resolution for a rigorous quantitative assessment. For these lift stations, the calibration was evaluated qualitatively by plotting the modeled and observed head over time and visually confirming that the curves were similar in their averages, ranges, and patterns.

For lift stations that were monitored with Telog pressure recorders, differences between the hourly average modeled head and observed head were evaluated based on Integral Square Error (ISE). ISE is a statistical measure of goodness-of-fit defined by the following equation[19]:

$$ISE = \frac{\sqrt{\sum_{i=1}^{N}(O_i - M_i)^2}}{\sum_{i=1}^{N} O_i} \text{ x } 100$$

Where:

O_i = observed value for hour i,

M_i = modeled value for hour i, and

N = number of hours.

ISE is dimensionless, allowing comparison across datasets of varying magnitudes. Because the error term $(O_i - M_i)$ is squared, data points with errors of greater magnitude are weighted disproportionately. This makes ISE sensitive to outliers. This is useful because if the model predicts average pressures well and peak pressures poorly, the goodness-of-fit value will reflect that the calibration is flawed.

Evaluation criteria based on ISE are presented in Table 3-11. These rating thresholds have been used in water management modeling for over 40 years[15,20]. A calibration rating of Excellent is desired for final design, but a rating of Good is considered suitable for planning and preliminary design. Therefore, for master planning purposes, the goal of calibration is to achieve an Excellent or Good rating for the majority of lift stations.

Table 3-11: Hydraulic Pressure Calibration Criteria

ISE Range	ISE Rating
0 < ISE ≤ 6	Excellent
6 < ISE ≤10	Good
ISE > 10	Poor

3.4.3.3 Calibration Results

Figure 3-8 compares the modeled and observed WWRF influent flowrates on July 26th, 2022. The pattern of model-predicted flowrates closely follows observed values. With exception of the first hour of the simulation, the modeled flowrate for each hour differed from the observed value by 6% or less, and the total flow volume throughout the simulation period differed from the observed volume by only 1%, meeting the criteria established in Table 3-10. The ISE value is 1.1, or 0.64 if the first hour is excluded; both values corresponding to a rating of Excellent. The greater difference in the first hour is expected due

19 Shamsi & Koran, "Continuous Calibration," *Journal of Water Management Modeling*, 2017 (DOI: https://doi.org/10.14796/JWMM.C414)

20 Marsalek et al., "Comparative Evaluation Of Three Urban Runoff Models," *Journal of the American Water Resources Association*, 1975. (DOI: https://doi.org/10.1111/j.1752-1688.1975.tb00683.x)

to the model initialization process that occurs at the beginning of any simulation and is considered acceptable since flows at that time of day are not critical for identification of system deficiencies.

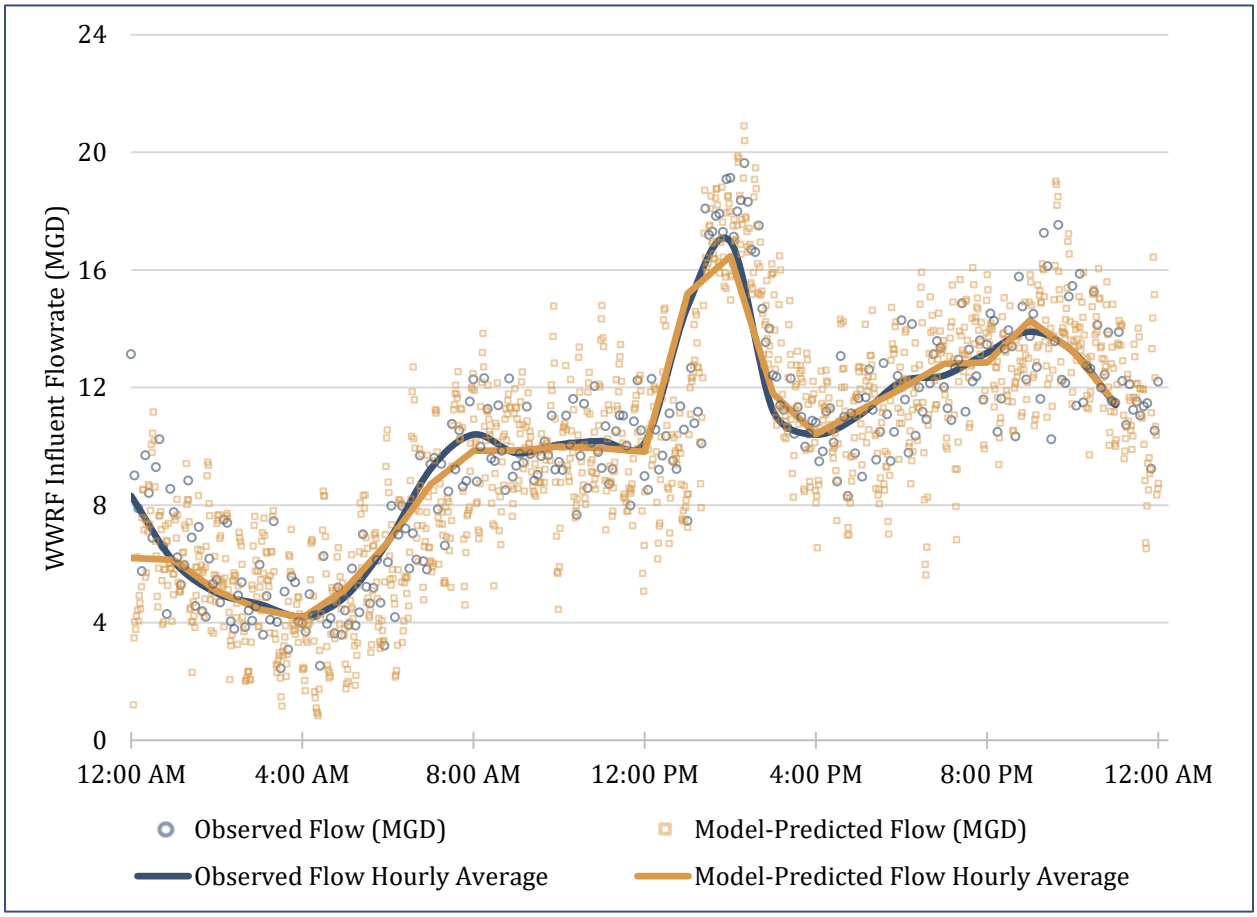


Figure 3-8: Model Calibration WWRF Influent Flowrate Comparison

Figure 3-9 presents the calibration results for LS-059 as an example for typical lift station calibration results. Results for all lift stations with Trimble Telog pressure recorders are presented in Table 3-12 and summarized in Table 3-13[21].

21 Results were not available for LS-065, LS-071, LS-114, and LS-PAL due to malfunctioning of those pressure recorders.

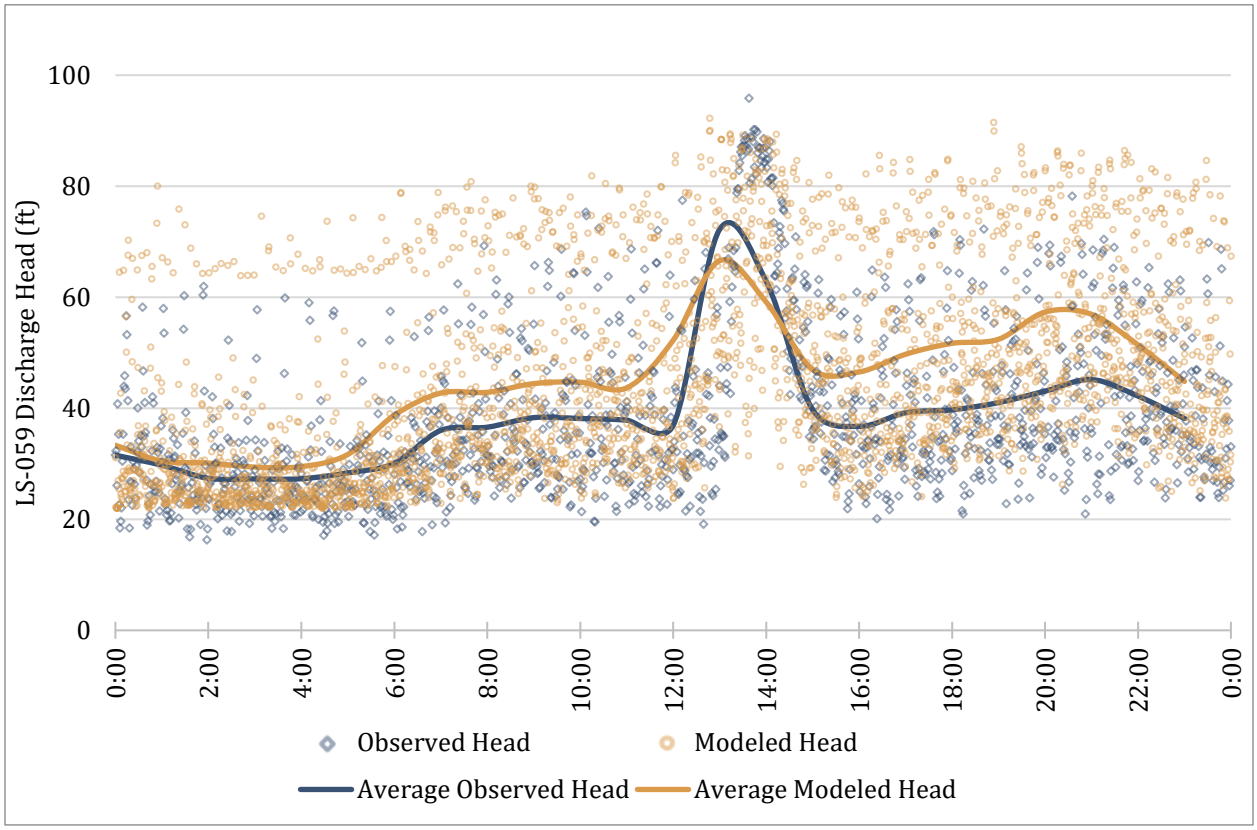


Figure 3-9: Model Calibration LS-059 Discharge Head Comparison

Table 3-12: Model Calibration Lift Station Goodness-of-Fit Ratings

Lift Station	ISE	Rating
005	4.3	Excellent
007	14.8	Poor
011	4.6	Excellent
013	6.2	Good
017	9.7	Good
024	3.4	Excellent
039	4.9	Excellent
047	2.1	Excellent
051	2.9	Excellent
052	2.2	Excellent
054	3.4	Excellent
059	4.3	Excellent
067	2.8	Excellent

Lift Station	ISE	Rating
069	2.2	Excellent
069	3.8	Excellent
070	5.7	Excellent
072	4.2	Excellent
078	4.7	Excellent
080	6.7	Good
081	2.2	Excellent
090	3.3	Excellent
098	3.2	Excellent
099	4.0	Excellent
105	17.5	Poor
106	9.2	Good
00L	2.0	Excellent

Table 3-13: Summary of Goodness-of-Fit Ratings

ISE Goodness-of-Fit Rating	Number of Lift Stations
Excellent	20
Good	4
Poor	2

According to industry standards, the respective ISE values for LS-007 and LS-105 of 14.8 and 17.5 are in the acceptable range for planning purposes but are considered unsuitable for preliminary design[22]. Based on the criteria selected for the Master Plan, these values correspond to Poor calibration ratings. However, these lift stations were investigated, and for reasons discussed below, the results were deemed acceptable.

Figure 3-10 shows that the minimum and maximum modeled head at LS-007 were similar to the observed values. However, during the middle of the day, the modeled pump cycled more frequently than the actual pump did on the calibration day. Thus, the higher head occurred more often in the model, resulting in higher average head. This indicates that the input flow to the wet well was too high. Because the model calibration is based on the conservation of WWRF influent volume, input flow modifications made at one lift station require an equal and opposite modification be made at one or more other lift stations. Therefore, the LS-007 inflow hydrograph could not be adjusted without determining which others should be adjusted with it.

Nevertheless, the results show that the model successfully simulates the same pressure range of the transmission system downstream of the lift station. The mismatch in inflows is not a major concern because the calibration day for LS-007, December 24, 2021, is representative of dry weather flow

22 See Shamsi & Koran, "Continuous Calibration," *Journal of Water Management Modeling,* 2017 (DOI: https://doi.org/10.14796/JWMM.C414)

conditions, which are dominated by base sanitary flow. However, peak flows, which govern capacity constraints, are driven by infiltration and inflow.

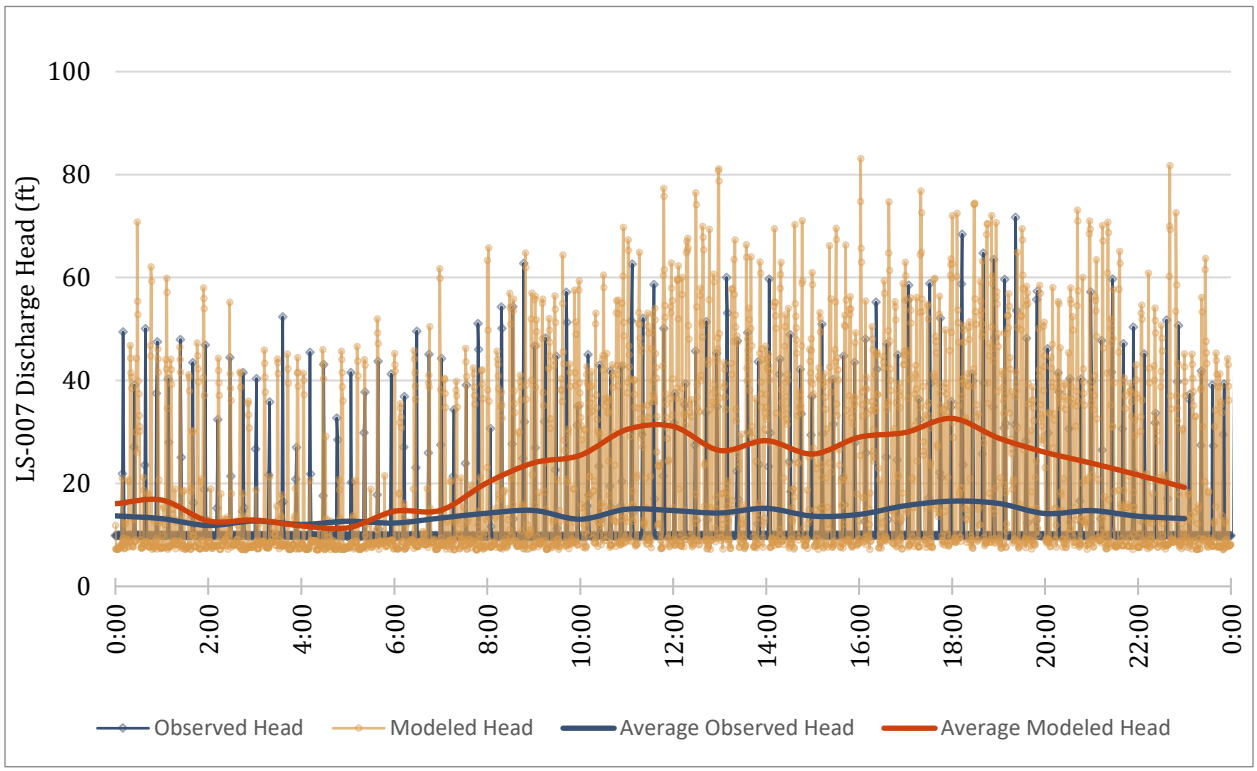


Figure 3-10: Model Calibration LS-007 Discharge Head Comparison

The results for LS-105, illustrated in Figure 3-11, show that the modeled head was consistently higher than the observed head, but this appears to be due to pressure recorder error. LS-105 pumps directly to the WWRF, and during periods of lower influent flowrates, the water level at the headworks is known to be approximately 23 feet. The pressure recorder data show head levels that are consistently lower than this, which is physically impossible. However, the pressure range is similar in the modeled and observed data. If the observed data were to be adjusted higher, it would match the modeled pressure range fairly well. Therefore, despite the poor goodness-of-fit rating, the calibration result for LS-105 is acceptable.

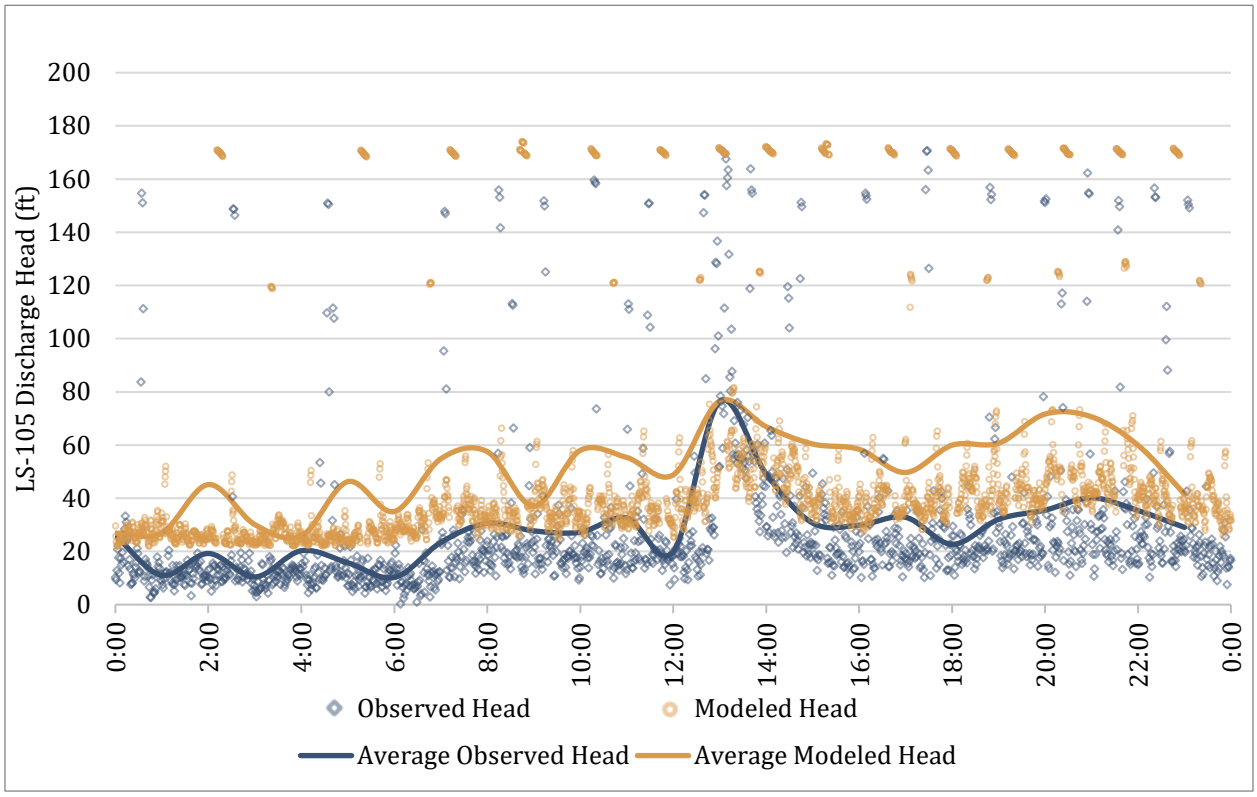


Figure 3-11: Model Calibration LS-105 Discharge Head Comparison

3.4.4 Assessment Criteria

The criteria used to assess the adequacy of the City of Miramar's collection and transmission system are based on standard typical performance guidelines for wastewater systems. These criteria are defined Table 3-14 and include wet well level, force main flow velocity, head loss through force mains, and pump runtime. Model simulation results were evaluated against these performance criteria and form the basis for recommendation of capacity improvements for the transmission system.

Table 3-14: Transmission System Assessment Criteria

Criterion	Standard
Wet Well Level	No surcharge or overflow
Force Main Flow Velocity	2 to 8 feet/second (fps)
Head Loss	Less than 10 ft/1,000 ft for force mains ≥ 500 linear feet
Pump Runtime (NAPOT)	Less than 10 hours per day (duplex station) Less than 20 hours per day (triplex station)

Wet well surcharging indicates overloading of the wastewater system such that the flow is greater than the system is capable of conveying. It is defined as a condition in which the wet well level rises above the

invert of the influent sewer pipe. If the wastewater rises too high in the wet well, there is a potential for an overflow at the wet well or within the collection system. Overflows are public health hazards and permit violations. Overflows are the primary indicators of capacity deficiencies. Capacity improvements were identified such that no wet well surcharging is expected under peak wet weather flowrates.

Force mains should be sized such that the velocity during pumping is between two and eight fps. Low velocities may allow solids to deposit in the force main, reducing the capacity and/or potentially clogging the line. High velocities may result in excessive energy consumption and scouring of the force mains. Excessive head loss associated with high flow velocity may also result in excessive energy consumption. Head loss should be less than 10 feet per 1,000 feet, or 0.01. These criteria exclude piping internal to the lift station.

The existing transmission system was not evaluated for low force main flow velocity; however, proposed improvements were selected such that the velocity in the new force main would be high enough to prevent sedimentation. Excessive force main velocity and head loss in existing large diameter pipe segments of longer length were used to identify capacity bottlenecks. Not all these pipe segments were selected for capacity improvements, but they were identified as areas where potential capacity improvements could have greater impact on surrounding lift stations.

Pump runtime, the hours per day that pumps operate in a lift station, provides a measure of lift station capacity. Many utilities in South Florida consider the Yearly Nominal Daily Average Pump Operating Time (NAPOT) when assessing lift station capacity. NAPOT is defined as the average pump runtime in a 365-day period divided by one less than the total number of pumps installed in that station. As shown in Table 3-14, NAPOT criteria limits pump runtime to 10 hours per day for duplex stations and 20 hours per day for triplex stations. Considered as a single criterion, a run time that slightly or moderately exceeds recommended limits may not trigger the need for improvements. The extent of the excess run time must be evaluated with other assessment criteria to determine the magnitude of the required upgrade.

3.4.5 Simulation Results

Model simulations based on the existing transmission system infrastructure were run for four flow conditions: current dry weather flow, current peak (wet weather) flow, 2045 dry weather flow, and 2045 peak (wet weather) flow. All simulations were performed assuming that no flow was diverted to the City of Hollywood. Flow conditions were defined by the inflow hydrographs discussed in Section 3.4.2. The results were used to evaluate the transmission system based on the assessment criteria previously presented.

Model results predicted lift station wet well surcharges for both dry and wet weather conditions, as presented in Table 3-15. No overflows were predicted for dry weather conditions. Because wastewater flows are expected to increase, any surcharge or overflow predicted in 2022 was also predicted in 2045. However, the increase in predicted problems is slight, reflecting a modest projected population growth. In addition, RDII, the main driver of peak flows, is anticipated to remain the same throughout the planning period.

Table 3-15: Lift Stations Wet Wells Predicted to Surcharge or Overflow

Lift Station	2022			2045		
	Dry Weather Flow	Wet Weather Flow		Dry Weather Flow	Wet Weather Flow	
	Surcharge	Surcharge	Overflow	Surcharge	Surcharge	Overflow
LS-001						
LS-002						
LS-003						
LS-004						
LS-005						
LS-006						
LS-007						
LS-008						
LS-009						
LS-010						
LS-011		X	X		X	X
LS-012						
LS-013						
LS-014						
LS-015						
LS-016						
LS-017						
LS-018						
LS-019						
LS-020	X	X	X	X	X	X
LS-021		X			X	
LS-022						
LS-023						
LS-024	X	X	X	X	X	X
LS-025						
LS-026						
LS-027						
LS-028						
LS-029						
LS-030						
LS-031						
LS-032						
LS-033						
LS-034						
LS-035						
LS-036						
LS-037						

Lift Station	2022			2045		
	Dry Weather Flow	Wet Weather Flow		Dry Weather Flow	Wet Weather Flow	
	Surcharge	Surcharge	Overflow	Surcharge	Surcharge	Overflow
LS-038		X			X	
LS-039						
LS-040						
LS-041						
LS-042						
LS-043						
LS-044		X			X	
LS-045						
LS-046					X	
LS-047		X	X	X	X	X
LS-048		X			X	
LS-049					X	
LS-050						
LS-051		X			X	
LS-052		X	X		X	X
LS-053		X			X	
LS-054						
LS-055						
LS-056						
LS-057		X	X	X	X	X
LS-058					X	
LS-059		X			X	
LS-060		X	X		X	X
LS-061		X	X		X	X
LS-062						
LS-063						
LS-064					X	
LS-065		X			X	
LS-066						
LS-067						
LS-068						
LS-069						
LS-070						
LS-071					X	
LS-072						
LS-073						
LS-074						
LS-075						
LS-076		X			X	

Lift Station	2022			2045		
	Dry Weather Flow	Wet Weather Flow		Dry Weather Flow	Wet Weather Flow	
	Surcharge	Surcharge	Overflow	Surcharge	Surcharge	Overflow
LS-077						
LS-078		X			X	
LS-079		X			X	
LS-080		X	X		X	X
LS-081						
LS-082		X			X	
LS-083		X			X	
LS-084						
LS-085						
LS-086						
LS-088						
LS-089					X	
LS-090		X			X	
LS-091					X	
LS-092		X			X	
LS-093		X			X	
LS-094		X			X	
LS-095						
LS-096						
LS-097					X	
LS-098		X	X		X	X
LS-099		X			X	
LS-100						
LS-101					X	
LS-102						
LS-103						
LS-104						
LS-105						
LS-106						
LS-107						
LS-108					X	
LS-109					X	
LS-110						
LS-111						
LS-112						
LS-113		X			X	
LS-114						
LS-115						
LS-116						

Lift Station	2022			2045		
	Dry Weather Flow	Wet Weather Flow		Dry Weather Flow	Wet Weather Flow	
	Surcharge	Surcharge	Overflow	Surcharge	Surcharge	Overflow
LS-117						
LS-118						
LS-119						
LS-120						
LS-121						
LS-PR01						
LS-PR02						
LS-PR03						
LS-PR04						
LS-PR05						
LS-PR06						
LS-PR07						
LS-PR08						
LS-PR09						
LS-00A						
LS-00B						
LS-00C						
LS-00D						
LS-00E						
LS-00F						
LS-00G						
LS-00H						
LS-00I						
LS-00J						
LS-00K						
LS-00L						
LS-00M						
LS-PAL						
MPS						
Total	**2**	**29**	**10**	**4**	**40**	**10**

Model results predicted excessive force main flow velocity and head loss downstream for many of the lift stations previously predicted to surcharge or overflow. This may indicate that the force mains lack sufficient capacity to convey the flow pumped by upstream lift stations. Improvements were identified to increase force main capacity and alleviate modeled wet well surcharging and overflows.

Modeled pump runtimes were evaluated for lift stations that showed the highest wet well levels during current dry weather flow conditions. None of the stations exceeded ten hours per day with the exception of LS-024, which showed a runtime of 13 hours per day. This lift station also shows wet well surcharging under simulated dry weather flow conditions and has been considered for improvements.

Although staff confirm that actual overflows have not been observed at Miramar's lift stations, many of the lift stations that show surcharges and/or overflows in the model have experienced high pump runtimes during wet weather events. Peak flows simulated by the model reflect a two-year, 24-hour storm of 4.5 inches. Several rain events of similar or greater magnitude have occurred in recent years, including three such events in 2022. In each of these cases, the City has diverted wastewater flow to Hollywood. The model predicts outcomes for such flow conditions without diverting flow. It is possible that if the flow diversion is discontinued, pressure spikes caused by higher flowrates from the MPS could impact lift stations in western Miramar, resulting in surcharges or overflows. It is recommended that the City continue to monitor the transmission system. If elevated wet well levels are observed as predicted by the model, capacity improvements should be implemented to avoid the possibility of overflows at multiple lift stations.

It is noted that RDII was applied uniformly across the service area. This may have impacted model results by overestimating flows in the western areas (with newer construction) and underestimating flows in the eastern areas (with older construction). It also may explain why the model did not identify problems at the MPS despite observed wet well surcharging. The MPS wet well surcharged three times during the three heavy rain events in 2022, including a near overflow in November. As noted previously, the City diverted flow to the City of Hollywood on these occasions. These rain events exceeded the modeled storm event of 4.5 inches in 24 hours. Table 3-16 provides information for each MPS surcharge event observed during 2022 and the corresponding rain event. Historical data demonstrate that flow diversion to Hollywood cannot be discontinued without capacity improvements.

Table 3-16: MPS Wet Well Surcharge Incidents

Rain Event	Total Rainfall Amount	Peak 24-Hour Rainfall Amount	Return Period[1]	Peak Wet Well Level (feet)[2]	Dates of Flow Diversion to Hollywood	Total Gallons Discharged to Hollywood
6/2/2022 – 6/4/2022	9.1 inches	8.4 inches	Between 5 and 10 Years	10.4	6/4/2022 – 6/5/2022	5,316,000
9/26/2022 – 9/28/2022	6.2 inches	4.6 inches	2 Years	11.7	9/27/2022 – 9/29/2022	6,251,000
11/20/2022	6.2 inches	6.2 inches	3 Years	24.5	11/20/2022	1,312,000

[1]Based on 24-hour rainfall amount, according to the Florida Department of Transportation (FDOT) Drainage Manual.
[2]MPS wet well levels typically cycle between about 5 and 7 feet.

3.4.6 Recommended Capacity Improvements

Capacity-related improvements for the City were identified as potential methods to address system deficiencies predicted by the hydraulic model. In addition to the four simulations discussed in the previous section, a hydraulic analysis was conducted to predict the impact of proposed developments in Miramar. The conclusions of the analysis were presented separately in the technical memorandum titled "Hydraulic Impact of Proposed Miramar Development" (March 2024), which is attached as Appendix C. The improvements presented here include all those needed to completely resolve modeled capacity deficiencies assuming connection of all proposed developments.

These projects have been identified for planning purposes only. Feasibility studies of improvements as well as basis of design reports should be undertaken prior to implementation. Additional modeling may be needed in the future to confirm the hydraulic impact of potential improvements as conditions change. Required pump sizes provided in this report are approximate. The model, based on the GIS data available, does not account for friction and minor losses within lift station yard piping, and the required pump head may differ from what was predicted. Future analysis will be necessary during detailed design to determine pump operating points.

Figure 3-12 and Figure 3-13 present the locations of predicted lift station surcharges and overflows. Additionally, these figures provide the proposed improvements recommended to address system deficiencies. Although 40 lift stations experienced wet well surcharging in the model due to transmission system capacity deficiencies, only fourteen of these were identified for capacity upgrades. In much of the City, system capacity was found to be limited by force main size. Seventeen force main improvement projects have been identified to resolve modeled surcharges and overflows.

Improvements were prioritized and assigned recommended implementation timeframes based on the size of impact and level of urgency. Projects needed to resolve modeled overflows under current peak flow conditions are recommended as near term improvements to be completed within 0-5 years. Force main improvements needed to resolve modeled surcharges under current peak flow conditions are recommended to be completed within 5-10 years. Projects required to resolve remaining modeled surcharges or overflows under 2045 peak flow conditions are recommended to be completed in 20+ years. Recommended projects have been prioritized in order to maximize cost-effectiveness of improvements. Not all modeled surcharges are resolved after the first group of projects; the priority is addressing lift stations that have the potential to overflow. Force main improvements are prioritized over lift station capacity upgrades due to their ability to provide relief to multiple lift stations.

Project cost estimates are provided in 2023 dollars and include contractor profit and overhead, permit fee allowances, and contingencies, as well as fees for engineering, permitting and construction management services. Breakdowns of costs are presented in Appendix A. These costs are Class 5 estimates as defined by the Association for Advancement of Cost Engineering International (AACE), with an expected range of accuracy of +100% to -50%.

Legend

- Miramar City Limits
- Existing Force Main
- Lift Station (82 of 145 shown)

Modeled Surcharges and Overflows

- Surcharge under current and 2045 peak flow conditions (8 of 29 shown)
- Surcharge under 2045 peak flow conditions only (6 of 11 shown)
- Overflow under current and 2045 peak flow conditions (6 of 10 shown)
- Overflow under 2045 peak flow conditions only (None)
- Surcharge under current and 2045 dry weather conditions (2 of 2 shown)
- Surcharge under 2045 dry weather conditions only (2 of 2 shown)

Improvements

- Proposed Force Main
- Existing Force Main to be Disconnected
- Proposed Connection
- Proposed Lift Station Capacity Upgrade
- Proposed Master Pump Station

CAP-LS-01 (Proposed MPS)
CAP-FM-01A
CAP-FM-01B
CAP-LS-03
CAP-LS-04
CAP-LS-12
CAP-FM-02A
CAP-FM-02B
CAP-FM-03
CAP-FM-04
CAP-LS-14
Tract Boundary
Hollybrook Club
Miramar Pineland Park
Lake Lucerne
Andover
Beverly Park
Heights
Florida's Tpke N
Snake Creek Canal
Miramar Pkwy
Pembroke Rd
Hollywood Blvd
Sheridan St
Pine Island Rd
Flamingo Rd
Palm Ave
Douglas Rd
University Dr
Dykes Rd
Windsor Dr
Sheraton Dr
Granada Blvd
Alhambra Blvd
Dillido Blvd
Fairway Blvd
Harbour Blvd
Premier Pkwy
Marks Way
W Elm Ln
W Heather Dr
Venetian St
Fillmore St
Pierce St
Plunkett St
Funston St
Mayo St
Fletcher St
SW 5th St
SW 6th St
SW 9th St
SW 12th St
SW 15th St
SW 18th St
SW 26th St
SW 27th St
NW 214th St
NW 213th St
NW 211th St
NW 210th St
NW 208th St
NW 207th St
NW 204th St
NW 202nd St
NW 199th St
NW 43rd Ave
NW 37th Ave
S State Road 7
Florida's Tpke N
MPS
PAL
PR01
PR02
PR03
PR04
PR05
PR08
BPS

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45024-007

Service Layer Credits: Esri, NASA, NGA, USGS, FEMA, FDEP, Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, Inc,

MIRAMAR

Hazen

Wastewater Master Plan

Recommended Capacity Improvements (East)

Figure 3-12

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Legend

- Miramar City Limits
- Existing Force Main
- Lift Station (78 of 145 shown)

Modeled Surcharges and Overflows

- Surcharge under current and 2045 peak flow conditions (24 of 29 shown)
- Surcharge under 2045 peak flow conditions only (8 of 11 shown)
- Overflow under current and 2045 peak flow conditions (6 of 10 shown)
- Overflow under 2045 peak flow conditions only (None)
- Surcharge under current and 2045 dry weather conditions (0 of 2 shown)
- Surcharge under 2045 dry weather conditions only (2 of 2 shown)

Improvements

- Proposed Force Main
- Existing Force Main to be Disconnected
- Proposed Connection
- Proposed Lift Station Capacity Upgrade

CAP-LS-05
CAP-LS-06
CAP-LS-07
CAP-LS-08
CAP-LS-09
CAP-LS-10
CAP-LS-11
CAP-LS-02
CAP-LS-13
CAP-LS-14
CAP-LS-15
CAP-FM-13
CAP-FM-14
CAP-FM-15
CAP-FM-05
CAP-FM-04
CAP-FM-06
CAP-FM-11
CAP-FM-09
CAP-FM-07
CAP-FM-08
CAP-FM-12
CAP-FM-02A

Pembroke Rd
SW 196th Ave
SW 184th Ave
SW 172nd Ave
SW 139th Ave
SW 136th Ave
SW 130th Ave
SW 128th Ave
SW 126th Ave
SW 114th Ave
SW 20th St
SW 24th St
SW 25th Ct
SW 41st St
SW 48th Ct
SW 49th St
SW 52nd St
SW 54th St
Bass Creek Rd
Somerset Pkwy
Memorial Hospital Miramar
Downtown Miramar
Flamingo Pines Shopping Center
Pembroke Crossing Shopping Center
Pembroke Lakes Mall
Flamingo Lakes Country Club
Washington St
821
75

0 3,000 6,000 Feet

45024-007
Service Layer Credits: Esri, NASA, NGA, USGS, FEMA, FDEP, Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, US Census Bureau, USDA, USFWS

MIRAMAR

Hazen

Wastewater Master Plan

Recommended Capacity Improvements (West)

Figure 3-13

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3.4.6.1 Recommended Force Main Improvements

Force main improvements may include the installation of new force mains or redirection/upgrades of existing force mains. Several force main projects identified provide relief to multiple lift stations.

Among the force main improvements are two projects recommended to address surcharging at the MPS. The first, CAP-FM-01A, is an upgrade of the 18-inch MPS discharge force main on Miramar Parkway. This force main was installed between 1965 and 1974 and is nearing the end of its useful life. It is recommended that the nearly two miles of 18-inch force main on Miramar Parkway from the MPS to Tara Road be replaced with a 24-inch force main. In addition, to accommodate anticipated growth in Historic Miramar and reduce reliance on the City of Hollywood's system, the City has identified the need for a second master pump station (CAP-LS-01). The force main for the new master pump station is included under Project CAP-FM-01B. Based on estimated peak hour flowrates, the recommended diameter of the force main is 16 inches. It is noted that because these projects are interrelated, required force main sizes will depend on whether one or both projects are implemented.

Transmission system capacity west of Interstate 75 is constrained by the size of the existing force mains. Force main upgrades are recommended to avoid potential surcharges or overflows at 18 lift stations in this area. Seven of the 15 recommended force main improvement projects (CAP-FM-05, -06, -07, -08, -09, -10, and -13) are west of I-75. These projects have been listed separately for clarity. However, they are interdependent and can be combined as practical.

The 16" force main on Miramar Parkway between Flamingo Road and SW 136th Avenue is another project that offers high value for cost. Upgrading this force main would alleviate problems for over a dozen lift stations (CAP-FM-04).

In other areas of the system, new connections are recommended to redirect flow to force mains with more available capacity, improving overall system capacity with minimal or no new force main (CAP-FM-02, -03, and -10). Projects CAP-FM-11 and -12 include substantial lengths of new force main but provide cost effective solutions by redirecting flow to existing larger force mains.

CAP-FM-01A: Upgrade 18” MPS Discharge Force Main to 24”

Project Need: Although observed wet well surcharging at the MPS was not replicated in the model, the 18” force main from the MPS along Miramar Parkway does not have sufficient capacity to convey peak flowrates without flow diversion to Hollywood. Segments of this force main were installed in either 1965 or 1974. Thus, it is anticipated to be nearing the end of its useful life. To provide sufficient capacity and prevent potential wet well overflows, the entire length of force main from the MPS to the connection with the 24” force main on Tara Road should be abandoned and replaced with a 24” force main. This is illustrated in Figure 3-14. The required size of the new force main should be reevaluated based on the implementation of projects CAP-LS-01 and CAP FM-01B, which include a second master pump station and associated force main.

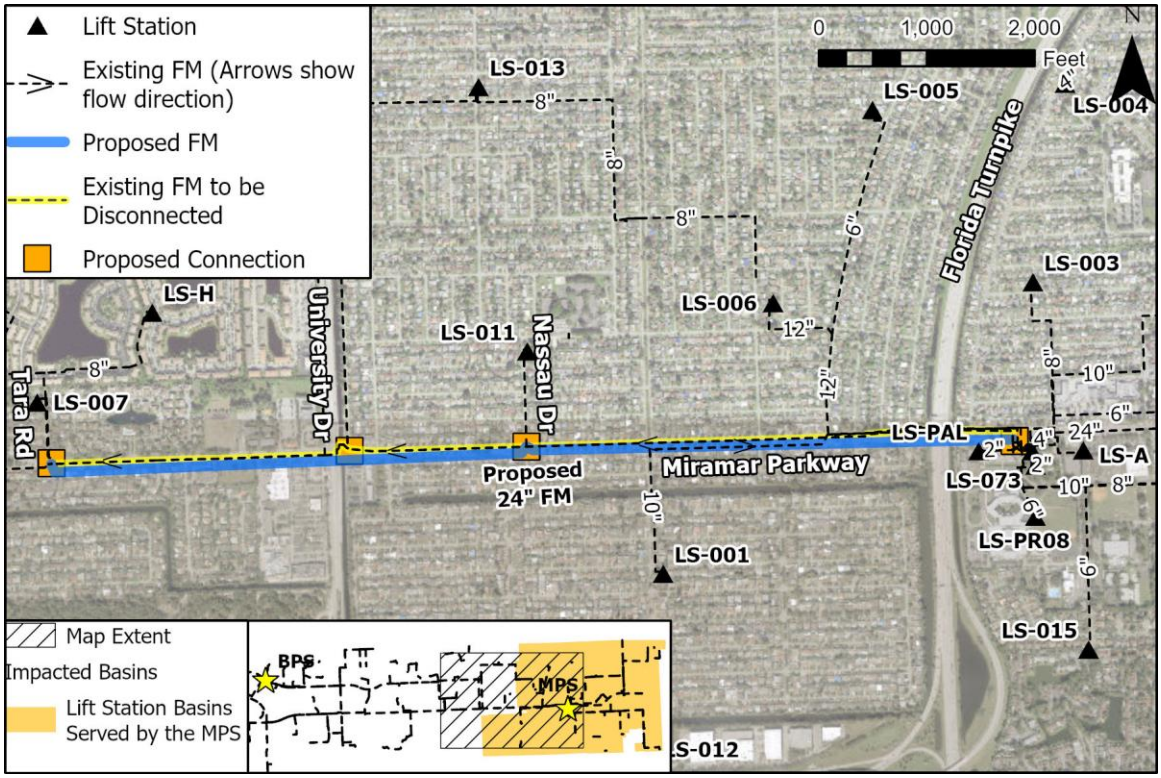


Figure 3-14: Project CAP-FM-01A

Project Description: Construct approximately 9,000 feet of 24” force main along Miramar Parkway from the MPS to the 24” force main on Tara Road. Construct connections to the 6” force main on Nassau Drive and the 8” force main on Utopia Drive. Abandon the existing 18” force main on Miramar Parkway.

Implementation Timeframe: 0-5 Years

Estimated Cost: $8,180,000

CAP-FM-01B: Force Main for Second Master Pump Station

Project Need: To accommodate anticipated growth in Historic Miramar and reduce reliance on the City of Hollywood's system, the City has identified the need for a second master pump station. A conceptual layout of the proposed master pump station and force main is shown in Figure 3-15. The second master pump station is proposed to serve all the City's lift stations north of Miramar Parkway and east of the Turnpike: LS-002, LS-003, LS-004, LS-008, LS-F, LS-I, LS-J, and LS-M. Based on an estimated peak hour flowrate of approximately 3 mgd, the discharge force main is recommended to be 16 inches in diameter. This project has been identified for planning purposes only. The required force main size will depend on a number of factors including the location and delineated sewershed of the proposed master pump station as well as implementation of CAP-FM-01A. It is recommended that the City undertake a feasibility study as well as a basis of design report prior to implementation of this project.

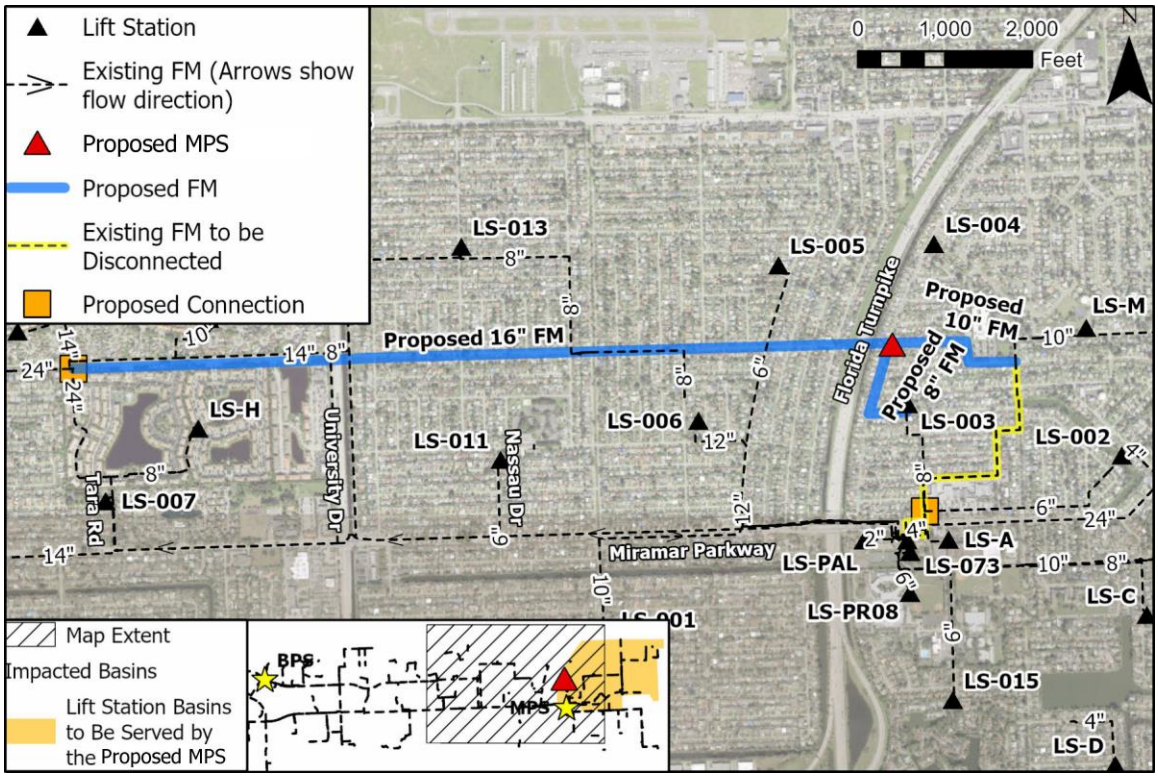


Figure 3-15: Project CAP-FM-01B

Project Description: Construct approximately 1,300 feet of 8" force main along SW 27th Street and Sunshine Boulevard from the LS-003 force main to the proposed MPS and approximately 1,700 feet of 10" force main along SW 26th Street, SW 69th Avenue, and Miramar Boulevard from the LS-M force main to the proposed MPS. Connect the LS-002 force main to the LS-003 force main north of Miramar Parkway to direct the flow to the proposed MPS. Construct approximately 9,400 feet of 16" force main along Miramar Boulevard from the proposed MPS to the existing 24" force main at Tara Road.

Implementation Timeframe: 0-5 Years

Estimated Cost: $8,760,000 – force main only / $19,560,000 total including lift station (CAP-LS-01)

CAP-FM-02A: Redirections to 30” Force Main on Red Road

Project Need: Under current and 2045 peak flow conditions, the model predicts surcharges at LS-046, LS-108, LS-109, and LS-110. Additionally, if all proposed developments are connected, the model predicts overflows at LS-108 and LS-109 (see Appendix C). As shown in Figure 3-16, the flow from these lift stations currently has two paths to the WWRF: south toward the 16” force main on Miramar Parkway or north to the BPS via the 8” force main on Hiatus Road. In either direction, the receiving force main has limited capacity. Redirecting flow west on Red Road (as shown in red) toward the 30” force main downstream of the BPS would provide relief to these lift stations while also eliminating unnecessary re-pumping through the BPS. Upon completion of connection, the 12” force main along Red Road would need to be disconnected as shown to prevent recirculation through the BPS.

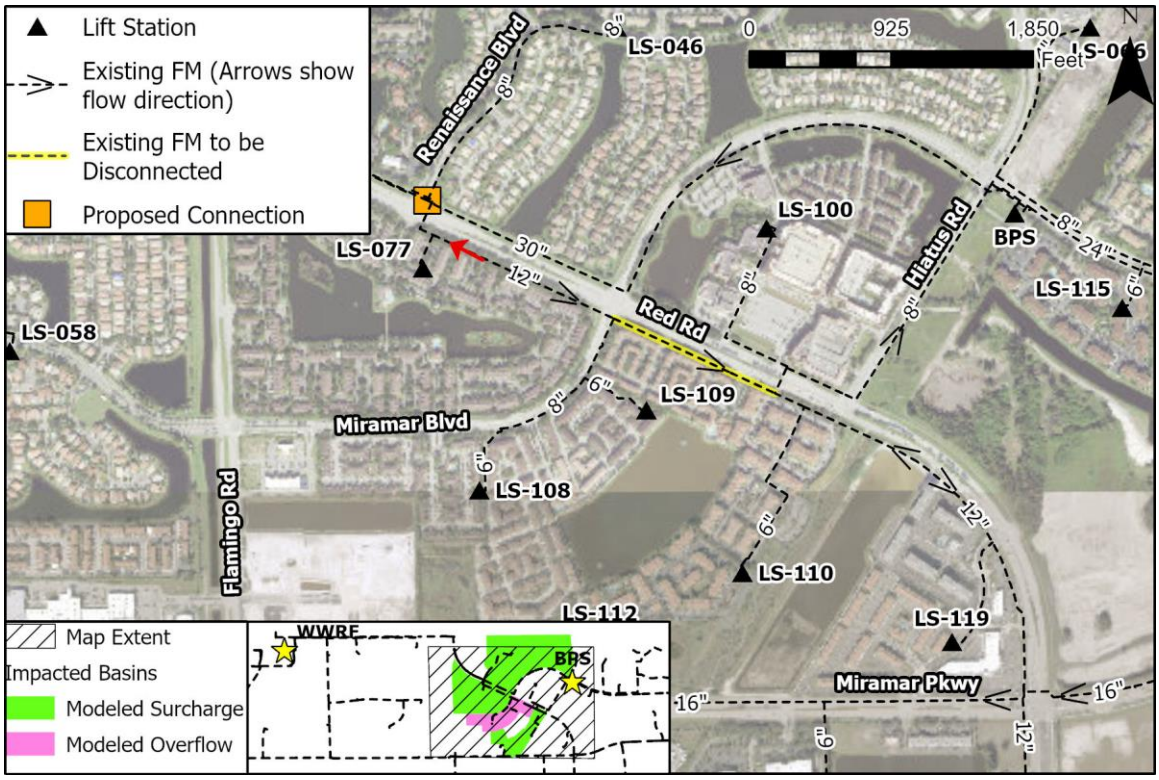


Figure 3-16: Project CAP-FM-02A

Project Description: Connect the existing 8” force main from LS-046 and the 12” force main from LS-077, LS-108, LS-109, and LS-110 to the 30” force main on Red Road. Disconnect the 12” force main along Red Road shown in yellow. Due to their proximity, this project can be combined with CAP-FM-02B as practical.

Implementation Timeframe: 0-5 Years (Prior to connection of MPV VI lift stations)

Estimated Cost: $90,000

CAP-FM-02B: Upgrade 8” Force Main Along Miramar Boulevard

Project Need: Under baseline current and 2045 peak flow conditions, the force main redirection in CAP-FM-02A and force main upgrade in CAP-FM-04, along with recommended lift station upgrades, are sufficient to resolve modeled surcharging at lift stations near the BPS. However, with all proposed developments connected, additional improvements are needed to resolve all modeled surcharging. The 8” force main highlighted in Figure 3-17 receives flow from three other 8” force mains, creating a bottleneck for the flow from these lift stations. Increased force main pressures also impact lift stations discharging west to the 16” force main along Miramar Parkway (not shown). To resolve modeled capacity deficiencies at these lift stations, the 8” force main along Miramar Boulevard should be upgraded as well as the force main along Miramar Parkway (CAP-FM-04).

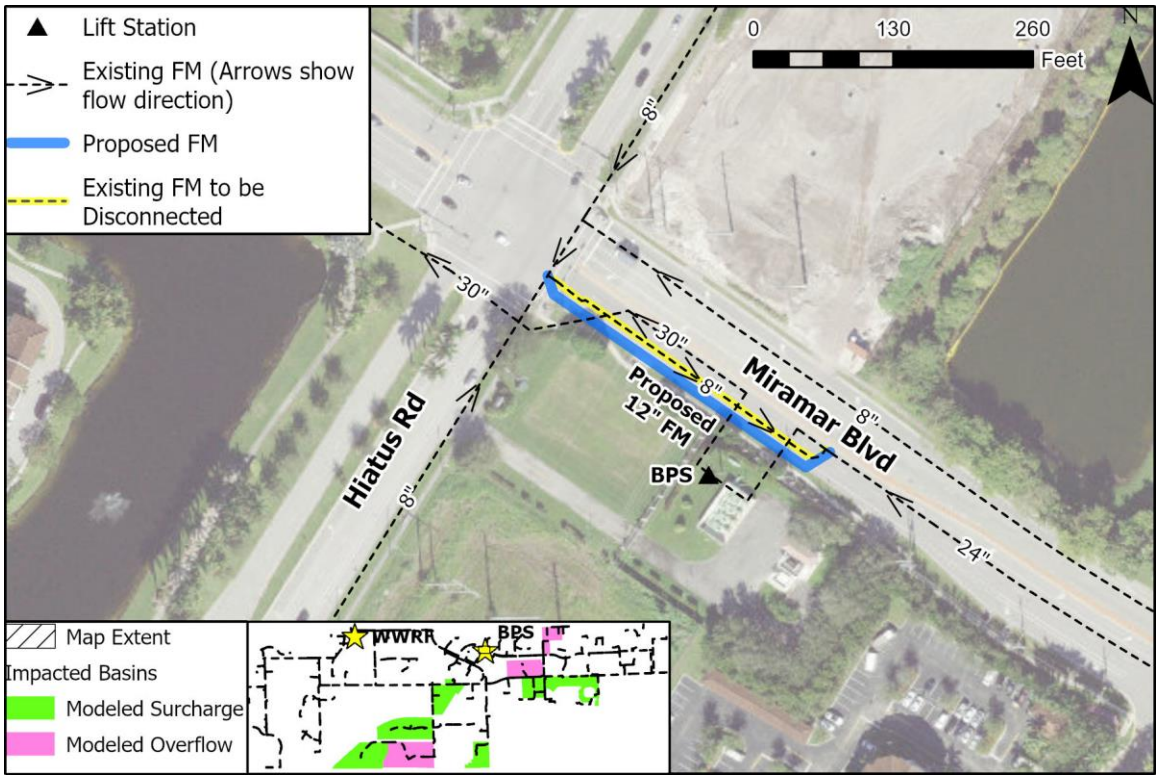


Figure 3-17: Project CAP-FM-02B

Project Description: Construct approximately 300 feet of 12” force main along Miramar Boulevard from Hiatus Road to the 24” force main upstream of the BPS. Disconnect the existing 8” force main. Due to their proximity, this project can be combined with CAP-FM-02A as practical.

Implementation Timeframe: 0-5 Years (Prior to connection of MPV VI lift stations)

Estimated Cost: $220,000

CAP-FM-03: Redirect LS-024 and LS-027 Discharge to Miramar Boulevard

Project Need: Under current and 2045 dry weather flow conditions, the model predicts a surcharge at LS-024. Under current and 2045 peak flow conditions, the model predicts an overflow at LS-024 as well as a surcharge at LS-027. As shown in Figure 3-18, the discharge of LS-027 and LS-024 currently flows to the 16" force main on Miramar Parkway. Model results indicate that pressures in the 24" force main on Miramar Boulevard are significantly lower than in the 16" force main. Connecting the discharge of both LS-024 and LS-027 to the 24" force main would improve pump operating conditions, resolving the modeled problems at these two lift stations. The connection to the Miramar Parkway force main should be disconnected to prevent recirculation.

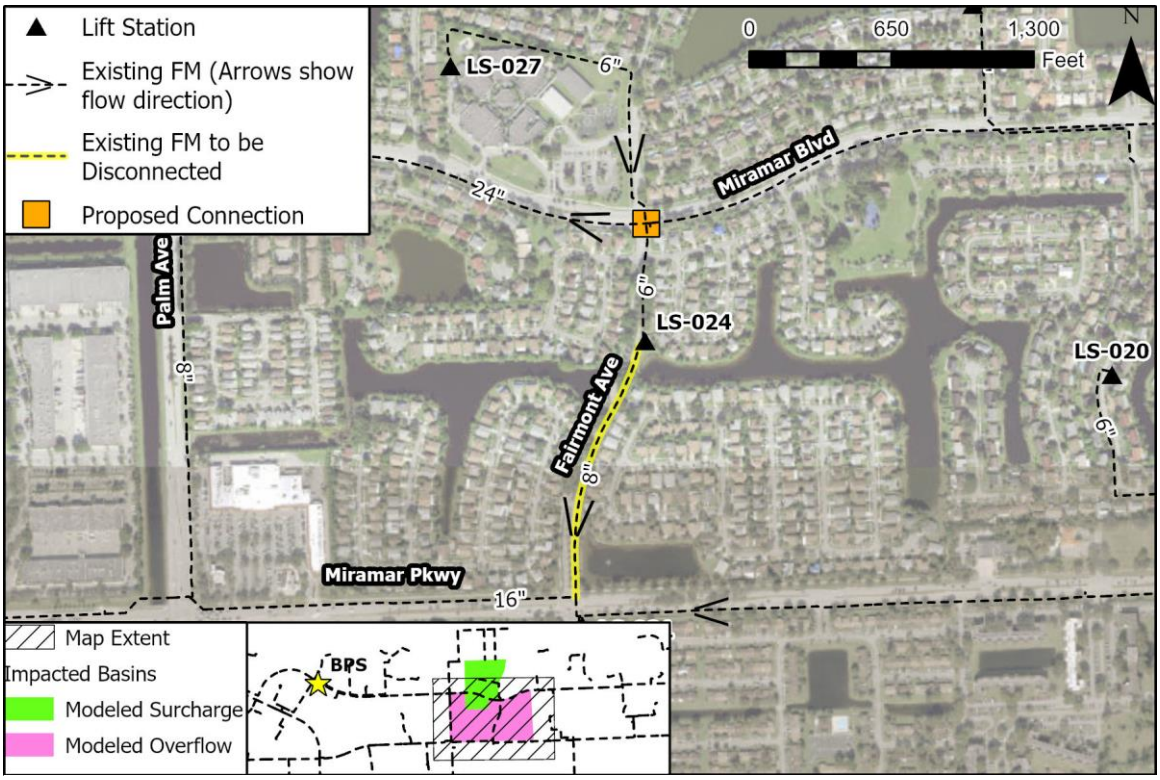


Figure 3-18: Project CAP-FM-03

Project Description: Connect the 6" force mains from LS-024 and LS-027 to the 24" force main at Miramar Boulevard and Fairmont Avenue. Disconnect the 8" force main from LS-024 to the 16" force main on Miramar Parkway.

Implementation Timeframe: 0-5 Years (Prior to connection of MPV VI lift stations)

Estimated Cost: $130,000

CAP-FM-04: Upgrade Force Main Along Miramar Parkway from Flamingo Road to SW 136th Avenue

Project Need: Under current and 2045 peak flow conditions, the model predicts overflows at LS-048 and LS-057 and surcharges at LS-009, LS-071, LS-081, LS-091, LS-094, LS-095, LS-101, and LS-112. Additionally, under 2045 peak flow conditions only, the model predicts a surcharge at LS-096. As shown in Figure 3-19, the existing 16” force main receives flow from two 16” force mains to the east at Flamingo Road, until its connection to the 24" force main at SW 136th Ave. Replacement of this section of force main with a new 24" force main is recommended. The existing force main, which was constructed in 1989, can provide redundancy for the remainder of its useful life. However, it should remain closed under normal operations to ensure that velocities are high enough to prevent sedimentation.

In combination with CAP-FM-02B, the recommended force main is anticipated to alleviate surcharges at all previously noted lift stations with the exception of LS-057. This lift station is still predicted to experience surcharging under peak flow conditions until completion of a lift station capacity upgrade (CAP-LS-14).

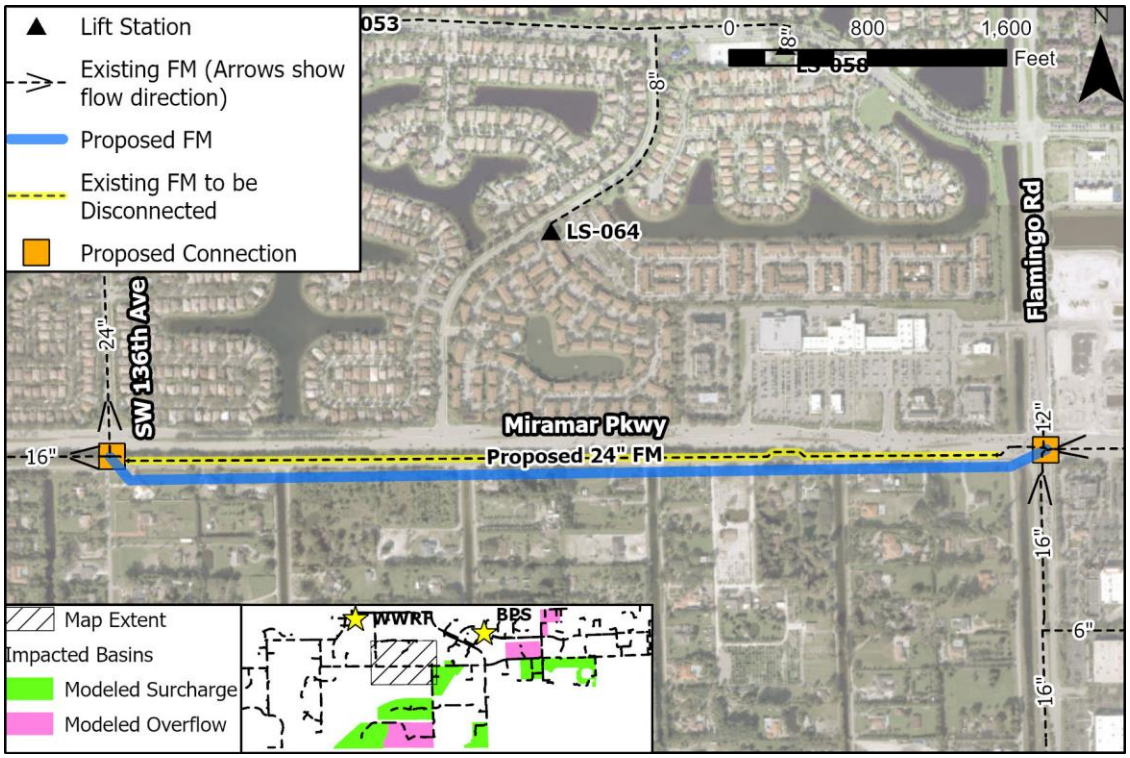


Figure 3-19: Project CAP-FM-04

Project Description: Construct approximately 5,400 feet of 24” force main parallel to the existing 16” force main along Miramar Parkway, connecting to the existing force main at Flamingo Road and SW 136th Avenue. Disconnect the existing 16” force main.

Implementation Timeframe: 0-5 Years (Prior to connection of MPV VI lift stations)

Estimated Cost: $4,480,000

CAP-FM-05: Upgrade Force Main Along Miramar Parkway from SW 184th Avenue to SW 160th Avenue

Project Need: Under current and 2045 peak flow conditions, the model predicts overflows at LS-060, LS-061, LS-080, and LS-098 as well as surcharges at LS-051, LS-059, LS-065, LS-078, LS-079, LS-083, LS-092, and LS-113. As shown in Figure 3-20, the existing force main on Miramar Parkway is 12" from SW 184th Avenue to SW 178th Avenue and 20" from SW 178th Avenue to SW 160th Avenue. It does not have sufficient capacity to convey the flow from these lift stations to the WWRF. Replacement of this entire length of force main with a 24" pipe is recommended. The existing force main, which was constructed in 1989, can provide redundancy for the remainder of its useful life. However, it should remain closed under normal operations to ensure that velocities are high enough to prevent sedimentation. To resolve all modeled overflows and surcharges, additional force main improvements are necessary upstream and downstream (CAP-FM-06, -07, -08, -09, -10, and -13). Lift station capacity upgrades are also needed at LS-065 and LS-113 (see CAP-LS-07 and CAP-LS-11).

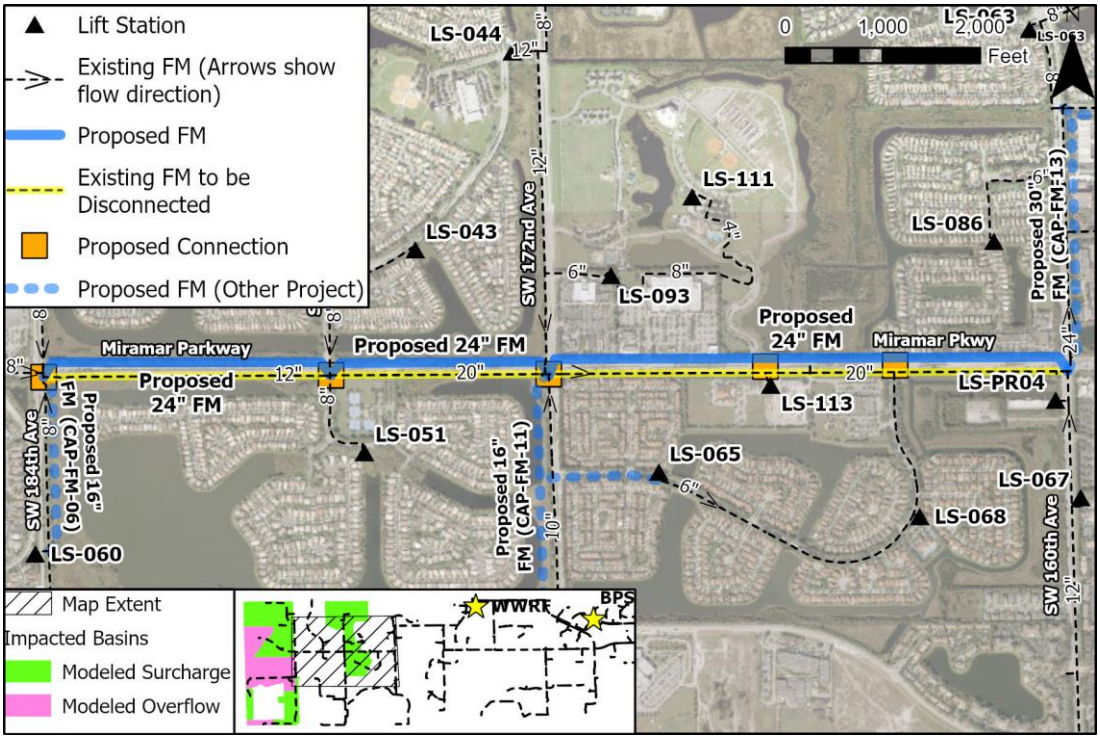


Figure 3-20: Project CAP-FM-05

Project Description: Construct approximately 10,600 feet of 24" force main parallel to the existing force main on Miramar Parkway from SW 184th Avenue to SW 160th Avenue. As shown in the figure, connect to the existing force mains at SW 184th Avenue, SW 178th Avenue, SW 172nd Avenue, and SW 160th Avenue as well as to the force mains from LS-113 and LS-068. Disconnect the existing 12" force main from SW 184th Avenue to SW 178th Avenue and the existing 20" force main from SW 178th Avenue to SW 160th Avenue.

Implementation Timeframe: 0-5 Years

Estimated Cost: $7,520,000

CAP-FM-06: Upgrade Force Main from LS-060 Tie-in to Miramar Parkway

Project Need: Under current and 2045 peak flow conditions, the model predicts an overflow at LS-060. The 8" force main downstream of the LS-060 tie-in on SW 184th Ave does not have sufficient capacity to convey peak flows. As shown in Figure 3-21, replacement with a 16" force main is recommended. The existing force main, which was constructed in 1999, can provide redundancy for the remainder of its useful life. However, it should remain closed under normal operations to ensure that velocities are high enough to prevent sedimentation. Resolution of the overflow is contingent on completion of project CAP-FM-05, the parallel force main shown on Miramar Parkway. To fully resolve the surcharging, further downstream improvements in CAP-FM-13 are also needed.

This improvement is also necessary prior to implementation of CAP-FM-07, -08, and -09 in order to alleviate surcharges and/or overflows at upstream lift stations.



Figure 3-21: Project CAP-FM-06

Project Description: Upon completion of CAP-FM-05, construct approximately 1,800 feet of 16" force main from the LS-060 tie-in on SW 184th Avenue to Miramar Parkway. Disconnect the existing 8" force main.

Implementation Timeframe: 0-5 Years

Estimated Cost: $1,080,000

CAP-FM-07: Proposed 12" Force Main Along Bass Creek Road from Sunrise Avenue to 172nd Avenue

Project Need: Under current and 2045 peak flow conditions, after completion of recommended projects CAP-FM-05 and CAP-FM-06, the model still predicts overflows at LS-080 and LS-098 as well as surcharges at LS-051, LS-059, LS-060, LS-078, LS-079, LS-083, and LS-092. The installation of a 12" force main on Bass Creek Road as shown in Figure 3-22 parallel to the force main on Miramar Parkway would provide another pathway for flow from the lift stations south of SW 40th Street (LS-080, LS-083, LS-092, and LS-098). In addition to providing relief to these lift stations, it would increase available capacity on SW 184th Avenue and Miramar Parkway. To resolve the modeled overflows, CAP-FM-08 and CAP-FM-09 are recommended. To fully resolve all the modeled surcharges, completion of project CAP-FM-13 is also needed.



Figure 3-22: Project CAP-FM-07

Project Description: Upon completion of CAP-FM-05 and CAP-FM-06, construct approximately 6,000 feet of 12" force main along Bass Creek Road from Sunrise Avenue to 172nd Avenue.

Implementation Timeframe: 0-5 Years

Estimated Cost: $2,500,000

CAP-FM-08: Upgrade Force Main Along Sunrise Avenue from LS-083 Tie-in to SW 40th Street

Project Need: Under current and 2045 peak flow conditions, the model predicts an overflow at LS-098 and a surcharge at LS-083. The existing 6" force main directly downstream of these lift stations does not have sufficient capacity to convey peak flows. As shown in Figure 3-23, replacement with a 12" force main is recommended. According to the City's GIS, the existing force main was installed in 2001. It can provide redundancy for the remainder of its useful life. However, it should remain closed under normal operations to ensure that velocities are high enough to prevent sedimentation. Downstream improvements (CAP-FM-05, -06 and -07) are necessary to fully resolve the anticipated issues at these lift stations.

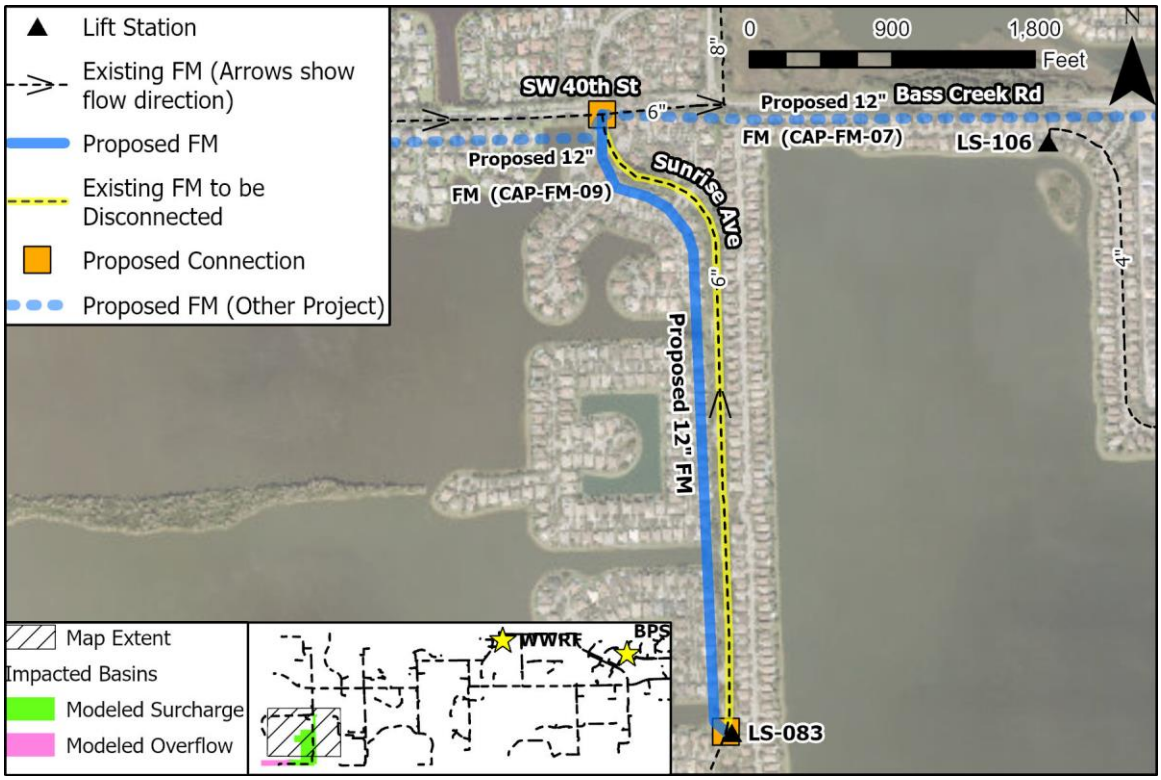


Figure 3-23: Project CAP-FM-08

Project Description: Upon completion of CAP-FM-05, -06, and -07, construct approximately 4,200 feet of 12" force main along Sunrise Avenue from the LS-083 tie-in to the existing 6" force main on SW 40th Street. Disconnect the existing 6" force main on Sunrise Avenue. Alternatively, if the existing force main is kept in service, a parallel 8" force main will provide sufficient additional capacity. Although a parallel force main would be a feasible solution, installing a single force main with sufficient capacity would delay the need for future rehabilitation and would therefore be less expensive in the long run. Costs for both alternatives are provided below, but the Capital Improvement Program was developed assuming the existing force main is to be disconnected.

Implementation Timeframe: 0-5 Years

Estimated Cost: $1,800,000 (Proposed 12" FM) / $1,240,000 (Parallel 8" FM)

CAP-FM-09: Upgrade Force Main Along SW 40th Street from LS-080 Tie-in to Sunrise Avenue

Project Need: Under current and 2045 peak flow conditions, the model predicts an overflow at LS-080 and a surcharge at LS-092. The existing 4" and 6" force main directly downstream of these lift stations does not have sufficient capacity to convey peak flows. As shown in Figure 3-24, replacement with a 12" force main is recommended. According to the City's GIS, the existing force main was installed in 1999. It can provide redundancy for the remainder of its useful life. However, it should remain closed under normal operations to ensure that velocities are high enough to prevent sedimentation. Downstream improvements (CAP-FM-05, -06 and -07) are necessary to fully resolve the anticipated issues at these lift stations.



Figure 3-24: Project CAP-FM-09

Project Description: Upon completion of CAP-FM-05, -06, and -07, construct approximately 4,000 feet of 12" force main along SW 40th Street from the LS-080 tie-in to the existing 6" pipe at the intersection with Sunrise Avenue. Disconnect the existing 4" and 6" force main along SW 40th Street. Alternatively, if the existing force main is kept in service, a parallel 8" force main will provide sufficient additional capacity. Although a parallel force main would be a feasible solution, installing a single force main with sufficient capacity would delay the need for future rehabilitation and would therefore be less expensive in the long run. Costs for both alternatives are provided below, but the Capital Improvement Program was developed assuming the existing force main is to be disconnected.

Implementation Timeframe: 0-5 Years

Estimated Cost: $1,710,000 (Proposed 12" FM) / $1,180,000 (Parallel 8" FM)

CAP-FM-10: Redirect LS-047 Discharge to 30-Inch Force Main

Project Need: Under current and 2045 peak flow conditions, the model predicts an overflow at LS-047. As shown in Figure 3-25, the lift station discharges to a 6" force main that runs south, parallel to the 30" force main on Red Road and connects to the 8" force main on Renaissance Boulevard. Assuming project CAP-FM-02 has been completed, the discharge then flows north through the 30" force main downstream of the BPS. By connecting LS-047 directly to the 30" force main as shown in the figure, head loss would be reduced enough to resolve the anticipated overflow.



Figure 3-25: Project CAP-FM-10

Project Description: Connect the 6" discharge from LS-047 directly to the 30" force main on Red Road. Disconnect the 6" force main on Red Road (shown in yellow) parallel to the 30" line.

Implementation Timeframe: 0-5 Years (Prior to connection of MPV VI lift stations)

Estimated Cost: $70,000

CAP-FM-11: Upgrade Force Main on 172nd Avenue and New 6" Force Main on 37th Court

Project Need: Under current and 2045 peak flow conditions, the model predicts a surcharge at LS-065. As shown in Figure 3-26, the discharge of LS-065 currently flows east through a 6" force main. This force main is more than 4,500 feet long and conveys the discharge of LS-065 and LS-068 to the 20" force main on Miramar Parkway. The surcharge could be alleviated by connecting LS-065 to the force main on SW 172nd Avenue, thereby reducing the total head loss of the flow. However, the 10" force main is undersized and should be replaced with a 16" force main. The existing 6" force main downstream of LS-065 should remain open. The age of the existing 10" force main is unknown, but based on the age of surrounding infrastructure, it is likely less than 30 years old. It can provide redundancy for the remainder of its useful life. However, it should remain closed under normal operations to ensure that velocities are high enough to prevent sedimentation. To fully resolve the modeled surcharge, a lift station capacity upgrade is also recommended at LS-065 (see CAP-LS-07).



Figure 3-26: Project CAP-FM-11

Project Description: Construct approximately 2,600 feet of 16" force main along SW 172nd Avenue from SW 48th Court to Miramar Parkway. Construct approximately 1,100 feet of 6" force main along 37th Court from LS-065 to the new 16" force main. Disconnect the existing 10" force main along SW 172nd Avenue. Alternatively, if the existing force main is kept in service, a parallel 12" force main will provide sufficient additional capacity. Although a parallel force main would be a feasible solution, installing a single force main with sufficient capacity would delay the need for future rehabilitation and would therefore be less expensive in the long run. Costs for both alternatives are provided below,

but the Capital Improvement Program was developed assuming the existing force main is to be disconnected.

Implementation Timeframe: 5-10 Years

Estimated Cost: $1,360,000 (Proposed 16” FM) / $1,120,00 (Parallel 12” FM)

CAP-FM-12: Proposed 8” Force Main from LS-076 to 172nd Avenue

Project Need: Under current and 2045 peak flow conditions, the model predicts a surcharge at LS-076. The lift station does not have sufficient capacity to pump peak flows; a lift station capacity upgrade is recommended in CAP-LS-08. Notwithstanding this upgrade, limited capacity in the receiving force main results in an anticipated surcharge. Like LS-065 in project CAP-FM-11, the flow from LS-076 should be reversed and connected to the existing force main on SW 172nd Ave. The existing path of flow to the east should remain open as well.

Under current and 2045 peak flow conditions, the model also predicts a surcharge at LS-082, which is downstream of LS-076. The proposed force mains would provide relief to this lift station by reducing the flowrate through the 8” force main on SW 49th Street.



Figure 3-27: Project CAP-FM-12

Project Description: Construct approximately 2,100 feet of 8” force main along SW 49th Street and SW 50th Place from the LS-076 tie-in to the 8” force main on 172nd Avenue.

Implementation Timeframe: 5-10 Years

Estimated Cost: $660,000

CAP-FM-13: Upgrade Force Main Along SW 160th Avenue and SW 25th Street

Project Need: The 24" force main shown in Figure 3-28 conveys the flow from all lift stations west of I-75. Under current and 2045 peak flow conditions, after the completion of all previously recommended capacity improvements, the model still predicts surcharges at 11 of these lift stations (LS-051, LS-059, LS-060, LS-076, LS-078, LS-079, LS-082, LS-090, LS-093, LS-099, and LS-113). Constructed in 1989, the 24" force main would be expected to be near the end of its useful life at the end of the planning period. When this force main needs replacement, in order to fully resolve all modeled wet well surcharges in the western part of the city, it should be replaced with a 30" force main.

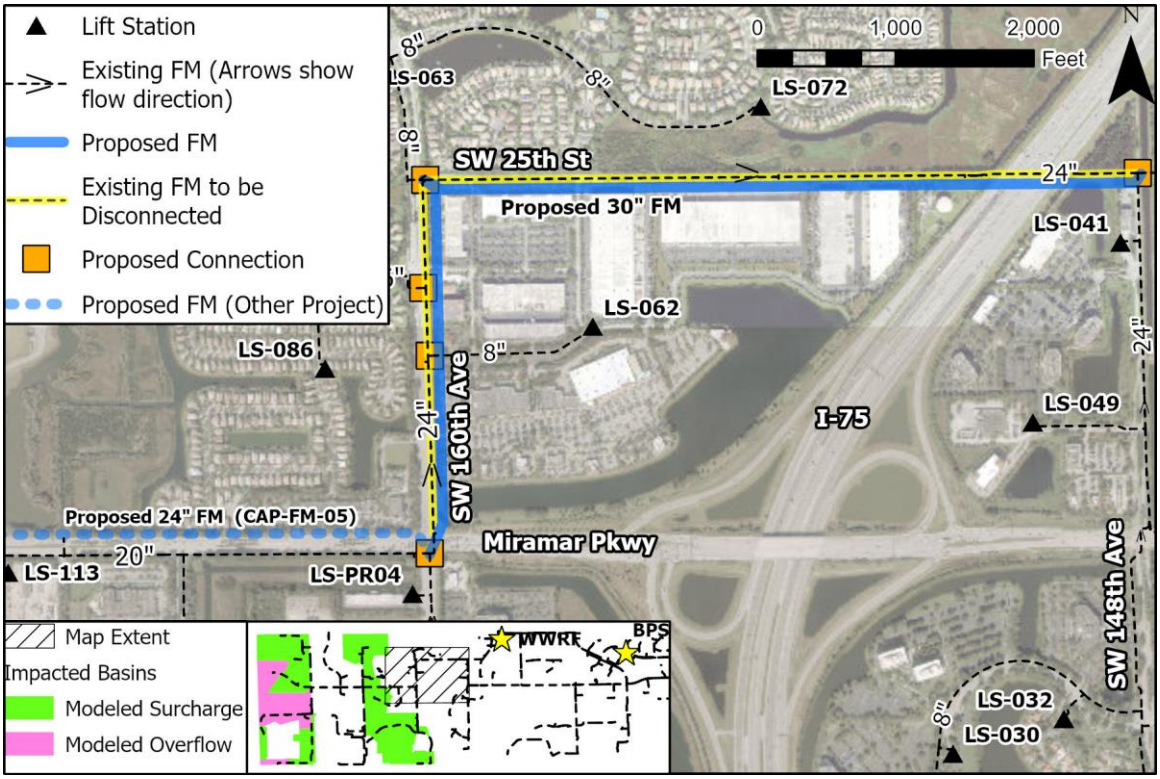


Figure 3-28: Project CAP-FM-13

Project Description: Construct approximately 2,700 feet of 30" force main parallel to the existing 24" force main along SW 160th Avenue from Miramar Parkway to SW 25th Street, including connections for the force mains from LS-062, LS-086 and LS-066. Construct approximately 5,200 feet of 30" force main parallel to the existing 24" force main on SW 25th Street from SW 160th Avenue to the end of SW 148th Avenue (near Fire Rescue Station 84). Abandon the existing 24" force main. This project includes about 600 feet of HHD under I-75.

Implementation Timeframe: 20+ Years

Estimated Cost: $8,530,000

CAP-FM-14: Upgrade Force Main Along SW 25th Street from SW 130th Avenue to SW 136th Avenue

Project Need: Under current and 2045 peak flow conditions, the model predicts surcharges at LS-053, LS-058, and LS-064. Excessive head loss in the model indicates that the 8" force main shown in Figure 3-29 on SW 25th Street does not have sufficient capacity to convey peak flows from these lift stations. The force main was installed in 1998. When it reaches the end of its useful life, it should be replaced with a 12" force main. To fully resolve the modeled surcharge at LS-053, a lift station capacity upgrade is also needed (CAP-LS-13).



Figure 3-29: Project CAP-FM-14

Project Description: Construct approximately 3,200 feet of 12" force main along SW 25th Street from SW 130th Avenue to the existing 24" force main on SW 136th Avenue. Include a connection on SW 132nd Terrace to the LS-053 tie-in. Abandon the existing 8" force main along SW 25th Street.

Implementation Timeframe: 20+ Years

Estimated Cost: $1,450,000

CAP-FM-15: Upgrade Force Main from LS-049 to SW 148th Avenue

Project Need: Under current and 2045 peak flow conditions with existing infrastructure, no hydraulic constraints are identified at LS-049. However, once all preceding improvements are completed, the model predicts a surcharge at LS-049. A capacity upgrade is recommended at this lift station (CAP-LS-11). However, because the discharge force main is too small, the modeled surcharge is not resolved without a force main improvement as well. The force main was installed in 1997. When it reaches the end of its useful life, to fully resolve the modeled surcharge, the existing 4" force main should be replaced with an 8" force main.

This is a low priority project. The City should monitor LS-049 and consider implementing this improvement if the need is realized.

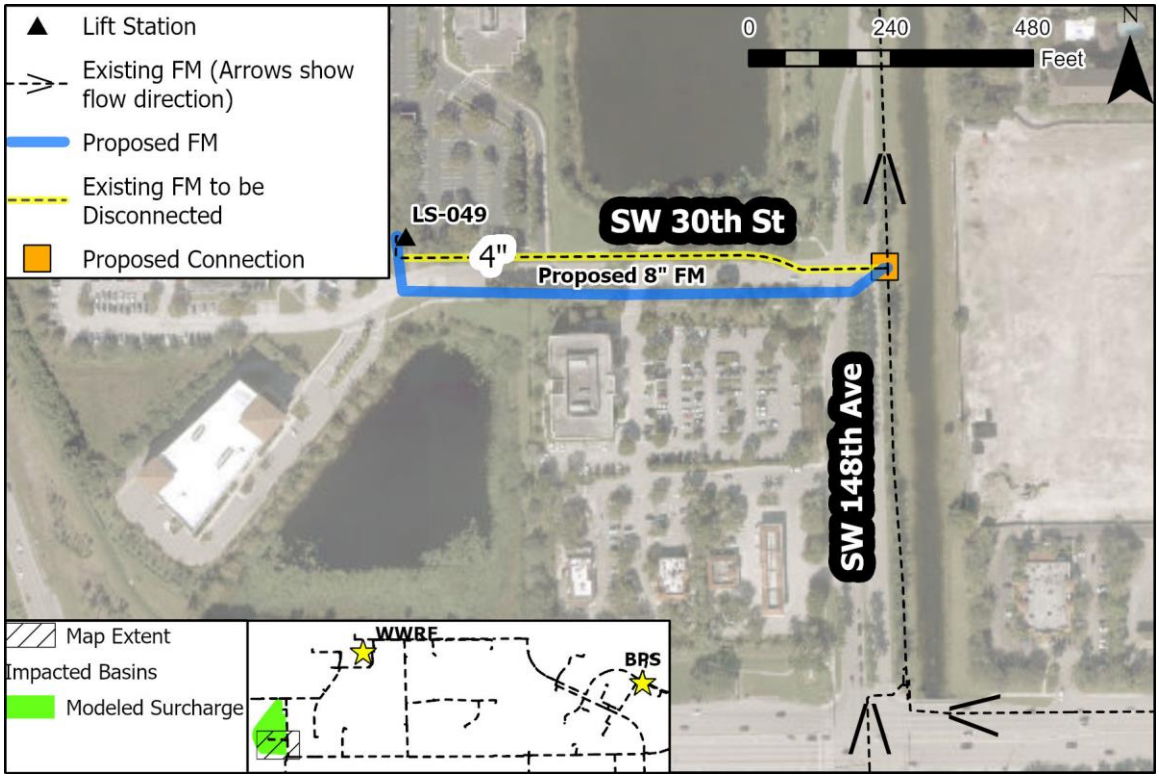


Figure 3-30: Project CAP-FM-15

Project Description: Construct approximately 870 feet of 8" force main on SW 30th Street from LS-049 to the existing 24" force main along SW 148th Avenue. Abandon the existing 4" force main.

Implementation Timeframe: 20+ Years

Estimated Cost: $380,000

3.4.6.2 Lift Station Capacity Upgrades

Lift station capacity upgrade projects were recommended based on the results of hydraulic modeling simulations. For purposes of estimating project costs for these capacity improvements, it is assumed that renewal and replacement will simultaneously occur with upgrades in capacity. In addition to engineering, permitting, and construction management costs, capacity improvement project costs generally include the following items for traditional duplex submersible stations:

- Replacement of pumps and motors
- Replacement of discharge valves
- Replacement of discharge piping
- Re-coating of wet well
- Miscellaneous site improvements such as lighting, fencing, etc.
- Replacement of local control panel and remote telemetry unit
- Replacement of hatches
- Bypass pumping

Lift stations were categorized by size based on the predicted horsepower of the proposed replacement pumps. Estimated costs were established for each size category with adders for stations anticipated to require upgrades in Florida Power and Light (FP&L) service. Pumps with motors equivalent to 20 horsepower or larger generally require 480 volt, 3 phase power. Lift station categories and associated costs are described in Table 3-17.

Table 3-17: Lift Station Improvement Categories

Category	Proposed Pump Size, each (hp)	Opinion of Probable Project Cost
Small	≥3	$314,000
Medium	>3 to <20	$660,000
Large	≥20	$862,000

CAP-LS-01: Second Master Pump Station

Project Need: As discussed in Section 3.4.5, the existing MPS surcharges during heavy rain events. To accommodate anticipated growth in Historic Miramar and reduce reliance on the City of Hollywood's system, the City has identified the need for a second master pump station. A conceptual analysis was done assuming that the sewershed for the proposed master pump station will include LS-002, LS-003, LS-004, LS-008, LS-F, LS-I, LS-J, and LS-M and that the discharge force main will connect to the 24" force main on Miramar Boulevard. Figure 3-31 shows the proposed sewershed and potential master pump station location. Based on modeled wet weather flows and pressures, the proposed master pump station would have to pump approximately 2,000 gpm at approximately 144 feet of head. To satisfy this condition, the proposed master pump station should be equipped with three pumps of approximately 80 hp. The required pump head may differ from what was predicted by the model.

Future analysis will be necessary during detailed design to determine pump operating points. It is noted that the size of the pumps does not significantly impact the cost of constructing a new master pump station.

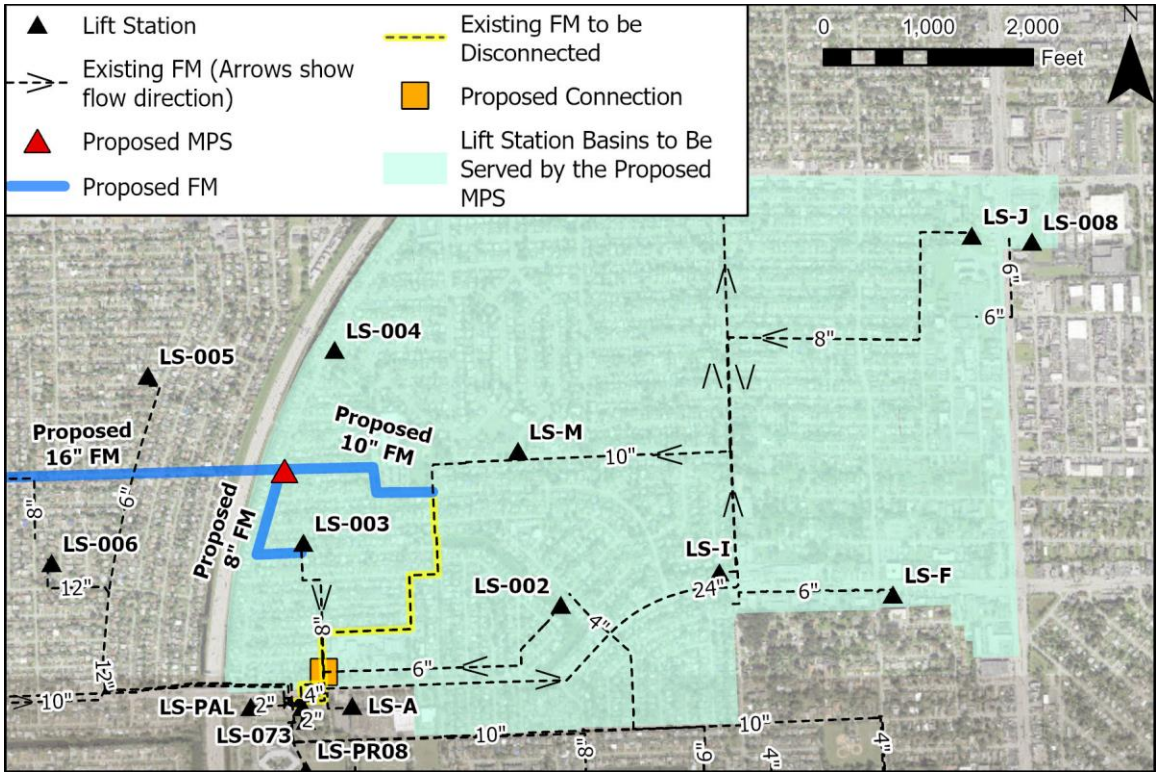


Figure 3-31: Project CAP-LS-01

Project Description: Construct new lift station with three 80-hp pumps. Includes building, onsite generator, site work, and yard piping as well as engineering, permitting, and construction management costs. The force main is included in CAP-FM-01B.

Implementation Timeframe: 0-5 Years

Estimated Cost: $10,800,000 – lift station only / $19,560,000 including force main (CAP-FM-01B)

Note: Cost of property acquisition is not included.

CAP-LS-02: Upgrade LS-056 Pumps

Project Need: Although the model does not predict a surcharge at LS-056 under baseline current and 2045 peak flow conditions, the wet well is predicted to surcharge with all proposed developments connected. The lift station lacks sufficient capacity to pump peak flowrates at the increased head.

Project Description: Upgrade from 10-hp pumps to 15-hp pumps.

Implementation Timeframe: 0-5 Years (Prior to connection of MPV VI lift stations)

Estimated Cost: $660,000

CAP-LS-03: Upgrade LS-011 Pumps

Project Need: Under current and 2045 peak flow conditions, the model predicts an overflow in the LS-011 wet well. The lift station lacks sufficient capacity to pump peak flowrates at the necessary head.

Project Description: Upgrade from 15-hp pumps to 25-hp pumps.

Implementation Timeframe: 0-5 Years

Estimated Cost: $912,000

CAP-LS-04: Upgrade LS-020 Pumps

Project Need: Under current and 2045 dry weather conditions, the model predicts a surcharge in the LS-020 wet well. Under current and 2045 peak flow conditions, the model predicts an overflow. The lift station lacks sufficient capacity to pump peak flowrates at the necessary head.

Project Description: Upgrade from 7.5-hp pumps to 25-hp pumps.

Implementation Timeframe: 0-5 Years

Estimated Cost: $912,000

CAP-LS-05: Upgrade LS-044 Pumps

Project Need: Under current and 2045 peak flow conditions, the model predicts a surcharge in the LS-044 wet well. The lift station lacks sufficient capacity to pump peak flowrates at the necessary head.

Project Description: Upgrade from 15-hp pumps to 25-hp pumps.

Implementation Timeframe: 0-5 Years

Estimated Cost: $912,000

CAP-LS-06: Upgrade LS-061 Pumps

Project Need: Under current and 2045 peak flow conditions, the model predicts an overflow in the LS-061 wet well. The lift station lacks sufficient capacity to pump peak flowrates at the necessary head.

Project Description: Upgrade from 25-hp pumps to 47-hp pumps.

Implementation Timeframe: 0-5 Years

Estimated Cost: $912,000

CAP-LS-07: Upgrade LS-065 Pumps

Project Need: Under current and 2045 peak flow conditions, the model predicts a surcharge in the LS-065 wet well. The lift station lacks sufficient capacity to pump peak flowrates at the necessary head. The receiving force main also lacks sufficient capacity; to resolve the surcharge, project CAP-FM-11 should also be completed.

Project Description: Upgrade from 20-hp pumps to 25-hp pumps.

Implementation Timeframe: 0-5 Years

Estimated Cost: $862,000

CAP-LS-08: Upgrade LS-076 Pumps

Project Need: Under current and 2045 peak flow conditions, the model predicts a surcharge in the LS-076 wet well. The lift station lacks sufficient capacity to pump peak flowrates at the necessary head. The receiving force main also lacks sufficient capacity; to resolve the surcharge, project CAP-FM-12 should also be completed.

Project Description: Upgrade from 15-hp pumps to 25-hp pumps.

Implementation Timeframe: 0-5 Years

Estimated Cost: $912,000

CAP-LS-09: Upgrade LS-113 Pumps

Project Need: Under 2045 peak flow conditions, the model predicts an overflow in the LS-113 wet well. The lift station lacks sufficient capacity to pump peak flowrates at the necessary head. This lift station is anticipated to need rehabilitation in 15-20 years based on its age. For practical reasons, it is recommended that the capacity upgrade be done at this time.

Project Description: Upgrade from 23-hp pumps to 25-hp pumps.

Implementation Timeframe: 15-20 Years

Estimated Cost: $862,000

CAP-LS-10: Upgrade LS-038 Pumps

Project Need: Under current and 2045 peak flow conditions, the model predicts a surcharge in the LS-038 wet well. The lift station lacks sufficient capacity to pump peak flowrates at the necessary head.

Project Description: Upgrade from 7.5-hp pumps to 10-hp pumps.

Implementation Timeframe: 20+ Years

Estimated Cost: $660,000

CAP-LS-11: Upgrade LS-049 Pumps

Project Need: Under current and 2045 peak flow conditions with existing infrastructure, no problems are identified at LS-049. However, once all preceding improvements are completed, the model predicts a surcharge in the wet well. The lift station lacks sufficient capacity to pump peak flowrates at the necessary head. To resolve the surcharge, project CAP-FM-15 should also be completed.

Project Description: Upgrade from 10-hp pumps to 25-hp pumps.

Implementation Timeframe: 20+ Years

Estimated Cost: $912,000

CAP-LS-12: Upgrade LS-052 Pumps

Project Need: Under current and 2045 peak conditions, the model predicts an overflow in the LS-052 wet well. Recommended improvement CAP-FM-04 resolves the overflow, but the wet well would still be expected to surcharge. The lift station lacks sufficient capacity to pump peak flowrates at the necessary head.

Project Description: Upgrade from existing 15-hp pumps to 25-hp pumps.

Implementation Timeframe: 20+ Years

Estimated Cost: $912,000

CAP-LS-13: Upgrade LS-053 Pumps

Project Need: Under current and 2045 peak flow conditions, the model predicts a surcharge in the LS-053 wet well. The lift station lacks sufficient capacity to pump peak flowrates at the necessary head. To resolve the surcharge, project CAP-FM-14 should also be completed.

Project Description: Upgrade from existing 10-hp pumps to 10-hp pumps with higher head.

Implementation Timeframe: 20+ Years

Estimated Cost: $660,000

CAP-LS-14: Upgrade LS-057 Pumps

Project Need: Under current and 2045 peak conditions, the model predicts an overflow in the LS-057 wet well. Recommended improvement CAP-FM-04 resolves the overflow, but the wet well would still be expected to surcharge. The lift station lacks sufficient capacity to pump peak flowrates at the necessary head.

Project Description: Upgrade from 7.5-hp pumps to 10-hp pumps.

Implementation Timeframe: 20+ Years

Estimated Cost: $660,000

CAP-LS-15: Upgrade LS-090 Pumps

Project Need: Under current and 2045 peak flow conditions, the model predicts a surcharge in the LS-038 wet well. The lift station lacks sufficient capacity to pump peak flowrates at the necessary head.

Project Description: Upgrade from 15-hp pumps to 25-hp pumps.

Implementation Timeframe: 20+ Years

Estimated Cost: $912,000

3.4.6.3 Summary of Recommended Capacity Improvements

Estimated costs for all recommended transmission system capacity improvements are summarized in Table 3-18. The total cost in 2023 dollars of the recommended capacity improvements is expected to be approximately $70 million over 25 years.

Table 3-18: Summary of Recommended Capacity Improvements

Planning Period (Years)	Force Main Improvements		Lift Station Capacity Upgrades	
	No. of Projects	Total Estimated Cost	No. of Projects	Total Estimated Cost
0-5 Years	12	$36,540,000	8	$16,882,000
5-10 Years	2	$2,020,000	0	-
10-15 Years	0	-	0	-
15-20 Years	0	-	1*	$862,000
20+ Years	3	$10,360,000	6	$4,716,000
Total	**17**	**$48,920,000**	**15**	**$22,460,000**

*LS-113 is predicted to surcharge under 2045 peak flow conditions. However, it is anticipated to need rehabilitation in 15-20 years based on its age. For practical reasons, it is recommended that the capacity upgrade be done simultaneously with the rehabilitation.

3.5 Renewal and Replacement Evaluation

To identify areas of elevated risk and evaluate infrastructure rehabilitation and/or replacement needs, desktop condition assessments were conducted for assets of the wastewater collection and transmission system. These include the gravity system, force mains, and lift stations. Condition assessments can be used to establish areas of deficiency and/or infrastructure that is approaching the end of its useful life. At the end of an asset's useful lifespan, the asset may fail, resulting in loss of service. Depending on the type of asset, failure mode, and the level of redundancy, the consequence of failure may range from a minor inconvenience to major disruption of customer service.

The City's GIS database contains an inventory of the system assets. It includes characteristics of gravity sewers and force mains such as age, location, diameter, and material as well as lift station characteristics such as age, number of pumps, size of pumps, and lift station type. These asset characteristics, along with maintenance records and feedback from the City, were used to perform a desktop analysis of the gravity system, force mains, and lift stations. An overview of each condition assessment, the methodology used, and conclusions and recommendations are discussed in the following sections.

3.5.1 Gravity System

Although buried infrastructure was not physically evaluated, the general condition of sanitary sewers can be inferred based on the amount of I/I entering the system. As discussed in Section 2.4, AADF I/I was estimated using historical hourly WWRF influent flowrates. This includes GWI, which was estimated from typical minimum flowrates at night, as well as RDII, which was estimated by comparing wet weather flowrates to typical dry-weather flowrates. AADF I/I was estimated at approximately 3.6 mgd, or about 1,700 gallons per day/diameter-inch/mile (gpdim). For comparison, Miami-Dade County has defined excessive I/I (requiring rehabilitation) for its utilities as greater than 5,000 gpdim[23].

City-wide, the collection system is not experiencing excessive I/I. However, there may be sections of the system with excessive I/I, particularly in older areas of the City. It is recommended that the City engage in a program for ongoing assessment and rehabilitation of sanitary sewers to reduce I/I as the collection system ages. Limiting I/I will help the City maintain lower operational costs, continue to avoid SSOs, and preserve capacity at the WWRF.

In addition, a proposed amendment to Section 62-600 F.A.C, which is expected to be ratified in the 2023 legislative session, would require all utilities to assess 25% of their wastewater collection system every five years by smoke testing or other methods (see Section 5 for further details). Establishing a plan for such assessment, as well as subsequent rehabilitation if required, would help the City to remain in compliance with this rule when passed.

Information from the City's GIS database of its wastewater system, which was presented in Section 3.3, was used to assess the expected condition of gravity pipes across the system and determine anticipated renewal and replacement (R/R) needs. Installation dates are not provided for most gravity sewers. However, there is information on pipe material, which is useful for predicting pipe condition and planning

23 Miami-Dade County Code, Section 24-42.2(3)(a)

repairs. More than 99% of the City's gravity sewer is either PVC or vitrified clay; about 80% is PVC and about 20% is vitrified clay. Clay pipes tend to be older, as PVC and other materials have been used more frequently in recent decades. As shown in Figure 3-32, the geographic distribution of pipe material confirms that the clay pipes were installed in the older parts of the system, which were originally constructed in the 1950s, 60s, and 70s.

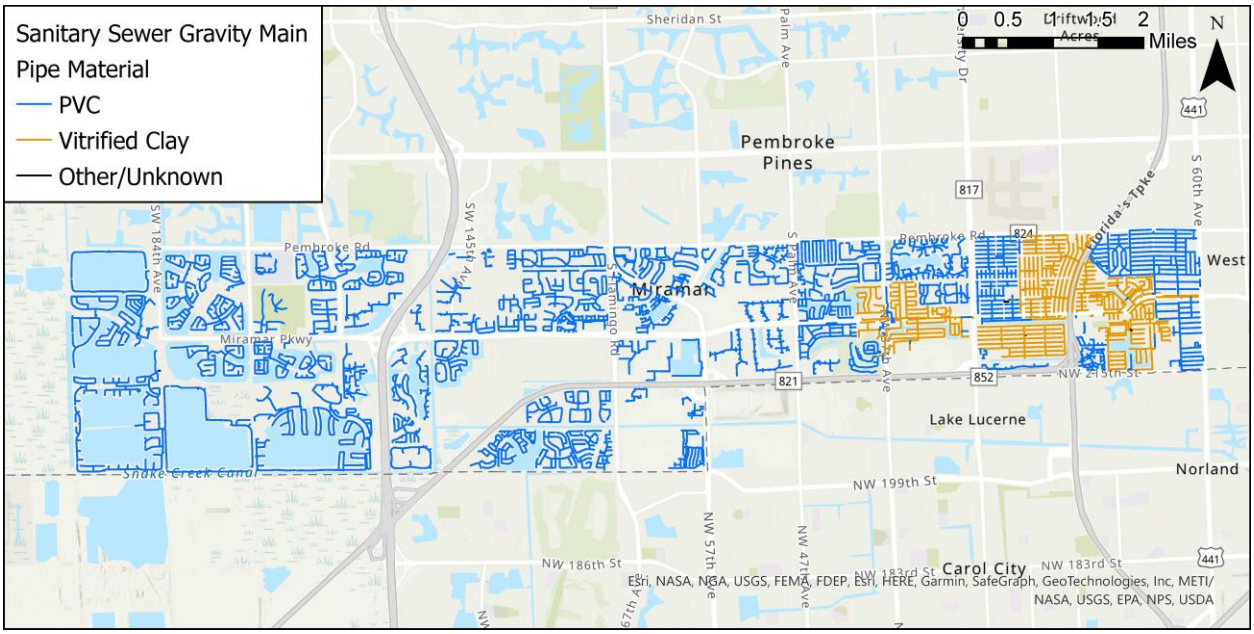


Figure 3-32: Gravity Sewer Pipe Material Map

The standard expected useful life of unlined clay sewer pipes is 50 years. About 20% of the clay pipes have been lined, increasing their expected useful life. It is anticipated that the remaining 80% of clay pipes are nearing the end of their useful life. It is recommended that the City plan to line these pipes by the end of this 25-year planning period.

PVC pipes have a longer expected useful life and are not anticipated to require widespread repairs during the planning period. Failures in PVC piping tend to be at the joints; therefore, when they do need repair, the preferred method is an excavation point repair or pipe segment replacement if necessary.

An order-of-magnitude cost estimate was completed based on the potential requirement to screen 25% of the system every five years and the anticipated rehabilitation needs previously noted. This estimate is intended to provide the City with guidance on future budgetary needs for R/R improvements to the gravity system. Estimated costs for inspection and rehabilitation are provided in Table 3-19. The total expected cost over 25 years is $26,410,000, with an approximate average annual cost of $1,056,000. Annual costs will depend on the City's spending; more up-front spending on R/R will result in lower annual costs in the following years and vice versa. A detailed breakdown of these costs is provided in Appendix A.

Table 3-19: Gravity Sewer Assessment and Rehabilitation Costs

Task	Estimated Cost Every 5 Years
Inspection	
Preliminary Evaluation and Prioritization	$68,000
Smoke Testing	$48,000
Manhole Inspection	$53,000
Cleaning and Video Inspection of Mains	$203,000
Cleaning and Video Inspection of Laterals	$117,000
Program Management and Reporting (20%)	$98,000
Subtotal	**$587,000**
R/R	
Lining – Manhole to Manhole	$1,367,000
Lining – Sectional	$134,000
Lining – Lateral	$712,000
Excavation Points Repair	$312,000
Excavation Line Replacement	$32,000
Manhole Liners – Cementitious	$199,000
Manhole Liners – Cementitious/Epoxy or Polyethylene	$74,000
Manholes Repairs – Miscellaneous	$85,000
Engineering and Construction Management (20%)	$583,000
Subtotal	**$3,498,000**
Estimated Total Over 5 Years	**$4,085,000**
Contingency (30%)	**$1,226,000**
Total Cost Over 5 Years	**$5,311,000**
Total Cost Over 25 Years	**$26,555,000**
Approximate Annual Cost	**$1,062,000**

3.5.2 Force Mains

The force main condition assessment is a desktop study that assigns risk scores to pipe sections to assist the City with a prioritized approach to address rehabilitation and/or replacement of existing underground infrastructure. Field assessments such as non-destructive or destructive testing of piping were not included. The force main condition assessment consists of the following tasks:

- Assessment of physical condition and probability of failure for each pipe segment
- Assessment of consequence of failure criteria for each pipe segment
- Calculation of risk scores for each pipe segment based on the probability and consequence of failure
- Development of capital improvement projects related to force main rehabilitation and replacement

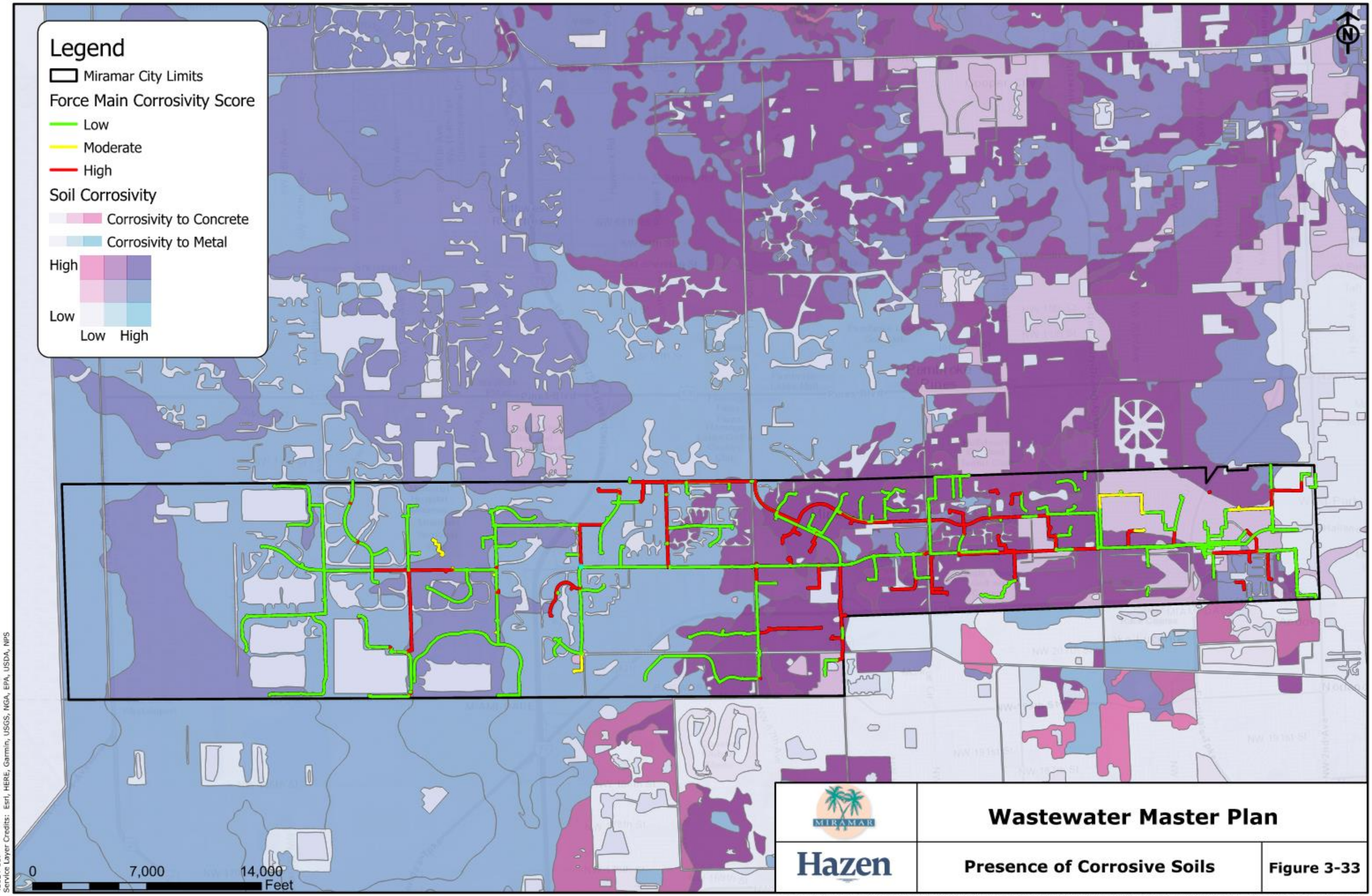
3.5.2.1 Assessment Methodology

The risk score for each pipe segment is based on the Probability of Failure (POF) and Consequence of Failure (COF). The risk score is defined as the product of POF (based on the condition and vulnerability of the asset) and COF (based on the criticality of the asset and impacted surroundings).

3.5.2.1.1 Probability of Failure (POF) Score

The Probability of Failure (POF) score represents the probability of failure based on the location and physical characteristics of the pipe segment. Evaluating the POF helps prioritize the pipe segments that are more likely to fail within the force main network. POF is scored on a scale of 1 to 5. POF criteria are described below.

- Pipe Age: All pipe segments in any force main network age and deteriorate over time due to abrasive, mechanical, and corrosive conditions. As a pipe reaches the end of its useful life, there is an increased likelihood of failure.
- Pipe Material: Pipe material is an important criterion for evaluating the probability of failure. Ferrous pipes such as ductile iron or cast iron are more susceptible to corrosion. Concrete pipes such as asbestos cement (AC) are more susceptible to abrasion but can also be susceptible to corrosion depending on soil type.
- Presence of Corrosive Soils: The presence of corrosive soils may reduce the expected service life of buried force mains. The United States Department of Agriculture (USDA) National Resources Conservation Service (NCRS) conducts soil surveys by state and county. Some soils may be corrosive to metal pipe while other soils may be more corrosive to concrete pipe. In Figure 3-33, the force main network for the City was overlaid on the current NCRS soil surveys for Broward County. The soil map color is varied based on corrosivity to concrete and corrosivity to metal; darker colors indicate generally more corrosive soil. Force main segments exposed to highly corrosive soils are shown in red; force main segments exposed to moderately corrosive soils are shown in yellow. Force main segments shown in green are either not exposed to corrosive soils or built with a material that is not susceptible to corrosion.
- Force Main Peak Operating Pressures: Operating pressures in the force main network may reduce the service life of pipe segments. High pressures cycling in the force main network may lead to small leaks and pipe breaks over time in pipe segments if not properly maintained. High operating pressures may also cause larger spills due to higher flows in the event that a pipe segment fails. Figure 3-34 shows the force main peak operating pressures of all the pipe segments in the force main network based on a model simulation of current peak flow conditions.



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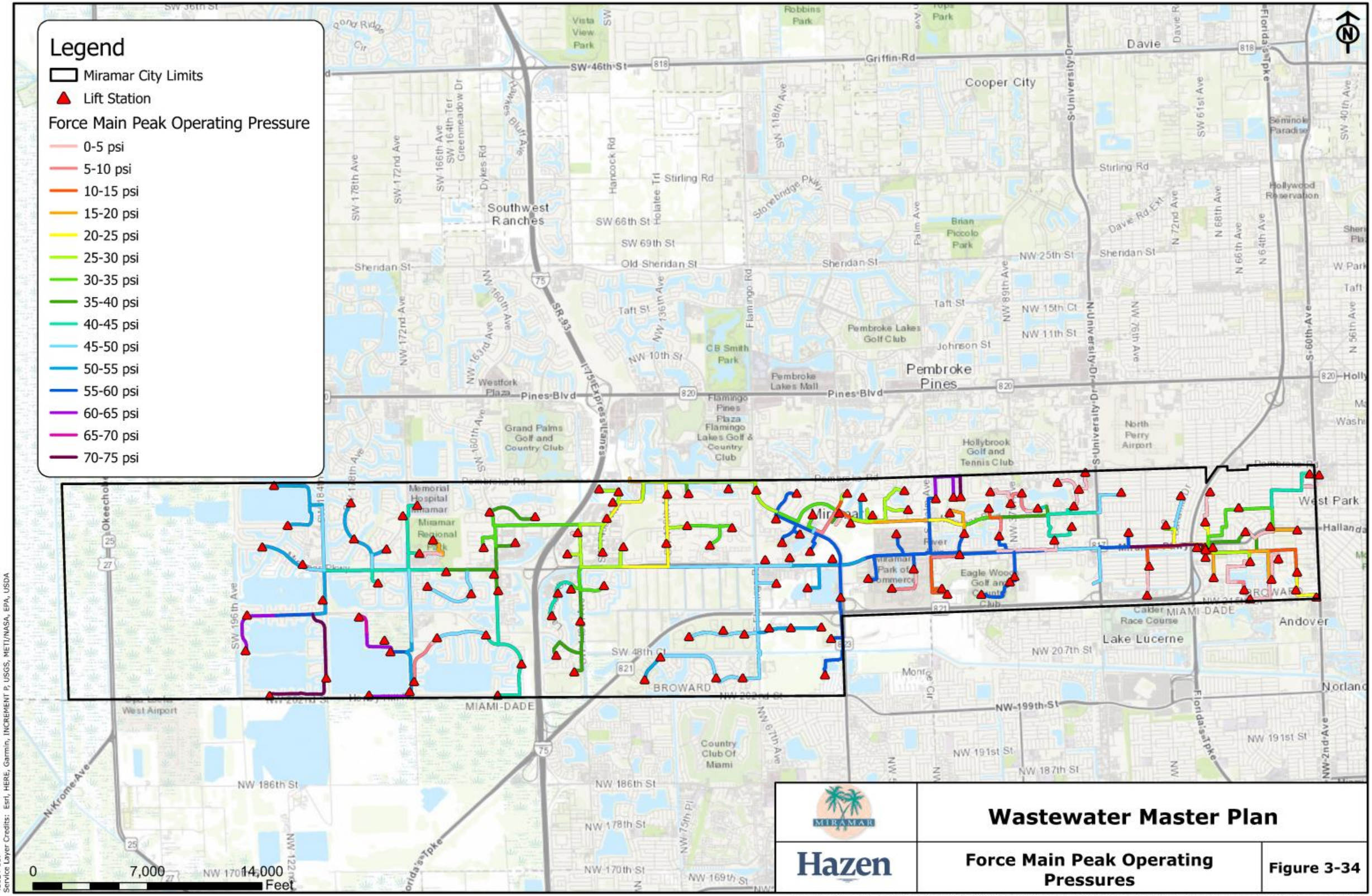
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Wastewater Master Plan

Presence of Corrosive Soils

Figure 3-33

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Legend
Miramar City Limits
Lift Station
Force Main Peak Operating Pressure
0-5 psi
5-10 psi
10-15 psi
15-20 psi
20-25 psi
25-30 psi
30-35 psi
35-40 psi
40-45 psi
45-50 psi
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SW 46th St
Davie
Cooper City
Stirling Rd
Southwest Ranches
Sheridan St
Pembroke Pines
Pines Blvd
Hollywood
Miramar
West Park
Andover
Lake Lucerne
NW 207th St
NW 199th St
NW 191st St
NW 186th St
NW 178th St
NW 170th St
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Wastewater Master Plan
Force Main Peak Operating Pressures
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Many municipalities also use an additional criterion of pipe break information as part of the assessment of probability of failure. Previous pipe breaks are indicative of the condition and integrity of a force main. Although pipe breaks can also result from construction activities or failed valves, breaks related to compromised structural integrity can provide critical information as to an asset's condition. There is limited information related to force main breaks within the City's transmission system. It is recommended that the City maintain records for force main breaks, including dates, suspected causes, pipe segment ID numbers, locations, and repair types. Force main breaks also present an opportunity to confirm pipe material.

Weighting factors for each POF category were assigned as presented in Table 3-20. These weighting factors reflect the relative importance of each POF category with respect to the overall POF score.

Table 3-20: Probability of Failure Category Weighting Factor

POF Category	Weight
Pipe Age	50%
Pipe Material	30%
Presence of Corrosive Soils	10%
Force Main Peak Operating Pressures	10%

Based on information from the City's GIS database, POF scores were assigned to each pipe segment using the scoring criteria presented in Table 3-21. Force mains of unknown age were classified with pipes 50 years old or older and assigned a POF score of 5. Force mains of unknown pipe material were given a POF score of 4.

Table 3-21: Probability of Failure Scoring Criteria

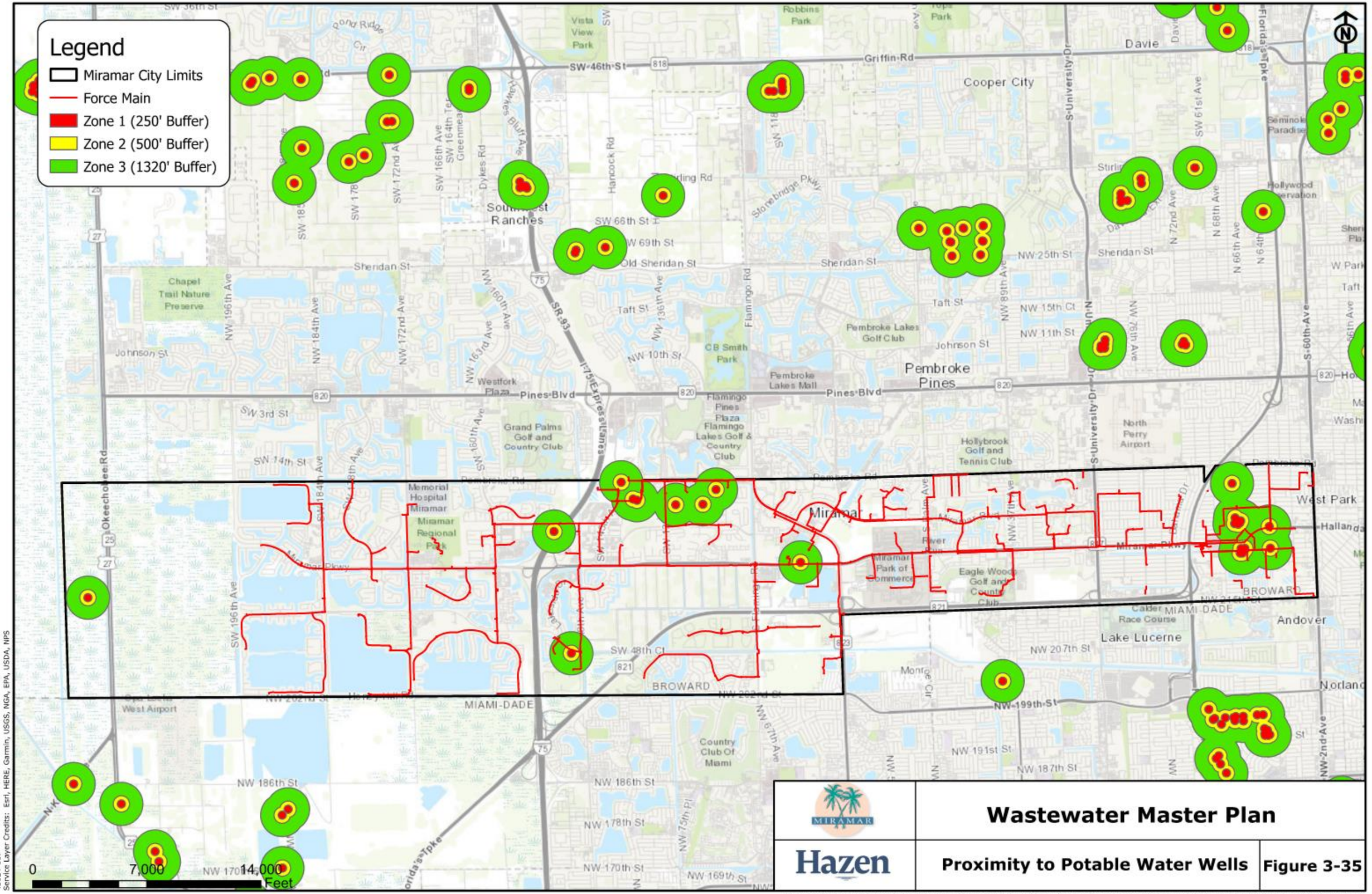
Probability Category	Negligible = 1	Unlikely = 2	Possible = 3	Probable = 4	Very Probable = 5
Pipe Age	Age < 20 years	20 years ≤ Age < 30 years	30 years ≤ Age < 40 years	40 years ≤ Age < 50 years	50 years ≤ Age; Unknown
Pipe Material	HDPE or PVC	DIP ≤30 years	Cast Iron Pipe	AC Pipe; DIP >30 years; Unknown	Not Used
Presence of Corrosive Soils	Not present	Not used	Medium Corrosive Soils Present	Not Used	Highly Corrosive Soils Present
Force Main Peak Operating Pressures (P)	P < 50 psi	Not Used	50 psi ≤ P < 80 psi	Not Used	80 psi ≤ P

3.5.2.1.2 Consequence of Failure (COF) Score

The COF parameter represents the consequences to the City, the community, and the surrounding environment when a force main fails. Consequence of failure can vary from a minor inconvenience to a major disruption to the community, inability to comply with permits, and a possible endangerment of public health. Determining COF helps prioritize improvements to pipe segments by highlighting force

main failures with the greatest negative impacts. COF is scored on a scale of 1 to 5. COF criteria are described below.

- Pipe Diameter: In the case of pipe failure, a larger pipe diameter is indicative of a larger spill.
- Proximity to Potable Water Wells: Force main breaks near potable water wells present an increased potential for cross contamination. Proximity to potable water wellfields was determined by overlaying the force main network onto a map detailing the wellfield protection zones and wellfield sites within the City of Miramar's corporate limits. This information is presented in Figure 3-35.
- Proximity to Land Uses and Businesses: Force main failures in close proximity to densely populated areas, schools, hospitals, nursing homes, or major businesses have more serious impacts than force mains in low density neighborhoods since these failures impact more people. In Figure 3-36, the Broward County Future Land Use Map was overlaid with the City's force main network. The locations of hospitals, public schools, and nursing homes-were also included.
- Proximity to Roadways: Force main breaks near roadways may lead to road closures and disruptions to normal traffic patterns. Depending on the classification of the roadway, a force main break may impact a large number of people. For purposes of this study, highways were defined as I-75 and Florida's Turnpike. The FDOT Roadway Characteristics Inventory map was used to classify the remaining roadways as arterials, collectors, or local roads. This information is presented in Figure 3-37.

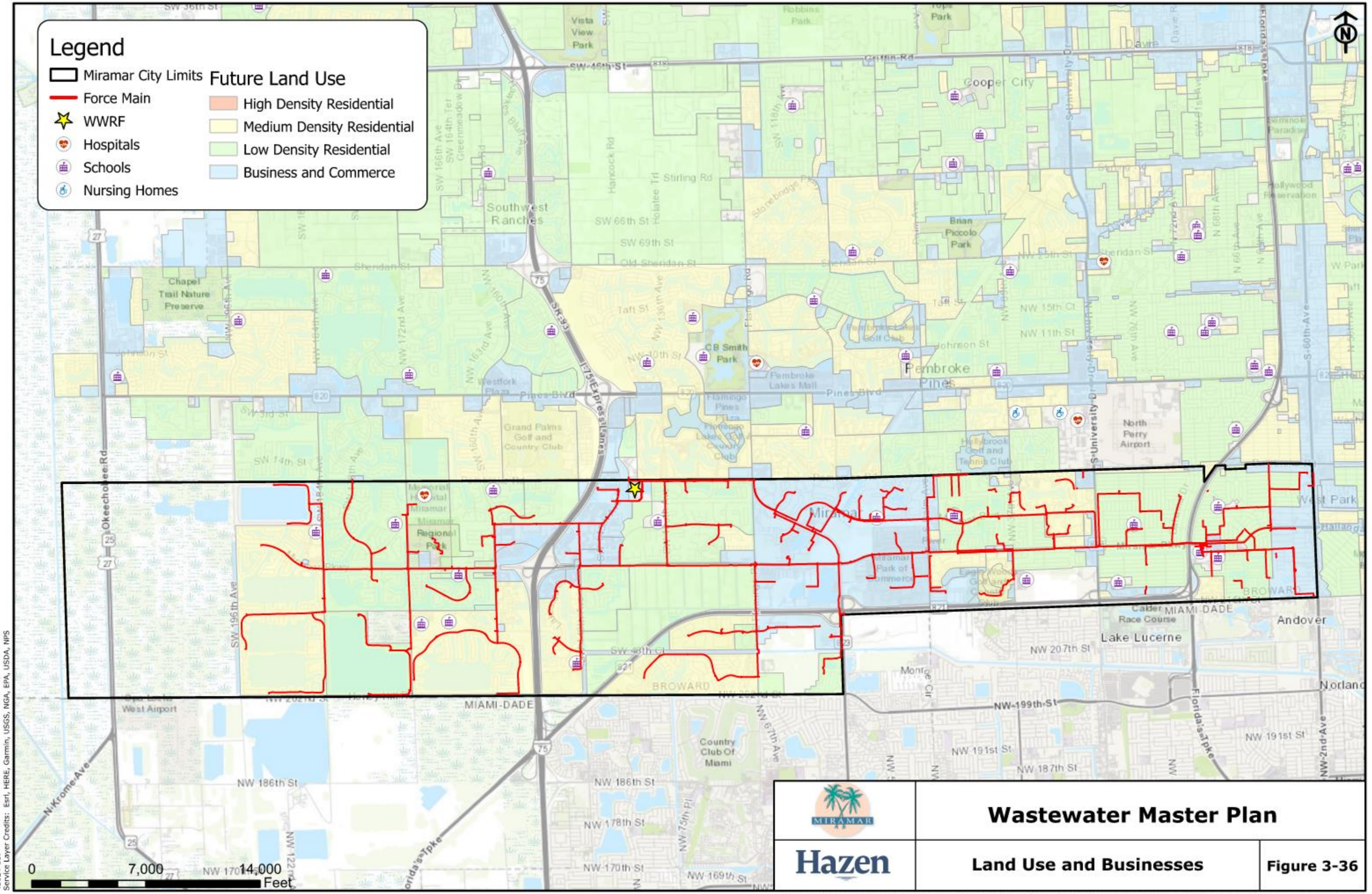


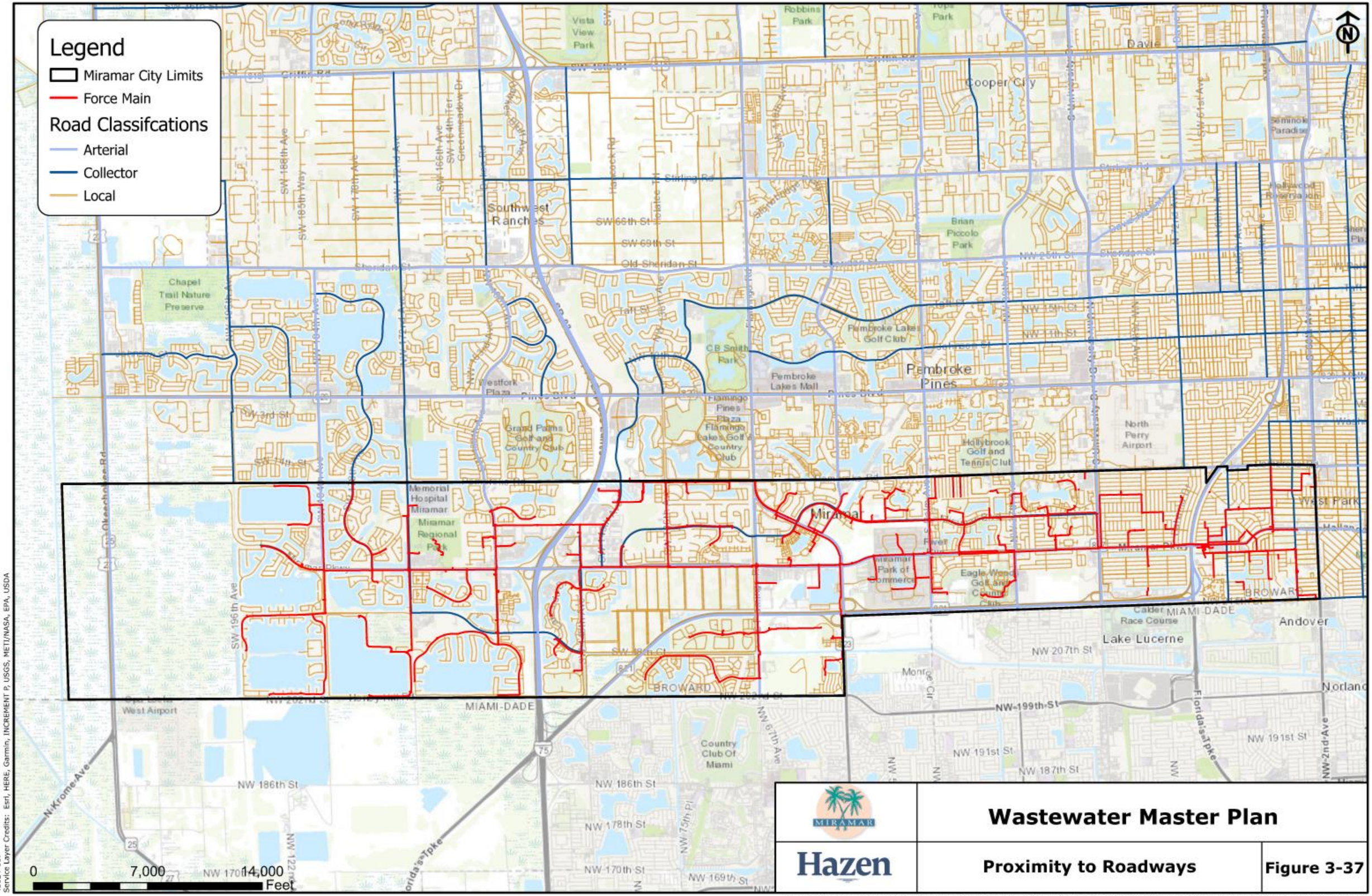
Service Layer Credits: Esri, HERE, Garmin, USGS, NGA, EPA, USDA, NPS

45024-007

MIRAMAR	**Wastewater Master Plan**	
Hazen	**Proximity to Potable Water Wells**	**Figure 3-35**

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Legend
Miramar City Limits
Force Main
WWRF
Hospitals
Schools
Nursing Homes
Future Land Use
High Density Residential
Medium Density Residential
Low Density Residential
Business and Commerce
Southwest Ranches
Chapel Trail Nature Preserve
Vista View Park
Griffin Rd
SW 46th St
Cooper City
Davie
Stirling Rd
SW 66th St
SW 69th St
Old Sheridan St
Sheridan St
Taft St
Pines Blvd
Pembroke Pines
CB Smith Park
Pembroke Lakes Mall
Brian Piccolo Park
NW 15th Ct
NW 11th St
Johnson St
Grand Palms Golf and Country Club
Hollybrook Golf and Tennis Club
North Perry Airport
Memorial Regional Hospital Miramar
Miramar Regional Park
Miramar
Miramar Park of Commerce
West Park
Hollywood Reservation
Andover
Lake Lucerne
Calder Race Course
NW 207th St
NW 199th St
NW 191st St
NW 187th St
Country Club Of Miami
NW 186th St
NW 178th St
NW 170th St
NW 169th St
West Airport
MIAMI-DADE
BROWARD
Okeechobee Rd
N Krome Ave
Florida's Tpke
I-75 Express Lanes
SR-93
0
7,000
14,000
Feet
45024-007
Service Layer Credits: Esri, HERE, Garmin, USGS, NGA, EPA, USDA, NPS
Wastewater Master Plan
Land Use and Businesses
Figure 3-36
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MIRAMAR

Hazen

Wastewater Master Plan

Proximity to Roadways

Figure 3-37

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Weighting factors were assigned to each COF category as presented in Table 3-22. These weighting factors reflect relative importance of each COF category with respect to the overall COF score.

Table 3-22: Consequence of Failure Category Weighting Factor

COF Category	Weight
Pipe Diameter	40%
Proximity to Potable Water Wells	20%
Proximity to Land Uses and Businesses	20%
Proximity to Roadways	20%

Based on information from the City's GIS database and other information related to the surrounding community, COF scores were assigned to each pipe segment using the scoring criteria presented in Table 3-23.

Table 3-23: Consequence of Failure Scoring Criteria

Consequence Category	Very Low = 1	Low = 2	Moderate = 3	Significant = 4	Severe = 5
Pipe Diameter (D)	Not Used	D < 8 inches	8 inches ≤ D < 16 inches	16 inches ≤ D < 30 inches	D ≥ 30 inches
Proximity to Potable Water Wells	Outside of Wellfield Protection Zone	Not Used	Within Zone 3 (1,320' buffer)	Within Zone 2 (500' buffer)	Within Zone 1 (250' buffer)
Proximity to Land Uses & Businesses	Low Density	Medium Density	High Density	Schools, Business and Commerce	Hospitals and Nursing Homes
Proximity to Roadways	Open/Parks	<100' to Local Road	<100' to Arterial/ Collector or <50' to Local Road	<50' to Arterial/Collector	<100' to Railroad or Highway

3.5.2.1.3 Risk Score

Risk scores provide an overall view of the risk that each force main presents in its current state. Risk scores can also be used to prioritize force mains for further assessment and for capital improvement planning purposes. Force main pipe segments were assigned risk scores based on the product of the POF and COF scores and categorized as very low, low, medium, high, or very high risk, as described in Table 3-24. A risk score prioritization matrix is presented in Figure 3-38.

Table 3-24: Risk Score Ranges

Risk Category	Risk Score (R.S)	Color Code
Very Low	R.S ≤2	
Low	2< R.S <4	
Medium	4≤ R.S <12	
High	12≤ R.S <19	
Very High	19≤ R.S <25	

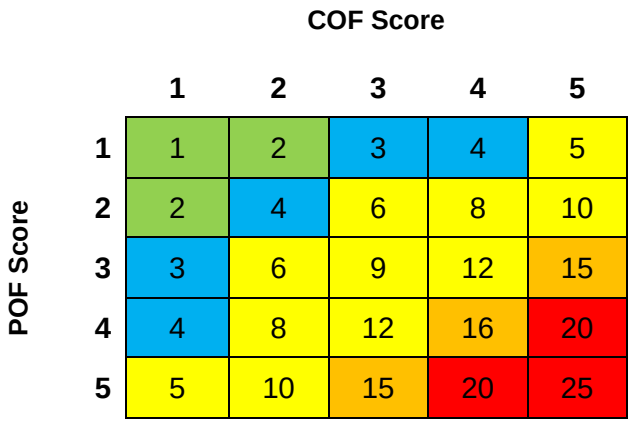


Figure 3-38: Risk Score Prioritization Matrix

3.5.2.2 Condition Assessment Results

Each active force main segment within the City was evaluated and assigned a POF score and a COF score in accordance with the previously noted criteria. Risk scores were calculated, and force main segments were categorized accordingly.

3.5.2.2.1 Probability of Failure (POF) Scores

Figure 3-39 through Figure 3-42 present the POF score breakdown by force main footage for each criterion listed in Table 3-21. These figures show the linear feet of force main and percent of force main footage at each score for each criterion that comprises the POF score. Figure 3-43 presents the overall POF scores for force main segments in the City's network. Approximately 16% of force main length has a POF score of 4 or higher, which is categorized as a probable or very probable possibility of failure.

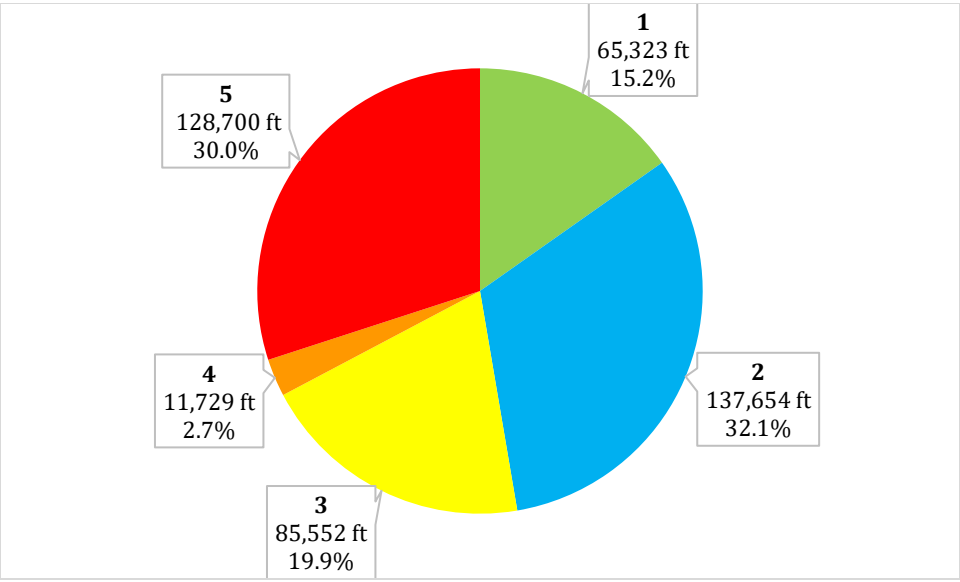


Figure 3-39: POF Score for Pipe Age

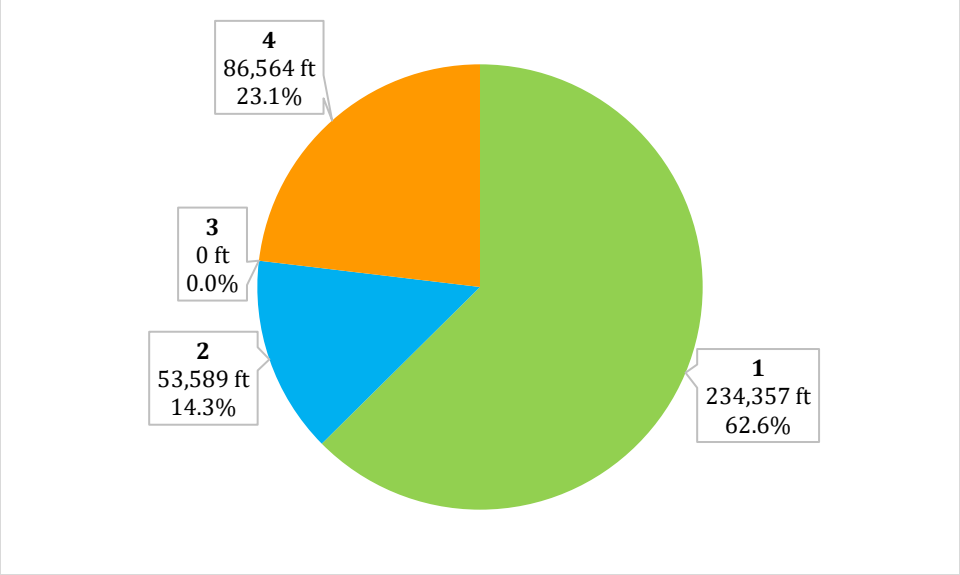


Figure 3-40: POF Score for Pipe Material

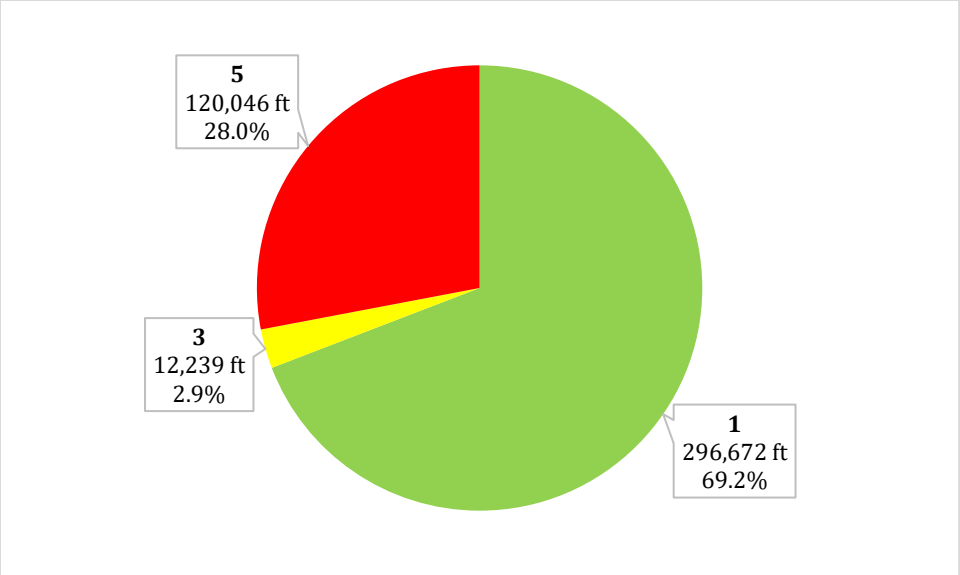


Figure 3-41: POF Score for Corrosive Soil

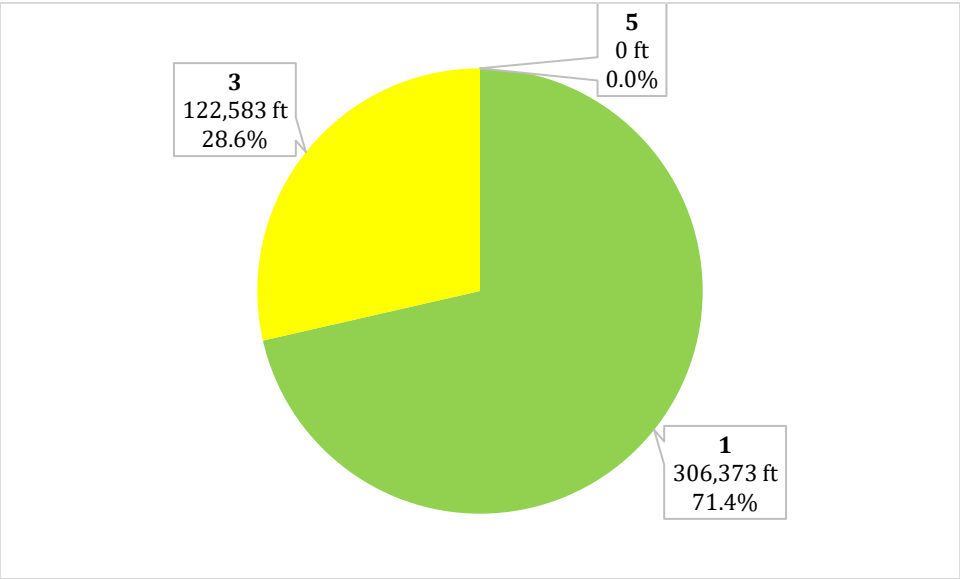


Figure 3-42: POF Score for Force Main Peak Operating Pressures

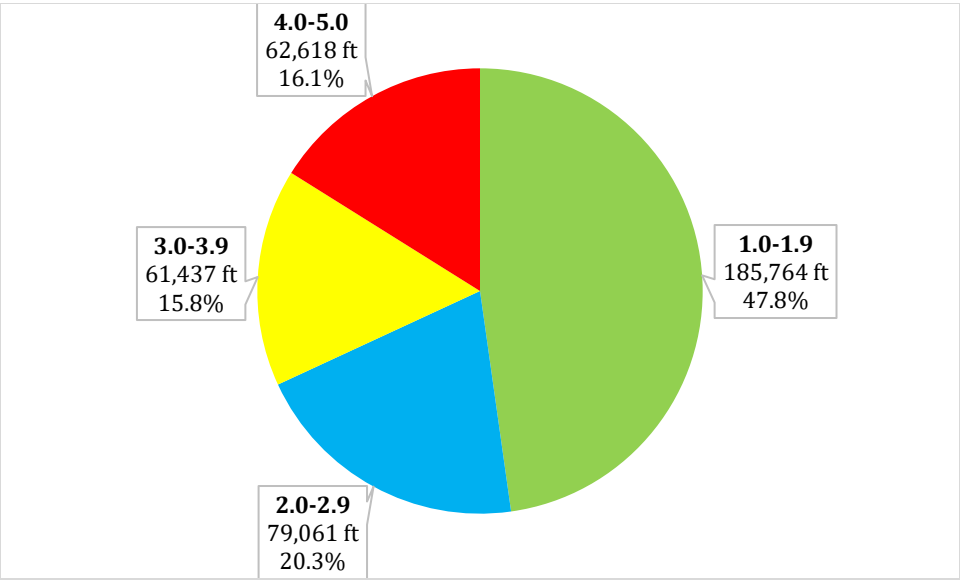


Figure 3-43: POF Score Breakdown

3.5.2.2.2 Consequence of Failure (COF) Scores

Figure 3-44 through Figure 3-47present COF score breakdown by force main footage for each criterion listed in Table 3-23. These figures show the linear feet of force main and percent of force main footage at each score for each criterion that comprises the COF score. Figure 3-48 presents the overall COF scores for force main segments in the City's network. Approximately 2% of force mains have a COF score of 4 or higher, which is categorized as a significant or severe consequence of failure.

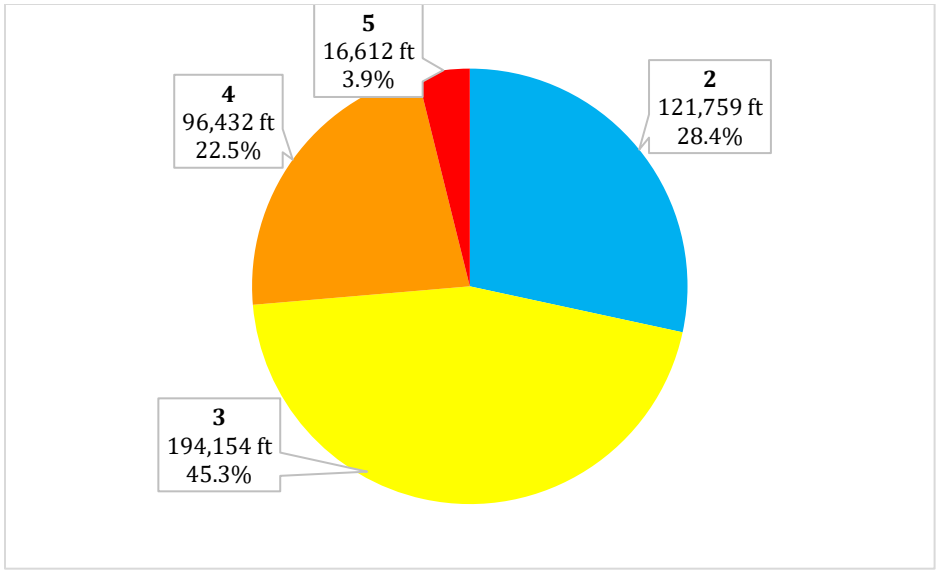


Figure 3-44: COF Score for Pipe Diameter

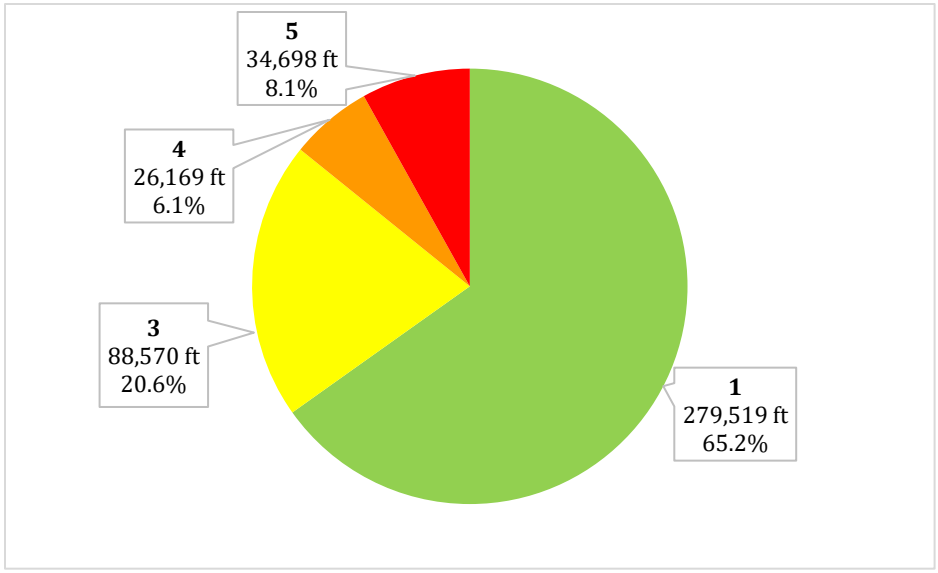


Figure 3-45: COF Score for Proximity to Potable Water Wells Source

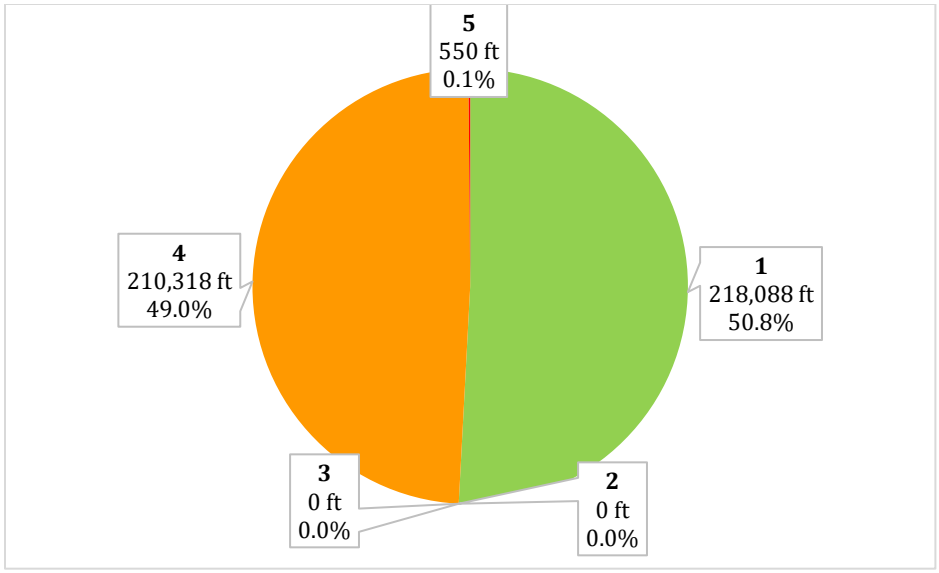


Figure 3-46: COF Scores for Land Uses & Businesses

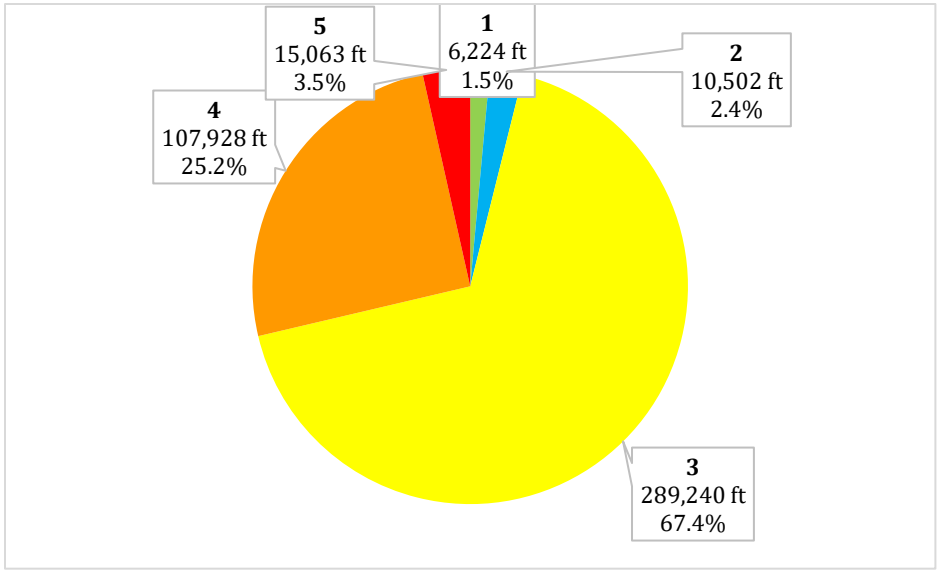


Figure 3-47: COF Score for Proximity to Roadways

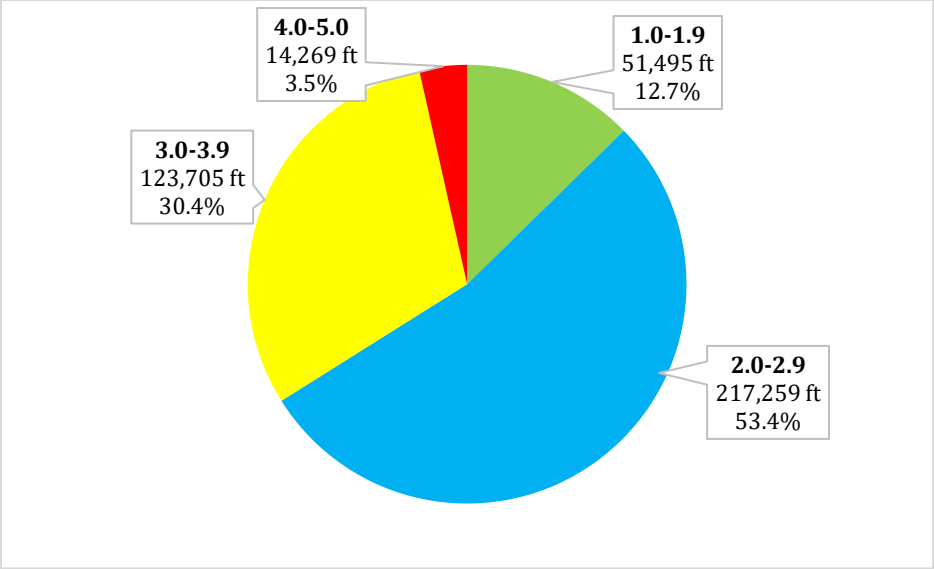


Figure 3-48: COF Score Breakdown

3.5.2.2.3 Risk Score

Using the POF and COF scores for each force main segment, the risk score was calculated. Figure 3-49 provides a breakdown of risk scores by pipe length for the City's force main network. Figure 3-50 provides a map of the force main network that is color coded to match risk categories. Although 11.8% of force main length is categorized as high risk, it is noted that there are currently no force mains within the City of Miramar that are considered very high risk based upon the assessment criteria used in this evaluation. Appendix D provides a detailed summary of each force main with a calculated risk score higher than 12 (high risk). These force main segments are identifiable in the City's GIS database by the force main identifier number. A detailed summary of all force main segments, including POF scores, COF scores, and risk scores is provided in Appendix E.

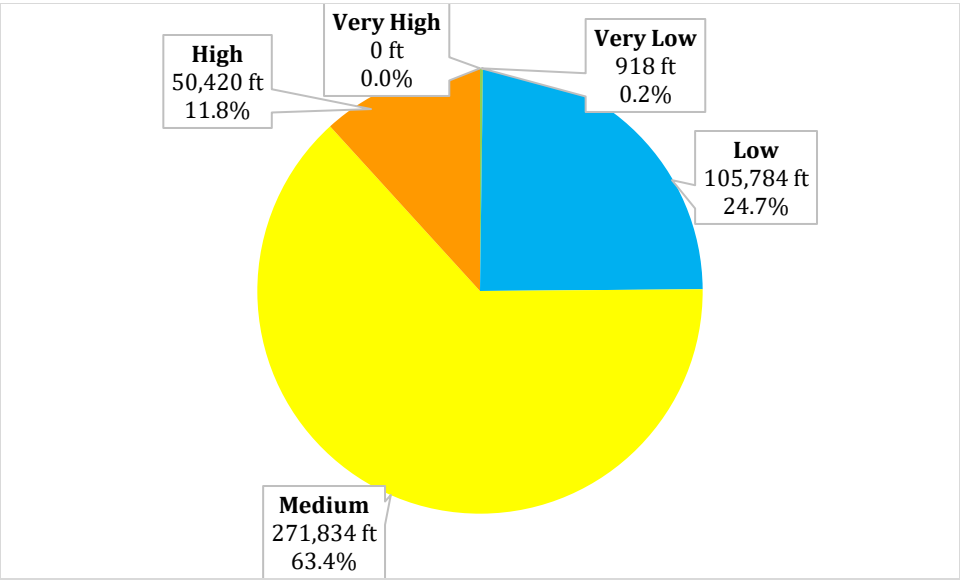


Figure 3-49: Risk Score Breakdown

Legend

Miramar City Limits

Force Main

Risk Score

- Very Low (# of Pipe Segments = 5) (Total length = 918 ft)
- Low (# of Pipe Segments = 165) (Total length = 105,784 ft)
- Medium (# of Pipe Segments = 682) (Total length = 271,834 ft)
- High (# of Pipe Segments =154) (Total length = 50,420 ft)
- Very High (# of Pipe Segments = 0) (Total length = 0 ft)

Davie
Cooper City
Pembroke Pines
North Perry Airport
Miramar
Broward
Miami-Dade
Andover
Lake Lucerne
Norland
Opa Locka West Airport
West P

0 7,000 14,000 Feet

45024-007
Service Layer Credits: Esri, HERE, Esri, HERE, Garmin, GeoTechnologies, Inc., USGS, EPA

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Wastewater Master Plan

Force Main Network Risk Scores | **Figure 3-50**

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3.5.2.3 Recommended Renewal and Replacement Projects

Recommended renewal and replacement projects for force mains lend themselves to implementation on an annual or otherwise recurring basis. These projects were grouped into implementation timeframes as part of an overall Force Main Rehabilitation Program. It is anticipated that improvement projects will be comprised of a combination of field assessments, point repairs, lining, and full replacements. Program costs were developed with the intention of establishing minimum annual capital improvement funds dedicated to force main rehabilitation.

For purposes of establishing an annual budget, the following assumptions were made:

- 5% of all pipes sized 12 inches in diameter or greater will be evaluated using a direct condition assessment technology, such as the Pure SmartBall or PipeDiver tools manufactured by Xylem.
- Two point repairs per 1,500 linear feet of pipe will be performed.
- 2% of all force mains will be replaced per year, in kind.

Direct condition assessments of buried piping can assist the City in making investment decisions by prioritizing force mains identified as high risk for rehabilitation efforts. Non-destructive direct condition assessments are classified as external or internal and vary from low level screening to high level, more expensive screening. Condition assessments include acoustic, visual assessments, laser/sonar, and electromagnetic inspections. The types of data that can be collected from these assessments include wall thickness (and associated wall loss), areas of corrosion, corrosion potential, areas of air pockets or leaks, pipe stress/anomalies, and internal pipe profile.

After a pipe has been assessed (externally or internally), areas for point repairs can be identified. Point repairs may include replacement of a pipe segment or installation of a repair sleeve or clamp. The type of repair is dependent upon pipe material, pipe size, and criticality of service. Point repairs vary widely in cost. For purposes of establishing a budget for this work, $8,000 per point repair was assumed.

All underground infrastructure will eventually reach the end of its useful service life. It is recommended that the City budget annually for replacement of piping. A nominal 2% per year is recommended such that all force main piping in the service area is replaced over the next 50 years. As funding varies from year to year, this amount can be increased in response.

Risk scores were used to prioritize force main segments for renewal and replacement projects. Estimated renewal and replacement costs by five-year planning periods are presented in Table 3-25.

Table 3-25: Force Main Renewal and Replacement Costs by Planning Period

		Condition Assessment		Point Repairs		Pipe Replacements		Total cost over 5 Years
Phase	Planning Period (Years)	Linear Feet	Total Cost	Linear Feet	Total Cost	Linear Feet	Total Cost	
1	0 to 5	44,981	$1,250,000	36,225	$193,000	39,918	$10,644,000	**$12,088,000**
2	5 to 10	42,779	$1,189,000	43,029	$229,000	78,438	$18,043,000	**$19,462,000**
3	10 to 15	43,453	$1,208,000	43,793	$234,000	73,952	$17,445,000	**$18,888,000**
4	15 to 20	28,904	$804,000	37,069	$198,000	76,104	$17,110,000	**$18,111,000**
5	20+	0	$0	0	$0	76,104	$17,110,000	**$17,110,000**

The summary of program projects recommended for force main renewal and replacements are presented in Table 3-26.

Table 3-26: Summary of Program Projects Recommended for FM R/R

Project ID Number	Project Name	Planning Period (Years)	OPPC
RR-FM-01	Force Main Renewal and Rehabilitation Phase 1	0 to 5	$12,088,000
RR-FM-02	Force Main Renewal and Rehabilitation Phase 2	5 to 10	$19,462,000
RR-FM-03	Force Main Renewal and Rehabilitation Phase 3	10 to 15	$18,888,000
RR-FM-04	Force Main Renewal and Rehabilitation Phase 4	15 to 20	$18,111,000
RR-FM-05	Force Main Renewal and Rehabilitation Phase 5	20+	$17,110,000

3.5.3 Lift Stations

Lift stations were evaluated for renewal and replacement projects based primarily upon age or time since previous rehabilitation. This evaluation did not include field inspections of individual lift stations, nor did it include an evaluation of the eight privately owned lift stations within the City's service area. The condition assessment consists of the following tasks:

- An asset inventory analysis, including a review of the City's GIS information detailing available lift station attributes such as date of commissioning or date of last major rehabilitation.
- A review of the age of lift station assets compared to industry standards for typical estimated useful service life.
- Development of capital improvement projects for renewal and replacement of lift station assets

3.5.3.1 Assessment Methodology

Information from the City's GIS database, SCADA data, and operation and maintenance records were collected and reviewed. Available data were limited and recommendations were renewal and replacement were primarily based on lift station asset age. A useful indicator for master planning purposes is an assessment of the remaining useful life of an asset. The estimated useful life for lift station assets is defined in Table 3-27.

Table 3-27: Lift Station Equipment Typical Estimated Useful Life

Equipment Description	Estimated Useful Life (years)
Submersible Pumps	20
Check Valves	30
Plug Valves	30
Electrical / Control Panel	15
Level Probes	10
SCADA System	10
Emergency Generator	25
Wetwell and Valve Vault Structural Coating	30
Wetwell and Valve Vault Structures	50
Structural Building Enclosure	50

The expected average useful life of a station is based upon typical experience for utilities in South Florida. For this Master Plan, a composite expected average useful life of 20 years was used to assess the overall timeframe when major renewal and replacement of lift stations would be needed over the planning period. To assess the remaining useful life for each lift station, the year the asset was placed into service (or last rehabilitated) needed to be known. This was determined through a review of available record drawings and discussions with City staff. On the basis of age, much of the equipment at the lift station are nearing the end or have exceeded their useful life.

Pump runtime data can also be used to assess the overall condition of the pump asset. A pump with higher operating hours may experience more overall wear. Reliable lift station on/off SCADA data was not available due to polling latency. It is recommended that the City's SCADA system is upgraded to accurately track runtime data at lift stations.

Lift stations were assigned a risk category based on age to determine anticipated renewal and replacement needs during the planning period. Lift station risk categories are presented in Table 3-28.

Table 3-28: Lift Stations Risk Categories

Risk Category	Planning Period (years)	Age (years)
Very Low	20+	0 to 5
Low	15 to 20	5 to 10
Medium	10 to 15	10 to 15
High	5 to 10	15 to 20
Very High	0 to 5	>20

3.5.3.2 Condition Assessment Results

The results indicate that 79 of the 137 lift stations evaluated (58%) are greater than 20 years old and 103 lift stations (75%) are at least 15 years old. Lift stations by age (or time since previous rehabilitation) are presented in Figure 3-51.

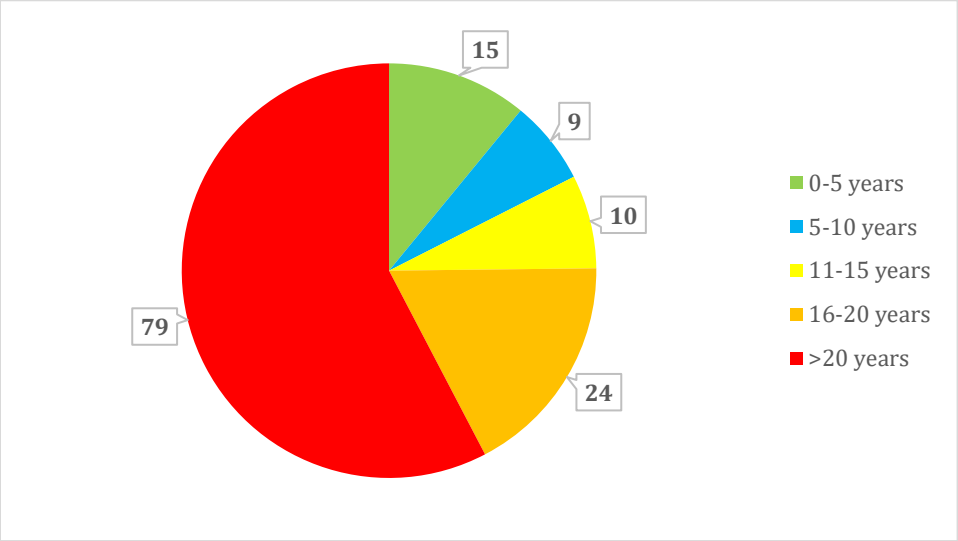


Figure 3-51: Lift Stations by Age

3.5.3.3 Recommended Renewal and Replacement Projects

Each lift station was evaluated based on age using the year of commission or the date of the latest rehabilitation. Preliminary results indicate that almost 60% of the lift stations will need to be rehabilitated in the next five years. It is recommended that detailed field condition inspections be performed to further prioritize near term rehabilitation needs and feasibility to fund projects.

Since the expected useful life has been estimated at 20 years, it is anticipated that the City will need to rehabilitate all 137 lift stations during the planning period of this Master Plan. As such, renewal and replacement projects have been developed as a lift station rehabilitation program in five-year increments. Recommended phasing of the rehabilitation program was based on lift station age and is as follows:

- 0-5 years: LS-001, LS-004, LS-005, LS-006, LS-007, LS-008, LS-009, LS-010, LS-012, LS-013, LS-022, LS-025, LS-026, LS-027, LS-028, LS-029, LS-030, LS-031, LS-032, LS-033, LS-034, LS-035, LS-036, LS-037, LS-038, LS-039, LS-040, LS-041, LS-042, LS-043, LS-045, LS-046, LS-047, LS-049, LS-050, LS-051, LS-052, LS-053, LS-054, LS-056, LS-057, LS-058, LS-059, LS-060, LS-062, LS-063, LS-064, LS-066, LS-067, LS-068, LS-069, LS-070, LS-071, LS-072, LS-073, LS-074, LS-075, LS-077, LS-078, LS-079, LS-080, LS-081, LS-082, LS-084, LS-088, LS-00A, LS-00C, LS-00D, LS-00E, LS-00F, LS-00G, LS-00I, LS-PAL, LS-MPS
- 5-10 years: LS-085, LS-086, LS-087, LS-089, LS-090, LS-091, LS-092, LS-093, LS-094, LS-095, LS-096, LS-097, LS-098, LS-099, LS-100, LS-101, LS-102, LS-103, LS-104, LS-111, LS-00B, LS-00H, LS-00M, LS-MBPS
- 10-15 years: LS-105, LS-106, LS-107, LS-108, LS-109, LS-110, LS-112, LS-00J, LS-00K, LS-00L
- 15-20 years: LS-114, LS-115, LS-116, LS-117, LS-021, LS-024
- 20+ years: LS-002, LS-003, LS-015, LS-016, LS-017, LS-018, LS-023, LS-048, LS-055, LS-083, LS-118, LS-119, LS-120, LS-121

As noted previously, lift stations were categorized by size based on the horsepower of the pumps. The MPS and BPS were considered as a separate category. Estimated costs were established for each size category. For traditional duplex submersible stations, estimates included the following items:

- Replacement of pumps and motors
- Replacement of discharge valves
- Replacement of discharge piping
- Re-coating of wet well
- Miscellaneous site improvements such as lighting, fencing, etc.
- Replacement of local control panel and remote telemetry unit
- Replacement of hatches
- Bypass pumping

If onsite generators are present, an additional cost was included. For the MPS and BPS, additional items associated with rehabilitation of building structures and ancillary features were included in the replacement and rehabilitation costs. Opinions of probable projects costs include engineering, permitting, and construction management costs.

Estimated opinions of probable project costs by size category for lift station renewal and replacement projects are presented in Table 3-29. An adder was included for stations with permanently installed generators.

Table 3-29: Lift Station Opinion of Probable Project Costs

Lift Station Category	Pump Size, each (hp)	Opinion of Probable Project Cost
Small	≤ 3	$314,000
Medium	>3 to <20	$660,000
Large	20 to <50	$862,000
MPS/BPS	50+	$6,008,000

The total estimated renewal and replacement costs by five-year planning periods are presented in Table 3-30.

Table 3-30: Lift Station Renewal and Replacement Costs by Planning Period

Project ID Number	Project Name	Planning Period (Years)	OPPC
RR-LS-01	Lift Station Rehabilitation Phase 1	0 to 5	$58,508,000
RR-LS-02	Lift Station Rehabilitation Phase 2	5 to 10	$23,031,000
RR-LS-03	Lift Station Rehabilitation Phase 3	10 to 15	$8,620,000
RR-LS-04	Lift Station Rehabilitation Phase 4	15 to 20	$3,246,000
RR-LS-05	Lift Station Rehabilitation Phase 5	20+	$11,260,000

It is noted that lift stations identified previously as requiring near-term capacity upgrades (0 to 5 years) are not included as part of the renewal and rehabilitation program. Lift stations identified as requiring capacity upgrades in the 20+ year planning period and rehabilitation in the 0 to 5 year planning period are included as both a capacity improvement project as well as a renewal and replacement project as presented in Section 6.3.

3.5.4 Portable Generators

The City of Miramar maintains portable generators for use at lift stations as needed during power outages. All lift stations have accommodations for portable generators and some lift stations are equipped with permanent onsite emergency generators. The City reports that the portable generators are in fair to good condition and are exercised regularly. As part of the overall CIP, the City should maintain an annual budget for portable generator renewal and replacement. The proposed Portable Generator Renewal and Replacement Program is based on some general assumptions for the purpose of establishing a dedicated, recurring budget. These assumptions include the following items:

- Replacement costs of existing portable generators will be extended over the planning period of the Wastewater Master Plan.
- New generators will be standardized at 120 kW to maximize use within the transmission system and to minimize operation and maintenance requirements.
- The nine additional portable generators discussed in Section 3.3.4 (FI-PG-01) will require replacement in the 20+ year planning period.

A breakdown of recommended portable generator renewal and replacement projects is presented in Table 3-31.

Table 3-31: Portable Generator Renewal and Replacement Projects by Planning Period

Project ID Number	Project Name	Planning Period (Years)	OPPC
RR-PG-01	Portable Generator Rehabilitation Phase 1	0 to 5	$440,000
RR-PG-02	Portable Generator Rehabilitation Phase 2	5 to 10	$440,000
RR-PG-03	Portable Generator Rehabilitation Phase 3	10 to 15	$440,000
RR-PG-04	Portable Generator Rehabilitation Phase 4	15 to 20	$440,000
RR-PG-05	Portable Generator Rehabilitation Phase 5	20+	$1,320,000







4 Wastewater Reclamation Facility

4. Wastewater Reclamation Facility

4.1 Introduction

The Miramar Wastewater Reclamation Facility (WWRF) is a secondary activated sludge treatment facility receiving domestic wastewater generated within the City's service area. This section presents a description of the WWRF, including its history, treatment process, and current operating permits. Additionally, the capacity analysis and the renewal and replacement (R/R) evaluation of existing infrastructure and major equipment at the WWRF are summarized to identify R/R projects considered necessary to maintain operation of the facilities through the planning year 2045. Project cost estimates are provided in 2023 dollars and include contractor profit and overhead, permit fee allowances, and contingencies, as well as fees for engineering, permitting and construction management services. Breakdowns are presented in Appendix A.

4.2 Facility Location and History

The WWRF is located at 13900 Pembroke Road, Miramar. It was constructed and placed into operation in 1997, originally permitted by the FDEP to treat up to 7.4 mgd AADF. It has since undergone several capacity upratings and is currently rated at 12.7 mgd AADF / 14.4 mgd TMADF.

The WWRF was expanded in 2010. Notable upgrades include:

- A fifth aeration basin
- Modifications to the existing four aeration basins
- Modifications to the existing blower building
- A fourth clarifier
- Modifications to the existing sludge pumping station
- One new injection well pump
- A fourth generator
- Replacement of the existing plant PLC network

An aerial of the Miramar WWRF as it exists in 2023 is presented in Figure 4-1.



Figure 4-1: WWRF Site Aerial

4.3 Treatment Process Description

A schematic process flow diagram of the WWRF is presented in Figure 4-2. Raw wastewater discharges into the headworks screening channel via a 36" force main. Flow passes through the bar screens and is distributed between two vortex type grit chambers before flowing by gravity to the various treatment units. The liquid treatment process consists of pretreatment, conventional activated sludge, and effluent disposal via deep injection wells. A portion of the effluent is also diverted to a reuse water system. This reuse water consists of secondary treated effluent, which is filtered and chlorinated to high-level disinfection standards prior to its use for onsite use and public-access reuse in residential, commercial and common areas west of Palm Avenue. The injection well system includes capacity for disposal of all the City of Miramar WWRF effluent, including the portion diverted to reuse, to ensure adequate disposal during wet weather conditions (when reuse is not needed).

Raw waste activated sludge is dewatered by gravity belt thickeners before being pumped into primary and secondary digesters where the sludge is digested to meet Class B requirements. After digestion, the sludge is pumped to belt filter presses where it is dewatered before being hauled offsite for land application. Major process components are summarized in Table 4-1 and discussed in detail in Section 4.7.

Table 4-1: Major Process Components

Process Area	Components
Pretreatment	• Two (2) Mechanical self-cleaning screens • Two (2) Forced vortex type grit chambers
Secondary Treatment	• Five (5) aeration basins • Four (4) circular secondary clarifiers • RAS/WAS pumping station with six (6) RAS pumps and two (2) WAS pumps
Solids Treatment	• Two (2) gravity belt thickeners • Two (2) anaerobic digesters • Two (2) belt filter presses
Effluent Disposal	• Effluent pump station with four (4) pumps • Two (2) deep injection wells
Reuse Facilities	• Two (2) filter feed pumps • Six (6) reuse filters • Three (3) chlorine contact basins • Three (3) reuse storage tanks • Four (4) high service pumps

Legend
- Flow Meter
- Sampling Point

Air to Odor Scrubbers
Fine Mechanical Screens
Air to Odor Scrubbers
Grit Chambers
FLW-4
Plant Influent
INF-01
Grit Pumps
Screenings to Landfill
Cyclone Degritter and Grit Classifier
Grit to Landfill
Air to Odor Scrubbers
Influent Channel
Un-aerated
Aerated
Air
RAS
RAS Pumps
Final Clarifiers
WAS
WAS Pumps
Sludge Manhole
Plant Site Pump Station
Filtrate, Backwash, Supernatant, Scum and Plant Drain Return
Chlorine
Chlorine Contact Tank
EFA-1
FLW-3
Reuse
EFB-1
Filter Feed Pumps
Effluent Filters
EFF-01
Deep Well Pumps
Strainers
Backwash/Reject
FLW-1
FLW-2
No. 1
No. 2
Injection Wells
Polymer
Filtrate
Supernatant
Digester Gas
To Boilers
To Waste Gas Burner
Polymer
Filtrate
Air to Odor Scrubbers
Belt Washwater
Air to Odor Scrubbers
Solids Processing Building (Sludge Thickening)
Thickened WAS Pumps
Stage 1
Stage 2
Anaerobic Digesters
Grinder
Belt Press Feed Pumps
Solids Processing Building (Sludge Dewatering)
RMP-B
Belt Washwater
Trucked to Off-site Land Disposal

45024-007

MIRAMAR
Hazen

Wastewater Master Plan

WWRF Process Flow Diagram | Figure 4-2

4.4 Operating Permits

The current permitted capacity of the WWRF is 12.7 million gallons per day (mgd) on an Annual Average Daily Flow (AADF) basis. FDEP issued the current operating permit for the City of Miramar WWRF on January 31, 2023, with an expiration date of July 9, 2028. Table 4-2 presents a summary of the permit effluent requirements.

Table 4-2: WWRF Effluent Permit Requirements Summary

Description	Unit	Value
Injection Wells		
$cBOD_5$ / TSS		
(Annual Average)	mg/L	20/20
(Monthly Average)	mg/L	30/30
(Weekly Average)	mg/L	45/45
(Single Sample)	mg/L	60/60
Reuse Quality (Single Sample)		
TSS	mg/L	≤ 5
Turbidity	NTU	Report Only
Chlorine Residual	mg/L	≥ 1.0

The WWRF is also permitted by Broward County through the Resilient Environment Department under license no. WWTP-1700-22. The license expires on June 30, 2023.

Additionally, the WWRF is subject to the following permits:

- Underground Injection Control Class I Injection Well System Operation Permit issued by the FDEP. The Permit (UIC Permit Number 125256-011-012-UO/1M) was issued on April 15, 2019, and expires April 15, 2024. The licensed capacity for each injection well is 18.5 mgd.
- License to Operate Air Pollution Source issued by the Broward County Resilient Environment Department (License No. AO-02451-21) in relation to the Sodium Hydroxide (Caustic Soda) material used in the plant. The license was issued on October 5, 2021, and expires October 5, 2023.
- Hazardous Material Management Facility License issued by the Broward County Resilient Environment Department (License No. WHS-02451-22). The license was issued on June 01, 2022, and expires on May 31, 2024.

4.5 Facility Capacity Evaluation

The treatment process and hydraulic capacity of the WWRF were evaluated in 2022 to determine if an uprating would be possible. This process evaluation considered 2017 through 2021 plant operating data, Class I Reliability requirements, current performance levels for the WWRF, regulatory guidelines, and engineering judgment typically utilized in the design and operation of municipal wastewater treatment plants. These considerations were combined to present a comprehensive review of the existing treatment

facilities. This process evaluation indicated that the WWRF has reliably treated the City's wastewater flows for the last 5 years.

To perform the capacity evaluation, a calibrated biological process model and a calibrated hydraulic model were developed. These tools allow for accurate simulation of liquids and solids unit processes throughout the facility under various flow and loading conditions. Process and hydraulic capacity were evaluated on a unit-process basis with various tools and compared to industry design standards as well as typical South Florida municipal treatment operations.

The analysis shows that to accommodate influent flows over 11.3 mgd, operational improvements would be necessary to increase secondary biological treatment capacity. In addition, a sixth aeration basin would be necessary to provide adequate treatment capacity for flows over 12.7 mgd. Based on flow projections presented in Section 2, a sixth aeration basin should thus be constructed within five to ten years. Additional blowers and upgrades to the RAS pumps will be needed as well. An additional digester, although not required under Class I reliability standards, is needed to provide sufficient capacity with one unit out of service for average flows greater than 10.9 mgd. The WWRF AADF influent flowrate is projected to reach this value by 2025; therefore, this project is recommended to be initiated within the next five years.

Detailed findings can be found in the report titled "Capacity Analysis, Evaluation and Re-Rating of the Wastewater Reclamation Facility," August 19, 2022. Capacity evaluation findings for individual process components will be discussed in Section 4.7.

4.6 Renewal and Replacement Evaluation

A renewal and replacement (R/R) evaluation of existing infrastructure and major equipment at the Miramar Wastewater Reclamation Facility (WWRF) was conducted in 2021/2022 to identify (R/R) projects considered necessary to maintain operation of the facilities through the planning year 2045. The R/R evaluation included major mechanical, structural, and electrical assets of the WWRF. Preliminary asset data were obtained from the City's computerized maintenance management system, Lucity. The asset list primarily included aboveground structures and equipment and represented key unit processes as identified by City staff for which field assessments were performed for each process area.

Review of each process area began with staff interviews followed by visual inspections of assets within the WWRF to identify areas of deficiency and/or infrastructure that is approaching the end of its useful life. Assets were assigned mechanical, structural, and electrical scores ranging from 1 to 5 during visual inspections based on physical condition and input from City staff. A score of 5 indicates an asset in poor condition while a score of 1 indicates an asset in good condition. Assets were then assigned a Risk Score based on the following:

- Probability of Failure (POF) score: An aggregate score based on mechanical, structural, and electrical condition scores that were assigned during the visual inspections.
- Consequence of Failure (COF) Score: A score indicating the consequence of failure for each asset, as determined by Regulatory Compliance, Criticality, Safety, and Operation and Maintenance (O&M) Impacts.

Risk scores were assigned for each asset by finding the product of the POF and COF of each asset. Adjusted Risk Score were then assigned based on the following:

- Estimated Useful Life (EUL): The length of time an asset is expected to last before needing replacement.
- Remaining Useful Life (RUL): The length of time an asset is estimated to have before requiring replacement based on the age and EUL of an asset.
- Risk Factor Adjustment: A score based on the RUL of an asset. Assets with a lower RUL equate to a higher Risk Factor Adjustment.

The Risk Score and the Risk Factor Adjustment of each asset was summed to get the Adjusted Risk Score.

Assets were then given a timeframe during which the City will likely need to implement each R/R project based on the Adjusted Risk Score and RUL of each asset. Implementation timeframes were assigned in five-year increments starting in the present. Cost opinions based on Class 5 estimates were then developed for each asset and grouped by process component. The cost opinions are project costs for replacement of an asset system and include construction costs, contractor overhead and profit, general conditions, estimated permit fees, contingency, and engineering services.

Renewal and replacement evaluation findings can be found in the report titled "Capacity Analysis, Evaluation and Re-Rating of the Wastewater Reclamation Facility," August 19, 2022. Renewal and replacement evaluation findings for each process component are discussed in section 4.7.

4.7 Facility Assessment

The following sections summarize major findings from previous reports, evaluations, and recent visual inspections performed by City Staff and Hazen and Sawyer. Discussion for each process area include:

- Process area overview and characteristics
- Estimated capacity based on hydraulic and biological process modeling.
- Observed conditions from field assessments.
- Recommendations and R/R costs and implementation timeframes

4.7.1 Influent Screening

Bar screens remove large solid objects in the influent flow stream to protect downstream mechanical equipment. The plant has two climber-type mechanical screens manufactured by Parkson Corporation, and a third manually cleaned screen within the bypass channel. Each mechanical climber screen is a fixed inclined bar screen with a traveling rake external mechanism that can be removed for maintenance purposes. Influent entering the Headworks Building passes through the bar screens before entering the grit chambers. Screened materials are deposited in dumpsters and trucked off-site by a private contractor for disposal.

At the time of the field assessment, staff reported that screening was inefficient for removal of debris and that the plastic internal teeth components continually break off and impact downstream processes. The City since replaced the original 3/8" opening screens with 1/8" opening screens. Design criteria for the new bar screens are presented in Table 4-3.

Table 4-3: Influent Screen Characteristics

Description	Unit	Value
Type of Screen	-	Mechanical Self Cleaning
No. of Filter Screen Channels	-	2
No. of Bypass Channels (manually cleaned)	-	1
Total No. of Channels	-	3
Channel Dimensions (width x depth)	in	36 x 102
Clear Opening, Horizontal	in	1/8
Clear Opening, Vertical	in	1
Screen Width	ft	3

4.7.1.1 Estimated Capacity

Parkson Corporation recently replaced both mechanical bar screens and has identified a peak flow capacity of 18.25 mgd for each screen. Capacity specifications are presented in Table 4-4.

Table 4-4: Screen Capacity Evaluation

Description	Unit	Value
Upstream Velocity1	ft/sec	1.63
Downstream Velocity1	ft/sec	2.44
Total Head loss1	in	23.09
PHF Capacity (each)1	mgd	18.25
PHF Capacity (total)1	mgd	36.5
Equivalent AADF	mgd	14.6

[1]Information Provided by Parkson Corporation

Based on a PHF factor of 2.5, the bar screens have a capacity of 14.6 mgd AADF with both bar screens in service. A manually cleaned bar screen with 1-5/8" spacing provides hydraulic relief to the mechanical bar screens via an overflow weir when upstream water levels exceed the set point.

4.7.1.2 Observed Condition

Visual inspections of the two mechanically cleaned bar screens performed in 2021 (prior to the replacement noted above) identified the following:

- Staff noted that inadequate screening had caused rag buildup in the downstream processes and has resulted in excessive maintenance needs, especially in the grit pumps, RAS pumping system, and WAS pumping system.
- Many of the teeth on the mechanical rakes were damaged or completely broken off. Staff reported that broken teeth resulted in excessive maintenance needs of the grit pumps. Figure

4-3 shows Bar Screen No.1 as it appeared during inspection. Both screens have since been replaced.

- The interior coating of the influent channels shows surface blistering.
- Cracks and some spalling were noted on the top roof slab and stairs especially around embeds with coating failure visible at parapet.
- In 2022, the City reported process drain issues in the headworks building due to buildup of debris from the headworks and grit processes. Attempts by the City to clear the pipes have been unsuccessful. Replacement of the process drain pipes may be required.



Figure 4-3: Headworks Bar Screen

4.7.1.3 Conclusion and Recommendations

Although adequate screening capacity exists through the year 2045, some deficiencies were noted. Staff reported that downstream processes were being impacted due to excessive rags and broken screen teeth. The City since contracted Parkson directly to replace both screens with a finer screening capability. The construction effort cost $182,715 and was completed in December 2022. The City reports a 33% increase of screened material since the screens have been replaced. The screens are anticipated to require replacement in the 20+ year planning period at an estimated cost of $828,000.

Drainage issues in the Pretreatment process drain pipe may warrant a CCTV inspection to determine if the process pipe has experienced a collapse or if the drainage issue stem from a blockage. It is estimated that the pretreatment process drain piping will cost a minimum of $50,000 to replace.

4.7.2 Grit Removal

Grit is removed from the wastewater system to:

- Protect mechanical equipment from abrasion and abnormal wear
- Reduce conduit clogging caused by deposition of grit in process piping
- Prevent grit accumulation in treatment basins which could interfere with their operation

After screening, influent flows into two forced vortex grit chambers where grit is separated from the wastewater. The grit is collected in the center of the grit chambers and then pumped to grit classifiers before being deposited into dumpsters and hauled off by a contractor. Influent leaves the headworks building and flows by gravity to the aeration basins.

Grit Collector Assemblies No. 1 and 2 were replaced in 2014 and 2019, respectively. Grit Pumps No. 1 and 2 were replaced in 2021 and 2018, respectively. Grit Classifiers No. 1 and 2 were both replaced in 2021. Grit removal characteristics are presented in Table 4-5.

Table 4-5: Grit Removal Characteristics

Description	Unit	Value
Grit Chamber		
Type of Unit	-	Forced Vortex
No. of Units	-	2
Upper Chamber Diameter	ft	18
Upper Chamber Side Water Depth	ft	6.25
Lower Chamber Diameter	ft	5
Lower Chamber Side Water Depth	ft	7.5
Removal Capacity	%	≥ 95
Motor Horsepower	hp	2
Grit Pumps		
No. of Units	-	2
Capacity (each)	-	220
Motor Horsepower	hp	15
Grit Classifier		
No. of Units	-	2

Description	Unit	Value
Motor Horsepower	hp	1

4.7.2.1 Estimated Capacity

Peak hourly flow grit removal capacity is based on hydraulic retention time. Grit chambers are typically designed with a hydraulic retention time of 20 to 30 seconds at PHF. A hydraulic retention time of 30 seconds was used to estimate the grit chamber capacity which is presented in Table 4-6.

Table 4-6: Grit Removal Capacity Evaluation

Description	Unit	Value
PHF Retention Time	seconds	30
PHF Based on Hydraulic Retention Time[1]	mgd	41.4
Equivalent Overall AADF Capacity	mgd	16.6

Based on the analysis presented above, the capacity of the grit chambers is 16.6 mgd at AADF, with one unit out of service.

4.7.2.2 Observed Condition

Visual inspections of the grit chambers performed in 2021 identified the following:

- Staff noted that grit removal is inefficient as evidenced by sand accumulation in aeration basins. Visual inspection of one of the aeration basins which was drained confirmed excessive sand accumulation.
- Staff reported that the grit pumps experience excessive clogging from bar screen teeth and subsequently require frequent maintenance. The City since replaced both bar screens with a finer screening capability.
- Corrosion was noted on the grit pipe supports.
- Cracking and spalling were noted on the roof slab of the Pretreatment Building.

4.7.2.3 Conclusion and Recommendations

Although grit facilities have adequate nominal capacity, grit continues to affect downstream processes, requiring excessive maintenance and replacement of mechanical equipment. The City should evaluate the existing grit facilities to see if higher grit removal efficiency can be achieved to reduce the impacts grit has on downstream processes. Grit Collectors No. 1 and 2 are expected to require replacement in 5-10 and 10-15 years, respectively. Grit Classifiers No. 1 and 2 and Grit Pumps No. 1 and 2 are expected to require replacing in 15-20 years. Grit System R/R costs for the existing system are presented in Table 4-7 and include grit collectors, classifiers, pumps, and associated appurtenances.

Table 4-7: Grit System R/R Costs

Asset System	<5 years	5-10 years	10-15 years	15-20 years	Total
Grit System Assemblies	-	$307,000	$307,000	$1,228,000	$1,842,000

4.7.3 Aeration Basins

The primary goal of the activated sludge process is the removal of biologically oxidizable materials. The organic pollutants in wastewater are synthesized through microbiological action into insoluble cell mass or are oxidized into carbon dioxide and water. The WWRF has five aeration basins which operate in parallel. Aeration Basins No. 1-4 were placed in service in 1997 and rehabilitated in 2010, while Aeration Basin No. 5 was placed in service in 2010 as part of the WWRF plant upgrade. Influent flows by gravity from the Headworks Building to the influent channel of the aeration basins where it mixes with return activated sludge (RAS). Five influent channel mixers ensure proper mixing before the flow enters one of the aeration basins via a slide gate. Influent Mixers No. 1-4 were installed in 1997 and Influent Mixer No. 5 was installed in 2010.

Each independent aeration basin is designated as a train. Within each train are eight cells through which flow passes in sequence, with an anoxic zone existing at the head of each train. These cells operating in series within the train are designed to approximate an ideal plug flow system that enhances the overall biological reaction rate and carbonaceous biochemical oxygen demand ($CBOD_5$) removal. Five air blowers provide air to the fine bubble diffusers within each aeration basin. Air Blowers No. 1-4 were installed in 1997 and Air Blower No. 5 was installed in 2010 as part of the WWRF plant upgrade. Air Blowers No. 1-3 were rehabilitated in 2019 and Air Blower No. 4 was rehabilitated in 2009. Fine Bubble Diffusers No. 1-4 were rehabilitated in 2010 at the time Fine Bubble Diffuser No. 5 was installed.

After passing through the aeration basins, effluent makes its way into the effluent channel where five effluent mixers ensure adequate mixing. Effluent then goes through clarifier splitter boxes before making its way by gravity to the clarifiers. Effluent Mixers No. 1, 2, and 4 were rehabilitated in 2011. Effluent Mixer No. 3 was rehabilitated in 2019 and Effluent Mixer No. 5 was installed in 2010.

The physical characteristics of the five existing aeration basins, blowers, and mixers are summarized in Table 4-8.

Table 4-8: Aeration Basin and Blower Characteristics

Description	Unit	Value
Aeration basins		
No. of Basins	-	5
No. of Zones per Basin	-	8
Basin Dimension:		
Depth	ft	23.25
Width	ft	25
Length	ft	205
Side Water Depth	ft	20.48
Volume (each)	cu ft	102,500
Total Volume	MG	3.83
Blowers		
Number of Blowers	ea	5

Description	Unit	Value
Flow Rate (each)	scfm	6525
Motor Horsepower	hp	500
Mixers		
No. of Influent Mixers	-	5
No. of Effluent Mixers	-	5
Motor Horsepower	hp	1.5

4.7.3.1 Estimated Capacity

Based on the capacity evaluation using BioWin™, the existing aeration basins have a capacity of 11.3 mgd AADF with one basin out of service. Improving settling or carbon removal could increase the capacity to 12.7 mgd AADF. Alternatively, adding a sixth aeration basin could result in a capacity of 13.6 mgd AADF. Any of these options would also increase clarifier capacity.

As discussed in Section 2, WWRF influent flows are projected to exceed the current capacity of 11.3 mgd prior to 2030 and reach 13.4 mgd by 2045. Thus, a sixth aeration basin, along with additional blowers and upgrades to the RAS pumps, will be necessary to provide adequate secondary treatment capacity.

4.7.3.2 Observed Condition

Visual inspections of the aeration basins performed in 2021 identified the following:

- Aeration Basins No. 1, 2, and 3 have leaking valves. Several of the mixers have been replaced in recent years but others are nearing or have reached the end of their useful life.
- Air blowers No. 1-3 are in fair to good condition with some cracking in the concrete pads noted. Air blowers No. 4 and 5 and appurtenances show signs of wear and are expected to need replacing within 5 years.
- A layer of sand is visible in the first few cells of Aeration Basin No. 2 (Figure 4-4), which was drained for regular maintenance. A few diffusers are partially visible in cell 1 as shown in the figure, but all other diffusers are completely covered with sand. An example of a downstream aeration basin cell (cell 7) with visible diffusers can also be seen in Figure 4-4. The Accumulation of grit and sand within each aeration basin has been reported by staff. Staff also reports the accumulation of grit and sand clogs air diffusers, reduces the effective basin volume, and impacts operation of the influent channel mixers.
- Exterior walls show signs of leaking with efflorescence and coating blistering and peeling on all four sides of the aeration basin structure. Cracking of handrail embeds were noted around the top of aeration basins.



Figure 4-4: Sand Accumulation in Aeration Basin No. 2

4.7.3.3 Conclusions and Recommendations

A sixth aeration basin, additional blowers, and upgrades to the RAS pumps will be necessary to treat projected 2045 WWRF influent flows. This is estimated to cost $16,688,000 and is part of the Capital Improvement Program discussed in Section 6. Additionally, improving grit removal efficiency upstream or increasing the frequency of maintenance would help to reduce sand and grit accumulation within aeration basin cells. Air Blowers No. 4 and 5, the aeration diffuser assemblies, and most mixers are expected to need replacing within 5 years. Aeration Basin Effluent Mixers No. 1, 2, and 4 are expected to require replacing in 5-10 years. Air Blowers No. 1, 2, and 3 are expected to require replacement in 5-10 years. Aeration Basin Effluent Mixer No. 3 is expected to require replacement in 10-15 years. Aeration system R/R costs are presented in Table 4-9 and do not include the addition of a sixth aeration basin.

Table 4-9: Aeration System R/R Costs

Asset System	<5 years	5-10 years	10-15 years	15-20 years	Total
Aeration Basin Assemblies and Mixers	$1,448,000	$399,000	$133,000	-	$1,980,000
Blower Assemblies and Ancillary Equipment	$2,743,000	$3,993,00	-	-	$6,736,000

4.7.4 Secondary Clarifiers

Secondary clarifiers provide a quiescent zone to permit settling of treated suspended materials discharged from the aeration basins. Wastewater flows by gravity from the Aeration Basins to the clarifiers where solids settle out with the help of polymer. Sludge is then pumped to the head of the aeration basins as Return Activated Sludge (RAS) or to the gravity belt thickeners where it is dewatered before being sent to the digester building as Waste Activated Sludge (WAS). Clarifiers No. 1-3 were constructed in 1997, while Clarifier No. 4 was constructed in 2010. The physical characteristics of each clarifier are summarized in Table 4-10.

Table 4-10: Secondary Clarifier Characteristics

Description	Unit	Value
Type of Unit	-	Circular/Center Feed, Peripheral Discharge
No. of Units	-	4
Dimensions:		
Side Water Depth	ft	14
Diameter	ft	100
Weir Length	ft	450
Basin Bottom Slope	in/ft	1
Surface Area (per clarifier)	ft^2	7,850
Total Surface Area	ft^2	31,400
Volume (per clarifier)	MG	0.91
Total Volume	MG	3.65

4.7.4.1 Estimated Capacity

The two methods used for evaluating final clarifier capacity are surface overflow rate (SOR) and solids loading rate (SLR). For secondary clarifiers under peak hour flow conditions, Ten State Standards suggests a maximum SOR of 1,200 gallons per day per square foot (gpd/sf) and a SLR of less than 40 pounds per day per square foot (lbs/day/sf) of TSS at max day conditions. For AADF, a surface overflow rate of 500 gpd/sf is used. In 2022, clarifier capacity was analyzed using the calibrated process model. The capacity evaluation using BioWin™ determined the clarifiers have a capacity of 11.3 mgd AADF with one clarifier out of service. A summary of the analysis is presented below on Table 4-11.

Table 4-11: Clarifier Analysis at Planning Horizon

Flow Condition	Influent Flow (mgd)	No. of Clarifiers in Service	SOR (gpd/sf)	SLR (lb/d/sf)
Annual Average	11.3	3	480	22.2
Max Month	14.2	3	600	33.3
Max Day	19.5	3	830	30.4
Max Day	19.5	4	620	22.8
Peak Hour Flow	26.2	3	1,110	37
Peak Hour Flow	26.2	4	830	28

Based upon this analysis, the clarifiers have sufficient capacity for the planning horizon but not the permitted capacity. Several Options to increase capacity are discussed in conclusions and recommendations.

4.7.4.2 Observed Condition

Visual inspections performed in 2021 of the clarifiers identified the following:

- Clarifier No.1 was out of service due to an issue with the drain valve. The valve has since been replaced and the clarifier put back into service.
- Staff reports that the influent slide gate of Clarifier No. 2 is stuck in an unknown position as the hydraulics between the aeration basin effluent channel that leads to Clarifier No.2 exhibits a significantly higher head loss.
- Drive motors of Clarifiers No. 1-4 show significant corrosion (Figure 4-5). The over torque protection devices for Clarifiers No. 1-4 are inoperable.
- All clarifiers show blistering and peeling of coatings, and small concrete spall areas. There are also vertical cracks seen mostly near the top of the clarifier structures, likely due to concrete shrinkage with no apparent signs of leaking.



Figure 4-5: Clarifier 3 Drive Motor

4.7.4.3 Conclusions and Recommendations

Options to increase clarifier capacity involve reducing solids loading or enhancements for better settling. Several options that the City should consider include:

1. Provide a 6th basin which would enable a secondary clarification capacity of 13.6 mgd by reducing the solids loading.

2. Improve settling to allow the facility to meet the permitted capacity. This can be achieved through one or more of the pathways noted below:

    i. Cyclones (physical separation of poor settling sludge)

    ii. Selector (improve current selector zone to ensure proper metabolic pathway for selection of appropriate bacteria for improved settling sludge)

    iii. RAS Chlorination (perform RAS chlorination during poor settling period to remove filament growth, which cause poor settleability).

Clarifiers No. 1-3 are expected to need rehabilitation within 5 years and Clarifier No. 4 in 5 - 10 years. The influent slide gate of Clarifier No. 2 should also be investigated to reduce hydraulic head loss. Clarifier System R/R costs are presented in Table 4-12 and include complete rehabilitation of all four clarifiers.

Table 4-12: Clarifier System R/R Costs

Asset System	<5 years	5-10 years	10-15 years	15-20 years	Total
Secondary Clarifier Equipment	$9,681,000	$3,227,000	-	-	$12,908,000

4.7.5 Return Activated Sludge (RAS) System

The return activated sludge (RAS) pumps recycle suspended biomass removed from the secondary clarifiers to the head end of the aeration basins. The RAS/WAS Pump Station and RAS pumps No. 1–4 were constructed in 1997. RAS Pumps No. 5 and 6 were installed in 2010. All RAS pumps were rehabilitated in 2020. Despite recent rehabilitation, the City has observed reduced capacity for the RAS pump station as the pumps currently operate constantly with no unit in standby. The RAS pumping system characteristics are presented in Table 4-13.

Table 4-13: RAS Pumping System Characteristics

Description	Unit	Value
Type of Unit	-	Horizontal, Centrifugal, Non-Clog
No. of Units	-	6
Pump Size	hp	15
Pump Capacity (each)	gpm	1700
Total Capacity	mgd	14.6
Firm Capacity (1 standby)	mgd	12.2

4.7.5.1 Estimated Capacity

RAS pumping system capacity requirements are generally determined as a percent of AADF. A value of 60% of AADF was selected for RAS pump evaluation with one pump out of service. RAS requirements were also corroborated in the calibrated process model and showed that the RAS Pumping System has adequate capacity through the planning period with one pump out of service.

4.7.5.2 Observed Conditions

Visual inspections performed in 2021 of the RAS pumping system identified the following:

- Staff reports RAS pumping system experiences excessive rag build up and wear and tear due to grit and sand which has caused a need to have the pump volutes and process piping to be replaced excessively.
- At the time of the field assessment, the City reported reduced pumping capacity for the RAS pump station, apparently due to rag buildup in the pipes. The pumps were observed to be operating constantly with no unit in standby. Replacement of the bar screens with a finer opening has since been completed and the City has seen a 33% increase of screened material. The City will evaluate the RAS pump station to see if the increased screening has an impact on the reduced RAS pumping capacity.

4.7.5.3 Conclusions and Recommendations

Although the RAS pumps have an estimated remaining useful life greater than five years based on age and limited field assessment, the RAS pump assemblies are included within the 5 year timeframe due to reduced pumping capacity as reported by the City. Should ragging issues persist after the bar screen replacement, the City may elect to replace the RAS pumps with chopper pumps or provide other upgrades or enhancements. Additionally, if the City elects to add a sixth aeration basin, additional RAS capacity will be required. The estimated project cost to install six chopper pumps and ancillary equipment is $960,000.

4.7.6 Waste Activated Sludge (WAS) System

In the activated sludge process, soluble organic material is converted to a settable solids form. Excess solids are removed from the liquid process stream and pumped to sludge treatment facilities for additional processing. The WAS pumps are located adjacent to the RAS pumps in the RAS/WAS Pump Station. WAS is dewatered and sent to the digester. Both WAS pumps were installed in 1997 and rehabilitated in 2021. The WAS pumping system characteristics are presented in Table 4-14.

Table 4-14: WAS Pumping System Characteristics

Description	Unit	Value
Type of Unit	-	Positive Displacement Progressive Cavity
No. of Units	-	2
Pump Size	hp	20
Pump Capacity (each)	gpm	400
Total Capacity	mgd	1.2
Firm Capacity (1 standby)	mgd	0.6

4.7.6.1 Estimated Capacity

Based on the BioWin™ process model update, the Max Month WAS requirements are 0.32 mgd at the permitted capacity. Based on a pumping capacity of 0.6 mgd with one pump on standby, the WAS pumping system has adequate capacity through the planning period.

4.7.6.2 Observed Conditions

Visual inspections performed in 2021 of the WAS pumping system identified the following:

- WAS Pumps No. 1 and 2 appear in good condition.
- WAS Pump No. 1 was leaking oil at the time of field assessment however a work order was being processed to fix the leak.

4.7.6.3 Conclusions and Recommendations

Pumping capacity of the WAS system is adequate through the planning period. Both pumps are estimated to require replacement in the 10-15 year time frame at an estimated project cost of $234,000.

4.7.7 Chlorination Facilities

Hypochlorite is used on treated effluent in the high-level disinfection process prior to being discharged for reuse. Hypochlorite is a strong oxidizing agent that destroys waterborne disease-causing organisms. To confirm sufficient disinfection, coliforms are used as a surrogate parameter to ensure adequate disinfection. Hypochlorite is pumped from metering pumps to the head of the chlorine contact tanks where it is injected into freshly filtered effluent. Hypochlorite is also pumped to the Injection Wells for slime control, the Plant Influent Force Main for odor control, the Sludge Pump Station for RAS filamentous and slime control, and the Pretreatment and Solids Handling Odor Control Systems. The chlorination facilities consist of eight storage tanks and three metering pump skids (seven metering pumps in total). Hypochlorite Tanks No. 1-3 were installed in 1997, Hypochlorite Tanks No. 4-6 were installed in 2008, and Hypochlorite Tanks No. 7 and 8 were installed in 2020 with Tank No. 4 being replaced that same year. Pump Skid No. 1 (3 pumps) was installed in 2020, Pump Skid No.2 (2 pumps) was installed in 2015, and Pump Skid No. 3 (2 pumps) was installed in 2016. Chlorination facility characteristics can be seen in Table 4-15.

Table 4-15: Chlorination Facilities Characteristics

Description	Unit	Value
Hypochlorite Facility (12% NaOCl)		
Reuse Water Demand	mg/L	20
Caustic Storage Tank		
Number of Storage Tanks	ea	8
Tank Capacity (each)	gal	3 @ 3625
Tank Capacity (each)	gal	5 @ 3700
Caustic Feed Pumps		
Number of Dosing Pumps	ea	7
Capacity (each)	gph	3 @ 39
Capacity (each)	gph	4 @ 70
Pressure	psig	100
Daily Average Consumption Rate	gpd	1100
Daily Peak Consumption Rate	gpd	1900

4.7.7.1 Estimated Capacity

The Miramar WWRF has a sodium hypochlorite storage capacity of 29,375 gallons. The plant receives replenishment every 8-10 days. Based on peak and average daily consumption of sodium hypochlorite, the WWRF has adequate storage for 15 and 26 days, respectively.

4.7.7.2 Observed Conditions

Visual inspections performed in 2022 of the Chlorination Facilities identified the following:

- Tanks No. 1 (Figure 4-6) and No. 3 were out of service due to leaks. Tanks No. 2, 5, and 6 show signs of leaking at the bottom flange. Concrete pads for Tanks No. 1-3 are cracking and spalling.
- Pump Skids No. 1 and 3 show some signs of corrosion but are in good condition overall. Salt formation was evident around piping connections on all skids which suggests minor leaks exist around pipe connections. Pump Skid No. 2 is in fair condition but one or more of the pumps exhibited an abnormal grinding noise which suggests it will need replacing or repairing within 5 years.
- Paint chipping and peeling is evident on the hypochlorite tank containment barriers.



Figure 4-6: Hypochlorite Tank No. 1

4.7.7.3 Conclusions and Recommendations

The City planned to replace Hypochlorite Tank Nos. 1-3 in fall 2023 and Hypochlorite Tank Nos. 5 and 6 in early 2024. As of May 2024, the City has yet to replace these tanks. The chlorine facilities are in fair to good condition and have adequate capacity for current and future flows through the planning period. It is recommended that the City replace Hypochlorite Tank Nos. 1-3, 5, and 6 along with Pump Skid No. 2 in the near term. The other Pump Skids are expected to require rehabilitation in the 5-10 year planning

period, while replacement of Hypochlorite Tank Nos. 4, 7, and 8 are expected in the 10-15 year planning period. The Chlorination Facilities R/R costs are presented in Table 4-16 and include replacement of all hypochlorite tanks, pump skids, and associated piping and instrumentation.

Table 4-16: Chlorination R/R Costs

Process Component	<5 years	5-10 years	10-15 years	15-20 years	Total
Chlorination Facilities	$698,000	$106,000	$387,000	-	$1,191,000

4.7.8 Pretreatment Odor Control System

Although there is a significant buffer zone between the WWRF and surrounding communities, the processing of organic vapors and inorganic gases generated from the City's wastewater collection and treatment facilities is important. The WWRF has an odor control system at the Pretreatment Building that is designed to process foul odor using chemical scrubbers before ejecting the air into the atmosphere. The Pretreatment Odor Control System consists of scrubber towers, a scrubber fan, recirculation pumps, chemical feed pumps, and caustic storage installed during plant construction. The system also receives Chlorine (Sodium Hypochlorite) from the Chlorination Facility. The scrubber fan was replaced in 2015. Two recirculation pumps were replaced in 2015 and the other two were replaced in 2021. All four chemical feed pumps were replaced in 2017.

The design characteristics of the Pretreatment Odor Control System is presented in in Table 4-17.

Table 4-17: Pretreatment Odor Control System Characteristics

Description	Unit	Value
Scrubber Fans		
No. of Units	ea	1
Air Flow Rate	cfm	3,250
Motor Horsepower	hp	15
Scrubbers		
No. of Units	ea	2
Inside Diameter	ft	3.5
Packing Depth	ft	10
First Stage Solution	-	Caustic Soda
Second Stage Solution	-	Chlorine with Caustic Soda
Recirculation Pumps		
No. of Units	ea	2+2
Capacity (each)	gpm	40
Motor Horsepower	hp	2
Caustic Soda Storage Tank		
No. of Units	ea	1
Capacity	gal	1,500
Caustic Feed Pumps		
No. of Units	ea	2+2
Capacity	gph	6.1
Pressure	psig	150

All components except for the scrubber towers and caustic storage tank were replaced between 2015 and 2021. Despite these replacements, the City reports that the system has been out of service since 2016. Currently, a fogging system is used to mask odors. One fogging unit sprays the top floor of the

Pretreatment Building while a second unit sprays the first floor. Staff reports significant foul odors on the first floor of the Pretreatment Building.

4.7.8.1 Estimated Capacity

The scrubber system was designed for 3,250 cfm. Manned spaces (storage room) are designed for 12 changes per hour, while unmanned areas (influent channels, chamber) are designed for 6 changes per hour. The system is designed to handle an average H2S concentration of 100 ppm and a peak of 200 ppm with a 99.9% removal efficiency.

4.7.8.2 Observed Conditions

Visual inspections performed in 2021 of the Pretreatment Odor Control System identified the following:

- Staff reports the Pretreatment Odor Control System was taken out of service since 2016 due to electrical issues which were not resolved with the latest replacement of the chemical feed pumps and recirculation pumps.
- Odors are strong on the first floor of the Pretreatment Building.
- The caustic storage tank has some corrosion and the suction flange leaks. The tank is also past its expected useful life.
- Recirculation Pump No.1 has significant corrosion, and the motor fan shroud is broken (Figure 4-7).



Figure 4-7: Pretreatment Odor Control System Recirculation Pump No.1

4.7.8.3 Conclusions and Recommendations

The odor control system is currently out of service. Despite use of a fogging system to mask odors, staff reports significant odors within the first floor of the Pretreatment Building. The Pretreatment Odor Control System should be investigated further by the manufacturer to resolve the noted electrical issues. Additionally, replacement of the caustic storage tank and recirculation pump motor is needed. The scrubber fan is also expected to need replacement within five years. Due to prolonged disuse, it is suggested that the remainder of the system be evaluated and tested. R/R costs associated with the Pretreatment Odor Control system are presented in in Table 4-18 and assume rehabilitation of the scrubbers and replacement of the caustic storage tank, damaged recirculation pump motor, and scrubber fan within the next five years. The other recirculation pumps and the chemical feed pumps are expected to require replacement on 10-15 years and 15-20 years, respectively.

Table 4-18: Pretreatment Odor Control System R/R Costs

Process Component	<5 years	5-10 years	10-15 years	15-20 years	Total
Pretreatment Odor Control System	$533,000	-	$72,000	$52,000	$657,000

4.7.9 Gravity Belt Thickeners

WAS is pumped from the RAS/WAS Pump Station to the Solids Handling Building where the sludge is thickened via two gravity belt thickeners (GBTs) before being transferred to the Primary Digester. Both GBTs were installed in 1997 and rehabilitated in 2021. Rehabilitation included replacing belts, rollers, and hydraulic fluid tanks. The GBTs have associated equipment such as washwater booster pumps, thickened sludge pumps, and a polymer system that were also installed in 1997. Wash Water Booster Pump No. 2 was rehabilitated in 2020 and both Sludge Pumps were replaced at that time. The polymer system consists of a polymer bulk storage tank and day tank. There are three polyblend feed systems that were installed in 2008. There are also two polymer transfer pumps that transfer polymer from the bulk storage tank to the day tank. The polymer transfer pumps were rehabilitated in 2015. The GBT characteristics are presented in Table 4-19.

Table 4-19: Gravity Belt Thickener Characteristics

Description	Unit	Value
Gravity Belt Thickeners		
No. of Unit	--	2 (1+1)
Size of Unit (width)	meters	2
Capacity (each)	gpm	350
Design Solids Loading	lbs/day	20,850
No. of Polyblend Feed Assembly	-	3
No. of Sludge Transfer Pumps	-	2
Polymer Bulk Storage Tank Size	gal	7,000
Polymer Day Tank Size	gal	600

4.7.9.1 Estimated Capacity

Hydraulic loading rate and solids loading rate are two criteria to consider when evaluating GBT capacity. A hydraulic loading of 100-250 (gpm/m) and a solid loading rate of 660-1190 (lbs/hr/m) are standard. Based upon a hydraulic loading of 150 (gpm/m) and a solids loading rate of 800 (lbs/hr/m), the existing GBTs have a capacity to treat an equivalent influent flow of 17.1 mgd based on 24/7 operation with one unit out of service.

4.7.9.2 Observed Conditions

Visual inspections performed in 2021 of the Gravity Belt Thickener identified the following:

- Both GBTs are in fair condition but staff reported that each GBT is close to maximum capacity when operated 8-hours a day, 5-days a week. The City has since extended operation of the GBTs.
- Polyblend Feed Assembly No. 2 was out of service due to clogging. Staff reports significant polymer clogging also occurs in the mixing chambers of Polyblend Feed Assemblies No. 1 and 3. Polymer Assemblies are operated manually due to instrumentation issues.
- Bulk storage and day tank are nearing their useful life and show evidence of leaks. A layer of caked polymer was noted at the bottom of containment area.

- Sludge Transfer Pumps No. 1 and 2 vibrate excessively.

4.7.9.3 Conclusions and Recommendations

The GBTs have adequate capacity to handle flow through the planning period. At the projected 2045 AADF of 13.4 mgd, with one unit out of service, the required operating time would be about 19 hours per day, seven days per week. It is estimated that the GBTs, the polymer bulk storage tank, day tank, and polymer transfer pumps will require replacement within the next 5 years due to age. The City should have the manufacturer of the polyblend feed system come out to investigate the cause of polymer clogging. The polyblend feed assemblies are estimated to require replacement in 5-10 years. The washwater and thickened sludge pumps are estimated to require replacement in 15-20 years. R/R costs are presented in in Table 4-20.

Table 4-20: Gravity Belt Thickener R/R Costs

Process Component	< 5 years	5-10 years	10-15 years	15-20 years	Total
Gravity Belt Thickeners	$2,767,000	$39,000	-	$864,000	$3,644,000

4.7.10 Anaerobic Digesters

After sludge is thickened on the GBTs, it is transferred to a fixed cover primary digester where the sludge begins the anaerobic stabilization process. The stabilization process uses boilers to operate within a temperature range of 95 °F to 210 °F to break down unstable, rapidly decomposable constituents into more organic compounds and achieve a high degree of pathogenic organism destruction and volatile solids reduction (VSR) to meet EPA Class B standards. Connected to the primary digester is an equalization line where sludge is transferred to a floating cover secondary digester. Both digesters and ancillary equipment were installed in 1997. Each digester uses mixers and sludge recirculation pumps to keep solids well-mixed and in suspension. The drive belts of the Primary Digester mixers were replaced in 2020, all four sludge recirculation pumps were rehabilitated in 2020, and the two sludge transfer pumps were rehabilitated in 2021. The recirculation pumps, the transfer pumps, and process piping are in the Digester Building which is located between the two digesters.

There are two boilers that can operate on digester gasses or diesel fuel and were rehabilitated in 2017. Heat exchangers are used to maintain sludge temperature in each digester. The seals on Heat Exchanger No. 1 were replaced in 2021 while Heat Exchanger No. 2 was replaced in 2007. Heat Exchanger No. 3 operates as a backup heat exchanger. There are three water recirculation pumps that were rehabilitated in 2010. The boilers and ancillary equipment are also housed in the Digester Building.

Two 10,000 gallon diesel tanks supply diesel to the boilers in addition to the emergency generator day tanks. The diesel tanks and generator day tanks will be discussed further in 4.7.16. The digester and ancillary equipment characteristics are presented in Table 4-21.

Table 4-21: Anaerobic Digester Characteristics

Description	Unit	Value
Digesters		
No. of Units	--	2
Diameter	ft	90
Side Water Depth	ft	35
Effective Side Water Depth	ft	25
Effective Volume (per digester)	cu ft	158,960
Total Volume	MG	2.38
Sludge Recirculation Pumps	--	
No. of Units	--	4
Design Flow (each)	gpm	280
Motor Horsepower	hp	15
Sludge Transfer Pumps	--	
No. of Units	--	2
Design Flow (each)	gpm	200
Motor Horsepower	hp	15
Boilers		
No. of units	--	2
Capacity (each)	Btu/hr	1,675,000
Heat Exchangers	--	
No. of Units	--	3
Design Flow (Water/Sludge)	gpm	116/116
Water Recirculation Pumps		
No. of Units	--	3
Design Flow (each)	gpm	115
Motor Horsepower	hp	1

4.7.10.1 Estimated Capacity

Over time, inert materials accumulate in anaerobic digester tanks, effectively reducing the usable volume of the tank. Typically, anaerobic tanks are taken out of service on a regular basis (every 5-10 years) to remove the inert material and restore capacity. In determining capacity, an operational volume reduction of approximately 30% was assumed to allow for a modest accumulation of inert solids in-between cleanings. This volume reduction assumption can be adjusted based on operational experience regarding site-specific accumulation rates according to the desired cleaning frequency – that is, a reduced allowance for inert accumulation can be offset by more frequent cleanings to preserve the digestion capacity required for permit compliance.

Digester redundancy is not required per Class I Reliability standards. Rather, the need for redundancy is based on operations and maintenance flexibility preferences. It should be noted that with two digesters, once inert solids accumulate to the point where a single digester cannot provide adequate solids treatment while the other digester is out of service for maintenance, additional (and more costly) solids treatment and/or disposal approaches become necessary. As presented in Table 4-22, retention times were verified for two conditions: both existing tanks in service and a 30% volume reduction due to inert material accumulation and one tank in service and 30% volume reduction due to inert material accumulation. Values in red do not meet Class B, EPA Part 503 requirements which require a minimum 15-day retention time and 38% VSR.

Table 4-22: WWRF Digestion Capacity

Parameter	Unit	Planning Horizon		Permitted Capacity		Note
		Annual Average	Max Month	Annual Average	Max Month	
HRT (Both units in service)	Days	43.7	27.7	38.8	24.4	Both tanks in service and 30% volume loss by inert solids
HRT (one tank operational/ one tank out of service)	Days	21.8	**13.9**	19.4	**12.2**	One tank in service (one tank out of service for maintenance) and 30% volume loss by inert solids

Inert material will continue to accumulate and reduce the effective volume of the digesters. Maintenance typically requires a digester to be out of service for 8-10 weeks. Beyond a flowrate of 10.9 mgd, which is projected to be realized by 2025, a single digester with 30% inert solids will have inadequate capacity to provide the necessary solids reduction while the other digester is undergoing maintenance.

4.7.10.2 Observed Conditions

Visual inspections performed in 2021 of the digesters and ancillary equipment identified the following:

- Staff has acknowledged that a significant amount of inert material is built up within the digesters such that line clogs occur frequently and excessive maintenance is required. Three of the six suction pipes of recirculation system No. 1 appear to be clogged based on the temperature difference between pipes.
- Transfer Pump No. 1 is leaking oil. A grinder exists on the suction side of Transfer Pump No. 2 and is in operation however, excessive ragging was reported in all sludge pumps. Staff reported that the switch on Transfer Pump No. 2 is wired to the wrong VFD.
- The elevator in the digester building has been out of service for several years due to water draining into the elevator. The Certificate of Operation has expired.
- The rollers and roller tracks of the floating cover of the secondary digester (Digester No. 2) show signs of corrosion. Deterioration of the fixed cover roof connections of the primary digester (Digester No. 1) was also noted as presented in Figure 4-8.
- Exterior coating of both digesters shows signs of potential leaking due to large blisters and multiple areas of sagging coating. Some stucco damage was noted on the exterior surface of the digesters.
- Water pooling was noted on the floor of the digester building. Some wall cracks and peeling and chipping of interior paint were also noted.
- There is a large spall at a handrail embed by digester cover No. 2. A large crack at a handrail embed by digester cover No. 1 was also noted. Staff reports that the digester gas quality requires frequent boiler maintenance.
- Temperature and pressure gauges on Heat Exchanger No.2 are corroded and cannot be read.

- The Level Indication Transmitter (LIT) on Diesel Tank No. 2 is not functioning.



Figure 4-8: Fixed Cover Roof Connections of Digester No. 1

4.7.10.3 Conclusions and Recommendations

In October 2022, the City approved the installation of a sludge equalization line to mitigate clogging issues due to excessive accumulation of sludge, rags, sand, and other solids at a cost of $73,962. The City is also in the process of having both digesters cleaned of the inert material that has built up within each digester and has hired a consulting firm to evaluate alternative methods to dispose of solids during digester cleaning. A third digester is recommended within the next five years. Otherwise, atypically frequent cleanings will likely be needed to maintain adequate digestion during single digester operation. A third digester with a floating cover is expected to cost $18,677,000 including all necessary process equipment. A third digester is included as a capacity upgrade in Section 6.

Digester No. 2 Mixers and the Floating Cover is expected to need replacing within 5 years and the Elevator should be repaired immediately. Additionally, both boiler assemblies, the boiler circulation

pumps, diesel tanks, the waste gas burner system, the exhaust fans, and Heat Exchanger No. 2 and 3 are expected to require replacing within 5 years. Digester Hot Water Pumps No. 1 and 2 are expected to require replacing in 5-10 years. Heat Exchanger No. 1 is expected to require replacing in 10-15 years. Digester No. 1 Mixers and Digesters No. 1 and 2 Recirculation and Transfer Pumps are expected to require replacing in 15-20 years. The R/R costs associated with existing digesters and ancillary equipment can be seen in Table 4-23.

Table 4-23: Digesters and Ancillary Equipment R/R Costs

Process Component	<5years	5-10 years	10-15 years	15-20 years	Total
Digester and Ancillary Equipment	$7,815,000	$54,000	$53,000	$3,620,000	$11,542,000

4.7.11 Belt Filter Presses

After undergoing digestion, sludge is transferred from the Secondary Digester back to the dewatering building where the sludge is thickened using belt filter presses (BFPs). The belt filter presses convert the liquid sludge into a drier cake with a 16-18% solids content. Polymer is added to the sludge to aid in flocculation before excess water is drained. The sludge is then pressed between porous belts and passes between compression rollers to squeeze additional water out of the cake. The cake is deposited onto a conveyer belt and dropped into a dumpster where it is hauled off by a contractor and used as a fertilizer. The two 2-meter belt filter presses and ancillary equipment were installed in 1997. Both belt presses were rehabilitated in 2018 with new pans, rollers, belts, hydraulic systems, bearings, and sludge flow meters. The system has two washwater pumps that were replaced in 2020, and three polymer feed pumps that were replaced in 2021. The polymer system for the gravity belt filters and belt filter presses share a bulk storage tank. The belt filter characteristics are presented in Table 4-24.

Table 4-24: Belt Filter Press Characteristics

Description	Unit	Value
Belt Filter Press		
No. of Unit	--	2 (1+1)
Size of Unit (width)	meters	2
Capacity (each)	gpm	150
Design Loading	lbs/hr	1,500
No. of Polyblend Feed Assembly	-	3
No. of Conveyer Belts	-	1
Polymer Day Tank Size	gal	600

4.7.11.1 Estimated Capacity

Belt filter press capacity is evaluated based on hydraulic loading rate and solids loading rate, assuming one belt filter press running for 16-hours a day, 5-days a week with the second belt filter press on standby. Reference values for evaluation criteria are presented in Table 4-25 along with the selected values for this capacity evaluation (Table 4-26).

Table 4-25: Belt Filter Press Evaluation Criteria

Description	Hydraulic Loading Rate (gpm/ft)	Solids Loading Rate (lbs/hr/ft)
WEF MOP No. 8	30-45	100–200(average) 300(max)
Selected Reference Criteria for Capacity Analysis	30	200 (average) 300 (max)

Table 4-26: Belt Filter Presses Evaluation Summary

Condition	Capacity	
	AADF	Max Month
Hours per week	80	80
Duty BFP	1	1
Standby BFP	1	1
Solids Loading Rate (lbs/hr/ft)	190	300
Hydraulic Loading Rate (gpm/ft)	10	17

The belt filter presses have adequate capacity based on an influent flowrate of 12.7 mgd and 16-hours a day, 5-days a week operation. The City reports that they have extended BFP operations to 24-hours a day, 5-days a week.

4.7.11.2 Observed Conditions

Visual inspections performed in 2021 of the belt filter press and ancillary equipment identified the following:

- The overhead steel beam for the bridge cranes shows corrosion and coating failure. The steel supports with bolts and washers also have corrosion with several vertical cracks. 1-2 vertical beam cracks were noted.
- Polyblend feed No. 2 is out of service.
- Metal doors and louvers show signs of corrosion. There is minor stucco and paint damage.

4.7.11.3 Conclusions and Recommendations

The belt filter presses have adequate capacity through the planning period based on current operating times. The polymer day tank is expected to need replacing within 5 years. The three polyblend assemblies are expected to need replacing in 5-10 years. All other equipment is expected to need replacing in 15-20 years. R/R Costs associated with the Belt Filter Presses are presented in Table 4-27.

Table 4-27: Belt Filter Presses R/R Costs

Process Component	<5years	5-10 years	10-15 years	15-20 years	Total
Belt Filter Presses	$43,000	$39,000		$2,408,000	$2,490,000

4.7.12 Solids Handling Odor Control System

The odor control system for the Solids Handling Building was placed into service in 1997. The system consists of scrubber towers, a scrubber fan, recirculation pumps, feed pumps, and caustic storage tank. Foul air is removed from the Solids Handling Building and processed through the two chemical scrubbers before being released into the atmosphere. The system also receives Chlorine (Sodium Hypochlorite) from the Chlorination Facility. The characteristics of the Solids Handling Odor Control System are presented in Table 4-28.

Table 4-28: Solids Handling Odor Control System Characteristics

Description	Unit	Value
Scrubber Fans		
No. of Units	ea	1
Air Flow Rate	cfm	44,000
Motor Horsepower	hp	125
Scrubbers		
No. of Units	ea	2
Inside Diameter	ft	12
Packing Depth	ft	10
First Stage Solution	-	Caustic Soda
Second Stage Solution	-	Chlorine with Caustic Soda
Recirculation Pumps		
No. of Units	ea	2+2
Capacity (each)	gpm	500
Motor Horsepower	hp	15
Caustic Soda Storage Tank		
No. of Units	ea	1
Capacity	gal	2,000
Caustic Feed Pumps		
No. of Units	ea	2+2
Capacity	gph	19.6
Pressure	psig	150

The City reports that the system has been out of service since 2016 due to electrical issues.

4.7.12.1 Estimated Capacity

The scrubber system was designed for 44,000 cfm. The entire Solids Processing Building is designed for 12 changes per hour. The system is designed to handle an average H2S concentration of 25 ppm and a peak of 50 ppm with a 99.9% removal efficiency.

4.7.12.2 Observed Conditions

Visual inspections performed in 2021 of the Solids Odor Control System identified the following:

- Staff reports that odor control system has not been in operation since 2016 due to electrical issues.
- Chemical Feed Pump Nos. 1 and 2 were disconnected from the chemical feed system.

- Concrete coating deterioration was noted on the wall and floor near the chemical tanks. There are minor cracks noted in equipment pads and slab. Three bollards are missing and the rest show signs of corrosion.
- Pipe base plates and pipe supports have corrosion present.

4.7.12.3 *Conclusions and Recommendations*

The odor control system is currently out of service. Solids Odor Control System should be investigated by the manufacturer further to resolve the noted electrical issues. Additionally, replacement of the caustic storage tank and chemical dosing pumps are needed. Due to prolonged disuse, it is suggested that the remainder of the system be evaluated and tested. R/R costs associated with the Solids Odor Control system are presented in Table 4-29 and assume rehabilitation of the scrubbers and replacement of the caustic storage tank, chemical dosing pumps, and scrubber fan within the next five years. The recirculation pumps are expected to require replacement in 5-10 years.

Table 4-29: Solids Odor Control R/R Costs

Process Component	<5years	5-10 years	10-15 years	15-20 years	Total
Pretreatment Odor Control System	$915,000	$408,000	-	-	$981,000

4.7.13 Injection Well Pump Station

Effluent flows from the clarifiers to the wet well of the Injection Well Pump Station (IWPS). The IWPS disposes of effluent via injection well pumps and effluent filter feed pumps which share a wet well. The filter feed pumps are discussed in section 0. Injection Well Pump No. 1 was rehabilitated in 2010 while Injection Well Pumps No. 3 and 4 were replaced in 2017 and 2009, respectively. There are also injection well strainers that were rehabilitated in 2021. The IWPS characteristics are presented in Table 4-30.

Table 4-30: Injection Well Pump Station Characteristics

Description	Unit	Value
Effluent Pumps		
No. of Unit	-	4 (2+2)
Capacity (each)	gpm	2 @ 6450
Capacity (each)	gpm	2 @ 7000
Motor Size	hp	2 @ 400
Motor Size	hp	2 @ 450
Injection Well Strainers		
No. of Strainers	-	4
Size	in	20
Firm Capacity	mgd	29.8

4.7.13.1 Estimated Capacity

The injection well pumps have a combined capacity of 29.8 mgd with one pump on standby. Based on flow projections presented in Section 2.6.1, the Injection Well Pump Station has adequate capacity through the planning period.

4.7.13.2 Observed Conditions

Visual inspections performed in 2021 of the IWPS identified the following:

- Effluent Pump No. 2 has significant corrosion present and is past its expected useful life.
- Injection Well Pump Strainers show signs of wear and leaking despite recent replacement of the seals and several motors. The strainers have reached the end of their useful life.
- Several equipment pads have cracks. Corrosion was observed on the steel support anchors and base plates of equipment. Chipping of the concrete floor was noted (Figure 4-9). Corrosion was observed on the frames of the exterior doors and paint chipping was noted at several interior and exterior locations.



Figure 4-9: IWPS Concrete Floor

4.7.13.3 Conclusions and Recommendations

No capacity upgrades to the Injection Well Pumps are expected through the planning period. Effluent Pump No. 2 and the Injection Well Strainers are expected to require replacing within 5 years. Effluent Pumps No. 1 and 4 and both exhaust fans are expected to require replacing in 5-10 years. Effluent Pump No. 3 is expected to require replacing in 15-20 years. R/R costs associated with the Injection Well Pump Station are presented in Table 4-31.

Table 4-31: Injection Well Pump Station R/R Costs

Process Component	<5years	5-10 years	10-15 years	15-20 years	Total
Effluent Pumps and Ancillary Equipment	$666,000	$1,395,000	-	$666,000	$2,727,000
Injection Well Pump Strainers	$1,492,000	-	-	-	$1,492,000

4.7.14 Deep Injection Well System

Effluent entering the IWPS is either pumped to the effluent reuse system or disposed of via a deep injection well system. The WWRF Deep Injection Well System was put into service in 1997 and consists of two 24-inch diameter Class I municipal injection wells, two dual-zone Floridan aquifer monitoring wells, and four injection well pumps. Operational testing of the injection well system commenced in 1997.

Injection wells IW-1 and IW-2 underwent mechanical integrity testing (MIT) in 2020 and were found to meet the requirements for mechanical integrity in accordance with FAC 62-528. There was no indication that the wells lacked mechanical integrity based on the results of the video survey, pressure test, temperature log, radioactive tracer survey and review of the monitoring well water quality data. These injection wells were successfully tested within their five-year window stipulated by the FDEP per FAC 62-528. The next mechanical integrity test for the injection well IW-1 will be performed prior to April 23, 2025, and IW-2 prior to April 15, 2025, in accordance with the five-year window stipulated by 62-528.300 (6) FAC.

Monitoring Well MW-2 Lower Monitoring Zone (LMZ) water quality data exhibited trends indicating a possible lack of integrity in the casing separating the LMZ and Upper Monitoring Zone (UMZ). Subsequent investigations supported this interpretation of a lack of integrity, as presented in the report titled, “Monitoring Well MW-2 LMZ Investigation Report and Modification Request”, submitted to FDEP in April 2022. FRP tubing was installed within the LMZ steel casing in 2023, restoring Monitoring Well integrity in compliance with FDEP UIC Permit Number 125256-011-012-UO (WACS ID 53444) at a construction cost of $773,000.

Since May 2023, low flow conditions have been observed at Monitoring Well MW-1, resulting in insufficient capacity for regulatory sampling. In March 2024, the City performed an investigation of Monitoring Well MW-1 at a cost of $41,000, which included visual inspection of the wellhead, flange, and drop pipe, removal and replacement of flange and drop pipe, capacity testing, and video survey of well conditions. The survey revealed casing scaling and debris plugging in the monitoring zone. As such, well capacity was not restored, and the monitoring well remains out of service.

Plans to rehabilitate Monitoring Well MW-1 are currently under development and include brushing of the casing, air-lifting/removal of debris from the monitoring zone, video surveying, and capacity tests. If integrity issues are suspected, pressure testing of the casing in its entirety will be performed. Failure of the pressure testing may warrant a recommendation to install FRP tubing within the steel casing, similar to the repairs performed at Monitoring Well MW-2. It is recommended that the City set aside $1,550,000 to implement necessary repairs to the monitoring well, and to restore capacity. This budget does not include cost necessary to replace the monitoring well, should rehabilitation efforts fail to restore well performance.

4.7.14.1 Estimated Capacity

The permitted capacity for each injection well is 18.5 mgd however, the injection well pumping system is limited to 29.8 mgd with the largest pump out of service. During normal operation, flow is split between the injection wells. It is noted that Class I Reliability was not considered for the injection wells. During

emergency conditions or should a well be out of service, disposal capacity may be increased corresponding to an injection velocity of up to 12 fps (FDEP UIC Permit Number 125256-011-012-UO, S.C. I.A.3.).

4.7.14.2 Observed Conditions

Visual inspections of the Injection Well System performed in 2022 identified the following:

- Injection Well Nos. 1 and 2 appear to be in good condition.
- The sampling pumps at Monitoring Well No. 1 appear in good condition. However, corrosion was noted on the steel base plate along with cracking on the concrete base.
- Monitoring Well No. 2 was undergoing evaluation and repairs, and has since been lined with FRP tubing.
- FDEP conducted an independent compliance evaluation inspection (CEI) of the injection well system in November 2021 and determined that the system was in compliance (FDEP UIC Inspection Report, December 2, 2021).

4.7.14.3 Conclusions and Recommendations

The injection wells are not expected to require replacement within the planning period. Should the rehabilitation of Monitoring Well MW-1 fail to restore performance, an additional monitoring well will be required. Each new dual-zone monitoring well is expected to cost $6,000,000.

4.7.15 Effluent Reuse System

The Miramar WWRF includes high-level disinfection and high service facilities to supply irrigation-quality reuse water for public access areas. The reuse permitted capacity was recently expanded to 7.5 mgd as part of a 2019 reuse expansion project by adding a third reuse treatment module. The project also included adding an additional reuse storage tank. The City plans to further expand the reuse system to 10.0 mgd capacity with the addition of a fourth reuse treatment module by the year 2030. The reuse system currently includes two filter feed pumps. There are also three treatment modules each with two filter banks and a chlorine contact tank. Each filter bank has five filter cells. There are three reuse storage tanks, and four high service pumps. Secondary effluent entering the IWPS is pumped to the reuse filters via the filter feed pumps. Filtered effluent then enters the chlorine contact basins where hypochlorite is continually dosed. The effluent flows in the chlorine contact channels where it achieves the minimum detention time to ensure adequate disinfection. Reuse quality effluent then flows by gravity to reuse storage tanks before it is pumped out into the system via the High Service Pumping Station (HSPS). The HSPS contains the high service pumps and associated appurtenances, in addition to air compressors for the reuse filters.

Treatment Module No. 1 and Reuse Storage Tank No. 1 were included in the original plant construction. Treatment Module No. 2 and Reuse Storage Tank No. 2 were installed in 2009. Filter Feed Pumps No. 1 and 2 were also upgraded at that time. The 2019 reuse system expansion resulted in the addition of Treatment Module No. 3, High Service Pump No. 4 and Reuse Storage Tank No. 3. Filter Feed Pumps

No. 1 and 2 were further upgraded at that time. Reuse system characteristics are presented in Table 4-32 through Table 4-35.

Table 4-32: Reuse Filter Characteristics

Description	Unit	Value
Filter Feed Pumps		
No. of Units	-	2
Capacity (each)	gpm	5460
Motor Size	hp	100
Firm Capacity (one on standby)	mgd	7.9
Reuse Filters (Continuous Backwash Type)		
No. of Filter Banks	#	6
No. of Filter Cells per Module	#	5
Total No. of Filter Cells	#	30
Filter Area per Cell	sqft	50
Total Filter Area	sqft	1,500
Recommended Loading Rate[1]	gpm / sqft	3.6
Reuse Filter Capacity	mgd	7.5

[1] Based on operational data submitted to FDEP during 2018 facility permit renewal.

Table 4-33: Chlorine Contact Tank Characteristics

Description	Unit	Value
No. of Basins (1 per Module)	#	3
Nominal Volume per Basin	gals	33,000
Minimum Detention Time (average flow)	min	30
Minimum Detention Time (peak flow)	min	15
Total Capacity (15 min contact time)	mgd	9.5

Table 4-34: Reuse Storage Tank Characteristics

Description	Unit	Value
No. of Tanks	#	3
Capacity Tank No. 1	gal	580,000
Capacity Tank No. 2	gal	710,000
Capacity Tank No. 3	gal	900,000
Total Capacity	gal	2,190,000

Table 4-35: High Service Pump Characteristics

Description	Unit	Value
No. of Pumps	#	4
Pump Capacity	gpm	3 @ 2400 gpm
		1 @ 2900 gpm
Firm Capacity (one on standby)	mgd	10.3

4.7.15.1 Estimated Capacity

The filter feed pumps, reuse filters, chlorine contact tanks, reuse storage tanks, and high service pumps have adequate capacity to meet the 7.5 mgd permitted reuse capacity.

4.7.15.2 Observed Conditions

Visual inspections performed in 2021 of the Effluent Reuse System identified the following:

1. Reuse Filters and Filter Feed Pumps
    - Filter feed pumps appear in good condition.
    - Minor roof cracking and minor corrosion of stainless steel grating was observed atop all filters.
    - There are signs of leaking and stucco damage to the exterior of Treatment Module No. 1 (Figure 4-10) and the stainless steel grating is loose.
    - Treatment Module No. 2 shows exterior stucco damage and stucco loss. Corrosion of conduit supports was observed.
    - Mechanical apparatuses show signs of corrosion due to chlorine leaks. Level Indicating Transmitters (LITs) for influent chambers did not appear to be recording correctly.



Figure 4-10: Filter No. 1 Exterior

2. Chlorine Contact Tanks

    - Contact Tank No. 1 shows concrete cracking on top with evidence of recent repair for newer grating and supports. Exterior shows signs of leaking, blistering, and peeling of coating.

- Contact Tank No. 2 has concrete spalling and cracks at roof grating embedment. Exterior crack noted with possible signs of leaking.
- Contact Tank No. 3 has minor stainless steel corrosion and discoloration but is otherwise in good condition.

3. Reuse Storage Tanks
    - Tank No. 1 has exterior cracks and notable signs of leaks. Coating is blistering with sagging and minor peeling at roof.
    - Tank No. 2 has some cracks in exterior wall and roof.
    - Tank No. 3 appears to be in good condition.
4. High Service Pumps
    - Small cracks around walls of building were noted along with corrosion of bollards and access door.
    - Paint chipping noted at several interior and exterior areas.
    - Corrosion noted on steel support anchors and equipment base plates
    - Pumps No. 1 and 2 are in good condition.
    - City reports that all High Service pumps experience excess volute and impeller wear.

4.7.15.3 Conclusions and Recommendations

The filter feed pumps have a pumping capacity of 7.9 mgd with one pump on standby. Filter Feed Pumps No. 1 and 2 are expected to need replacing within 15-20 years. Reuse Module No. 1 and 2 are expected to need rehabilitation within 5 years and 5-10 years, respectively. Reuse Module No. 3 is expected to need rehabilitation in 15-20 years. Rehabilitation of the Reuse Modules includes replacing the filter bank, and fill and reject valves, and associated appurtenances. High Service Pumps No. 1 and 2 are expected to need replacing within 5 years, High Service Pump No. 3 and exhaust fans are expected to require replacing in 5-10 years, and High Service Pump No. 4 is expected to need replacing in 15-20 years. Additionally, the reuse filter compressors and exhaust fans within the HSPS are expected to need replacing in 10-15 years. R/R costs for the effluent reuse system are presented in Table 4-36.

Table 4-36: Effluent Reuse System R/R Costs

Process Component	<5years	5-10 years	10-15 years	15-20 years	Total
Filter Feed Pump Systems	-	-	-	$666,000	$666,000
Reuse Filters	$551,000	$574,000	-	$740,000	$1,865,000
Reclaimed Water HS Pump Assemblies	$798,000	$419,000	-	$399,000	$1,616,000

4.7.16 Generator System

The WWRF relies on four diesel generators to provide emergency power in the event of a power failure at the WWRF. Two 10,000 gallon tanks provide diesel to four day tanks in addition to the digester boilers. Generators No. 1-3 were installed in 1997 and are 1275 kW each. Generator No. 4 was installed in 2008 and is 1500 kW. The City has a service contract with Pantropic Power. Generator No. 3 is out of service and is currently in the process of being replaced with a 1500 kW generator. The radiator of Generator No. 2 was recently replaced with the radiator of Generator No.3 which has been salvaged for parts. The City reports that two generators are adequate to run the entire plant during normal conditions but three are required during higher demand conditions seen during wet weather events. The WWRF has enough diesel capacity to run all four generators for 48 hours at full load. The generators are exercised on a monthly basis. The City plans on replacing the generator fuel lines, the batteries of Generator No. 4, and performing magnetometer and load bank testing of the generators in 2023. The generator building characteristics are presented in Table 4-37.

Table 4-37: Generator Building Characteristics

Description	Unit	Value
Generators		
No. of Units	-	4
Size	kW	3 @ 1275
Size	kW	1 @ 1500
Tanks		
No. of Bulk Storage Tanks	-	2
Bulk Storage Tank Capacity	gal	10,000
No. of Day Tanks	-	4
Day Tank Capacity (each)	gal	231

4.7.16.1 Observed Condition

Visual inspections performed in 2022 of the Generator System identified the following:

- All generators have corrosion around fan housings.
- Generator No. 3 is out of service but is in the process of being replaced. Day tanks also have some corrosion noted.
- Metal doors and frames show some corrosion. Paint cracking and peeling noted at several concrete columns and beams. Metal doors have since been replaced.

4.7.16.2 Conclusion and Recommendations

Generator No 3 is currently being replaced. It is estimated that Generators No. 1 and 2 and Day Tanks No. 1-3 will need to be replaced in 5-10 years. Generator No. 4 and Day Tank No. 4 will likely need to be replaced in 15-20 years. It is also recommended that an Arch Flash Study be performed, which is estimated at $100,000. R/R costs by term are presented in Table 4-38 and includes replacement of generators and day tanks.

Table 4-38: Generator Building R/R Costs

Process Component	<5 years	5-10 years	10-15 years	15-20 years	Total
Generator Building	$1,836,000	$3,753,000	-	$1,863,000	$7,452,000

4.7.17 Renewal and Replacement Summary

Evaluated assets at the WWRF were organized by process area and replacement planning period to create individual renewal and replacement projects. Each renewal and replacement project at the WWRF through the planning period is presented in Table 4-39. The total estimated renewal and replacement costs by five-year planning periods are summarized in Table 4-40. A detailed cost breakdown of each asset is presented in Appendix A.

Table 4-39: WWRF R/R Projects

Project ID Number	Project Name	OPPC	Project Description
0 to 5 years			
RR-WWRF-01	Digester Building Phase 1	$7,815,000	Replace Boiler Assemblies No. 1 and 2 and Circulation Pumps, Diesel Tanks No. 1 and 2, Heat Exchanger No. 2 and 3, Waste Gas Burner System, Digester No. 2 Mixers and Floating Cover, Digester Pressure Valves, and Building Exhaust Fans.
RR-WWRF-02	Hypochlorite Building Phase 1	$698,000	Replace Hypochlorite Tanks No. 1-3, 5 and 6, and Metering Skid No.2
RR-WWRF-03	Generator Building Phase 1	$1,836,000	Replace Generator No. 3
RR-WWRF-04	Aeration Basins Phase 1	$1,448,000	Replace Aeration Basins No. 1-5 Influent Mixers and Diffuser Assemblies and Aeration Basin No. 5 Effluent Mixer
RR-WWRF-05	Blower Building Phase 1	$2,743,000	Replace Aeration Blower Assemblies No. 4 and 5 and Building Exhaust Fans
RR-WWRF-06	IWPS Phase 1	$2,158,000	Replace Injection Well Strainers No.1-4, Injection Well Pump No. 2, and Exhaust Fan No. 3
RR-WWRF-07	Monitoring Well Phase 1	$1,550,000	Repair Monitoring Well No. 1
RR-WWRF-08	Reuse Modules Phase 1	$551,000	Replace Effluent Filter No. 1, Fill and Reject Actuator No. 1, and Filter Composite Sampler No. 1
RR-WWRF-09	Reuse High Service Station Phase 1	$798,000	Replace Reuse Distribution Pumps No. 1 and 2
RR-WWRF-10	RAS/WAS Phase 1	$960,000	Replace RAS Pumps No. 1-6
RR-WWRF-11	Clarifiers Phase 1	$9,681,000	Rehabilitate Clarifiers No. 1-3
RR-WWRF-12	Solids Building Phase 1	$2,810,000	Replace Belt Thickeners, Wash Water Pumps No. 1 and 2, Polymer Bulk Storage Tank and Day Tank, and Polymer Transfer Pumps
RR-WWRF-13	Solids Odor Control Phase 1	$915,000	Rehabilitate Solids Odor Control Scrubber Towers No. 1 and 2 and replace Scrubber Fan and Chemical Feed Pumps No. 1-4
RR-WWRF-14	Pre-Treatment Odor Control Phase 1	$533,000	Rehabilitate Pre-Treatment Scrubber Towers No. 1 and 2 and Recirculation Pump No. 3. Replace Scrubber Fan and Caustic Storage Tank.

5 to 10 years			
RR-WWRF-15	Aeration Basins Phase 2	$399,000	Replace Aeration Basins No. 1, 2 and 4 Effluent Mixers
RR-WWRF-16	Blower Building Phase 2	$3,993,000	Replace Aeration Blower Assemblies No. 1-3
RR-WWRF-17	Generator Building Phase 2	$3,753,000	Replace Generators No. 1 and 2 and Diesel Day Tanks No. 1-3
RR-WWRF-18	Hypochlorite Building Phase 2	$106,000	Replace Metering Skids No. 1 and 3
RR-WWRF-19	IWPS Phase 2	$1,395,000	Replace Injection Well Pumps No. 1 and 4, Effluent Composite Sampler, and Exhaust Fan No. 4
RR-WWRF-20	Pre-Treatment Phase 1	$307,000	Replace Grit Collector No. 1
RR-WWRF-21	Reuse Modules Phase 2	$574,000	Replace Effluent Filter No. 2, Fill and Reject Actuator No. 2, and Filter Composite Samplers No. 2 and 3
RR-WWRF-22	Reuse High Service Station Phase 2	$419,000	Replace Reuse Distribution Pump No. 3 and Exhaust Fans
RR-WWRF-23	Clarifiers Phase 2	$3,227,000	Rehabilitate Clarifier No. 4
RR-WWRF-24	Solids Building Phase 2	$78,000	Replace Belt Thickener Polyblend Feed Assemblies No. 1-3 and Belt Press Polyblend Feed Assemblies No. 1-3
RR-WWRF-25	Digester Building Phase 2	$54,000	Replace Digester Hot Water Pumps
RR-WWRF-26	Solids Odor Control Phase 2	$408,000	Replace Solids Tower Recirculation Pumps No. 1-4
10 to 15 Years			
RR-WWRF-27	Aeration Basins Phase 3	$133,000	Replace Aeration Basin No. 3 Effluent Mixer
RR-WWRF-28	Hypochlorite Building Phase 3	$387,000	Replace Hypochlorite Tanks No. 4, 7, and 8
RR-WWRF-29	Pre-Treatment Phase 2	$307,000	Replace Grit Collector No. 2
RR-WWRF-30	Pre-Treatment Odor Control Phase 2	$72,000	Replace Scrubber Tower Recirculation Pumps No. 1, 2, and 3
RR-WWRF-31	RAS/WAS Phase 2	$234,000	Replace WAS Pumps No. 1 and 2
RR-WWRF-32	Digester Building Phase 3	$53,000	Replace Heat Exchanger No. 1
15 to 20 years			
RR-WWRF-33	Generator Building Phase 3	$1,863,000	Replace Generator and Diesel Day Tank No. 4
RR-WWRF-34	IWPS Phase 3	$666,000	Replace Injection Well Pump No. 3
RR-WWRF-35	Pre-Treatment Phase 3	$1,228,000	Replace Grit Pumps No. 1 and 2 and Grit Classifiers No. 1 and 2
RR-WWRF-36	Pre-Treatment Odor Control Phase 3	$52,000	Replace Chemical Feed Pumps No. 1-4
RR-WWRF-37	Reuse Filters Phase 3	$1,406,000	Replace Effluent Filter No. 3, Fill and Reject Actuator No. 2, and Filter Feed Pumps No. 1 and 2
RR-WWRF-38	Reuse High Service Station Phase 3	$399,000	Replace Reuse Distribution Pump No. 4
RR-WWRF-39	Solids Building Phase 3	$3,272,000	Replace Belt Presses No. 1 and 2, Wash Water Pumps No. 1 and 2, and Thickened Sludge Pumps No. 1 and 2
RR-WWRF-40	Digester Building Phase 4	$3,620,000	Replace Digester No. 1 Mixers and Digester No. 1 and 2 Recirculation and Transfer Pumps
20+ years			
RR-WWRF-41	Pre-Treatment Phase 4	$828,000	Replace Mechanical Bar Screens No. 1 and 2

Table 4-40: WWRF R/R Costs by Planning Period

Project ID Number	Project Name	Planning Period (Years)	OPPC
RR-WWRF-01 to RR-WWRF-14	WWRF Rehabilitation Phase 1	0 to 5	$34,496,000
RR-WWRF-15 to RR-WWRF-26	WWRF Rehabilitation Phase 2	5 to 10	$14,713,000
RR-WWRF-27 to RR-WWRF-32	WWRF Rehabilitation Phase 3	10 to 15	$1,186,000
RR-WWRF-33 to RR-WWRF-40	WWRF Rehabilitation Phase 4	15 to 20	$12,506,000
RR-WWRF-41	WWRF Rehabilitation Phase 5	20+	$828,000







5 Regulatory Considerations

5. Regulatory Considerations

5.1 Introduction

Although the requirements for the collection, transmission, treatment, and disposal of domestic wastewater and biosolids at the WWRF have not drastically changed over the last two facility permit cycles, ongoing regulatory actions and discussions have prompted uncertainty with respect to some future utility practices. This section explores recent rule revisions as they pertain to wastewater systems, rules currently in development, and likely and/or possible regulatory changes and their potential impacts.

5.2 Applicable Regulations

5.2.1 FAC 62-600 Domestic Wastewater Facilities (Revision)

Amendments to Section 62-600 (Domestic Wastewater Facilities) of the Florida Administrative Code (FAC) have been proposed and are expected to be ratified in the 2023 legislative session. The amendments, primarily designated as 62-600.705 Collection and Transmission Systems, impart additional reporting requirements for wastewater treatment facility permit renewals related to the prevention of sanitary sewer overflows, collection and transmission system leakages, and inflow and infiltration. These requirements include the following provisions:

- Power Outage Contingency Plan
- Pipe Assessment, Repair and Replacement Action Plan (Collection System Action Plan)

The Power Outage Contingency Plan will require a description of the utility's general program and protocols to mitigate the impacts of power outages on the facility's collection/transmission system and pump stations, including any applicable mutual aid agreements. Submission of the power outage contingency plan will be required with facility applications for permit renewal or substantial permit revisions.

The Collection System Action Plan must have at least a five-year planning horizon to mitigate sanitary sewer overflows and pipe leaks to the extent technically and economically feasible. This plan must include a deliberate, proactive approach to evaluating at least 25 percent of the collection/transmission system during the planning period. Other requirements include record keeping activities such as the use of GIS mapping, an electronic maintenance management system, and a program for routine maintenance, cleaning and emergency repairs. A summary report of all actions shall be submitted annually and include documentation of transactions or allocations of expenditures on pollution mitigation and prevention for the wastewater system.

Lastly, as part of this rule revision, an amendment to Section 62-600.720, Operation and Maintenance Manual, requires the emergency response plan portion of the manual to address cybersecurity preparedness, response and recovery, and a vulnerability assessment.

These revisions are likely to have a modest impact to the City by requiring the development of the Power Outage Contingency Plan and the Collection System Action Plan for the next WWRF facility permit

renewal in 2028. Although details for the anticipated complexity of these plans are not known at this time, budget estimates for these items have been included in the Capital Improvements Plan.

5.2.2 FAC 62-604 Collection Systems and Transmission Facilities (Revision)

Proposed amendments to FAC Section 62-604, Collection Systems and Transmission Facilities, have been presented in public workshops and public comments have been received and are under review. The amendments would achieve the following:

- Prohibit the discharge of hazardous waste pharmaceuticals from healthcare facilities to a collection/transmission system or treatment plant without the necessary pretreatment
- Require consideration of storm surge and SLR for new pump stations
- Require annual updates to the Collection/Transmission System Operations and Maintenance Manual and Emergency Response Plan no later than January 1st of each year
- For unauthorized releases of 1,000 gallons or less, require an electronic report be submitted online to the Department's Business Portal within 24 hours, followed by a detailed report within 5 days
- Require bacteriological testing commence within 24 hours of unauthorized discharges to surface waters

These revisions are likely to have a minor impact to the wastewater utility in the form of revising notification procedures during wastewater spills to include use of the Department's Business Portal and more frequent updating of the Collection/Transmission System Operations and Maintenance Manual. Budget estimates for these items have been included in the Capital Improvement Program.

5.2.3 FAC 62-610 Reuse of Reclaimed Water and Land Application (Revision)

In anticipation of future challenges in meeting Florida's water supply needs, potable reuse was identified as a potential sustainable alternative water supply. FAC Section 62-610 was amended to provide a regulatory framework for implementing potable reuse including:

- Pretreatment/Source Control (revised)
- Treatment facility requirements (revised)
- Indirect potable reuse (revised)
- Direct potable reuse regulations
- Advanced water treatment
- Pilot testing (revised)
- Full-scale demonstration
- Monitoring and reporting

Current reuse practices of the WWRF reclaimed water system involve only irrigation of areas accessible by the public such as residential lawns, parks, and medians. Therefore, no impacts to the WWRF reuse practices due to these legislative changes are currently envisioned.

5.2.4 FAC 62-621 Generic Permits (Revision)

Due to the prevalence of red tide and blue-green algae in Florida's waterways, the Department of Environmental Protection is proposing development of a generic permit to allow authorization of certain activities for the control of red tide and blue-green algae blooms. A virtual public hearing is scheduled for April 13, 2023. These revisions are not anticipated to impact operations of the wastewater collection and transmission system or the WWRF.

5.2.5 FAC 62-640 (Biosolids)

Effective July 1, 2022, Section 403.0855 of the Florida Statutes was amended to include two key provisions related to biosolids land application. Per the amendment, all biosolids land application sites are required to enroll in a Florida Department of Agriculture and Consumer Services Best Management Practices program. Additionally, land application of biosolids on soils with a seasonal high water table within 6-inches of the soil surface or depth of biosolids placement is prohibited. As the WWRF produces a Class B biosolids and uses a contract hauler for its management, these revisions may indirectly impact the cost of biosolids operations at the WWRF. As bids were recently received (August 2, 2022) for WWRF biosolids hauling services, such costs should already be reflected in the newly contracted services.

5.2.6 Amendments to FS 403.064 (Chapter 2021-168)

Florida Senate Bill 64 was approved by the Governor and became effective June 29, 2021 as Chapter 2021-168. This bill amends Florida Statute 403.064 to require utilities to develop and implement a plan for eliminating non-beneficial surface discharges of effluent or reclaimed water by January 1, 2032. As the WWRF does not currently discharge effluent or reclaimed water to a surface water, this revision to the Florida Statutes is not anticipated to impact current practices of the wastewater collection and transmission system or the WWRF.

5.2.7 FS 403.928 (Chapter 2021-194) (House Bill 53 Needs Analysis)

Florida House Bill 53 was approved by the Governor and became effective July 1, 2021 as Chapter 2021-194 and is included in the Florida Statutes as Section 403.928. The law revises a prohibition relating to solicitation for construction services paid for with state-appropriated funds and requires counties, municipalities, and special districts that provide wastewater services and stormwater management to develop a 20-year needs analysis including the following:

- A detailed description of the facilities used to provide wastewater services
- The number of current and projected wastewater connections and residents served calculated in five-year increments

- The current and projected service area for wastewater services
- The current and projected cost of providing wastewater services calculated in five-year increments
- The estimated remaining useful life of each facility or its major components
- The most recent five-year history of annual contributions to, expenditures from, and balances of any capital account for maintenance or expansion of any facility or its major components
- A plan to fund the maintenance or expansion of any facility or its major components with an evaluation of how any projected funding gaps are to be overcome

The bill requires each municipality to submit its needs analysis, as well as the methodology and any supporting data necessary to interpret the results, to the county. Each county will compile all analyses, include its own analysis, and must file the compiled document with the Office of Economic & Demographic Research no later than July 31, 2022, and every five years thereafter. Because the state did not provide timely guidance for the initial submittal, subsequent submittals are anticipated to be more closely scrutinized beginning in 2027. A budget estimate for the updates required has been included in the Capital Improvement Program.

5.2.8 FS 125.59, 166.0481, and 689.301 (Chapter 2020-158)

Florida House Bill 1091 was approved by the Governor and became effective July 1, 2020 as Chapter 2020-158 and is included in the Florida Statutes as Sections 125.569, 166.0481, and 689.301. This bill encourages counties and municipalities to establish a sanitary sewer lateral inspection program and requires a seller of real property to disclose any known defects in the property's sanitary sewer lateral. As establishment of such a program is encouraged rather than mandated, this item has not been included in the recommended Capital Improvement Program.

5.2.9 Prohibition of Deep Wells (Senate Bill 454)

The latest version of a bill to prohibit the use of deep wells was filed in October 2019 by Senator Jose Javier Rodriguez of District 37 in Miami-Dade as Florida Senate Bill 454. As with previous attempts, the intent is to further increase reuse in the state by amending the prohibitions placed on ocean outfalls, passed in 2008, to include deep well disposal. As such, the legislation proposed to prohibit the construction of new deep wells, the expansion of existing deep wells and prohibit the use of deep wells after December 31, 2023. Although the WWRF provides a significant portion of its treated effluent as public access reclaimed water for irrigation in the community, deep well injection is a critical component of its daily operations. As proposed, the elimination of deep wells would have required the WWRF to substantially expand its reuse treatment and transmission system within an extremely short period of time. Because the bill died in the Environment and Natural Resources committee in March 2020, no impacts to the current operations of the wastewater collection and transmission system or the WWRF are envisioned, however careful attention regarding future legislation prohibiting or restricting the use of deep well disposal is warranted.

5.3 Recommended Regulatory-Driven Improvements

A key element of a Master Plan is identification of capital improvement needs that are required for compliance with existing regulations along with potential capital improvements for anticipated regulations. Based on a review of the recommended regulatory-driven improvements previously described, a detailed cost breakdown for inclusion into the City of Miramar's Capital Improvements Program is provided in Table 5-1. It is noted that the Collection System Action Plan is already included as part of the Gravity System Assessment and Rehabilitation costs described in Section 3.5. It is anticipated that an upfront cost for the preparation of formal program documentation will be required, and the yearly costs associated with carrying out the plan will be included as part of the Gravity System Assessment and Rehabilitation Program.

Table 5-1: Recommended Regulatory-Driven Improvements

Process Component	Immediate Cost	Costs on a Five-Year Basis	Planning Period (Years)				
			0 to 5	5 to 10	10 to 15	15 to 20	20+
Power Outage Contingency Plan	$50,000	$20,000	$70,000	$20,000	$20,000	$20,000	$20,000
O&M Manual Updates	$50,000	$10,000	$60,000	$10,000	$10,000	$10,000	$10,000
Needs Analysis Updates	$0	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000
Collection System Action Plan	$10,000	$0	$10,000	$0	$0	$0	$0

Table 5-2 provides an overall summary of the Recommended Regulatory Driven Improvements for inclusion into the overall Capital Improvements Program. For the purpose of classifying projects in the CIP, all regulatory-driven improvements have been considered to be located at the WWRF.

Table 5-2: Summary of Recommended Regulatory-Driven Improvements

Planning Period (Years)	Project ID Number	Asset Type	Project Name	OPPC
0 to 5	REG-WWRF-01	WWRF	Regulatory Improvements Phase 1	$150,000
5 to 10	REG-WWRF-02	WWRF	Regulatory Improvements Phase 2	$40,000
10 to 15	REG-WWRF-03	WWRF	Regulatory Improvements Phase 3	$40,000
15 to 20	REG-WWRF-04	WWRF	Regulatory Improvements Phase 4	$40,000
20+	REG-WWRF-05	WWRF	Regulatory Improvements Phase 5	$40,000







6 Wastewater System Capital Improvement Program

6. Wastewater System Capital Improvement Program

6.1 Introduction

The Capital Improvement Program (CIP) summarizes probable project costs for recommended wastewater improvements identified in previous chapters. These improvements are required to address future growth, renewal and replacement needs, and regulatory requirements. The CIP includes wastewater capital improvements through the planning year 2045 and provides a suggested implementation schedule based on the capacity, compliance, or condition concerns underlying each recommendation.

6.2 Cost Estimating

The opinions of probable project cost presented herein have been prepared based upon master plan level information. Because of the level of scope development at this stage, the opinions are Class 5 estimates as defined by the Association for the Advancement of Cost Engineering International (AACE). The expected range of accuracy for this type of opinion is +100 percent to -50 percent. These opinions of probable cost have been prepared for guidance in project evaluation and implementation from the information available at this stage of the estimate. The final costs of the projects will depend on actual labor and material cost, competitive market conditions, final project scope, implementation schedule, and other variable conditions. As a result, the final project costs will vary from the opinions presented herein.

The cost opinions are “project costs” and are inclusive of construction costs; contractor overhead and profit; estimated allowance for permit application fees; 20 percent estimated allowance for engineering services during the design, permitting, construction and startup of the project; as well as a 30 percent contingency. The costs are based upon 2023 dollars and do not include escalation or inflation.

6.3 Capital Improvement Program

Table 6-1 summarizes recommended improvements by project type, operational component, and planning period. Projects were grouped by implementation timeframes and do not consider the feasibility for funding. Implementation timeframes are presented based upon a determination of needs.

Table 6-1: Capital Improvement Program

Type of Improvement	Asset Type	Project ID Number	Project Name	Project Description	Project Cost
Planning Period: 0 to 5 years (Total: $184,082,000)					
Regulatory	WWRF	REG-WWRF-01	WWRF Regulatory Improvement Phase 1	Power Outage Contingency Plan, O&M Manual Updates, Needs Analysis Updates, and Collection System Action Plan	$150,000
Capacity	Force Mains	CAP-FM-01 through 10	Force Main Capacity Improvement Phase 1	CAP-FM-01A, CAP-FM-01B, CAP-FM-02A, CAP-FM-02B, CAP-FM-03, CAP-FM-04, CAP-FM-05, CAP-FM-06, CAP-FM-07, CAP-FM-08 CAP-FM-09, CAP-FM-10	$36,540,000
	Lift Stations	CAP-LS-01 through 08	Lift Station Capacity Improvement Phase 1	Second MPS, LS-056, LS-011, LS-020, LS-044, LS-061, LS-065, LS-076	$16,882,000
	WWRF	CAP-WWRF-01	Anaerobic Digester No. 3	Third digester to provide secondary anaerobic digester capacity.	$18,677,000
Renewal and Replacement	Force Mains	RR-FM-01	Force Main Rehabilitation Phase 1	In situ assessments, point repairs, and pipe replacements	$12,088,000
	Gravity System	RR-GS-01	Gravity System Rehabilitation Phase 1	Sewer inspection and rehabilitation	$5,311,000
	Lift Stations	RR-LS-01	Lift Station Rehabilitation Phase 1	LS-001, LS-004, LS-005, LS-006, LS-007, LS-008, LS-009, LS-010, LS-012, LS-013, LS-022, LS-025, LS-026, LS-027, LS-028, LS-029, LS-030, LS-031, LS-032, LS-033, LS-034, LS-035, LS-036, LS-037, LS-038, LS-039, LS-040, LS-041, LS-042, LS-043, LS-045, LS-046, LS-047, LS-049, LS-050, LS-051, LS-052, LS-053, LS-054, LS-056, LS-057, LS-058, LS-059, LS-060, LS-062, LS-063, LS-064, LS-066, LS-067, LS-068, LS-069, LS-070, LS-071, LS-072, LS-073, LS-074, LS-075, LS-077, LS-078, LS-079, LS-080, LS-081, LS-082, LS-084, LS-088, LS-00A, LS-00C, LS-00D, LS-00E, LS-00F, LS-00G, LS-00I, LS-PAL, LS-MPS	$58,508,000
		RR-PG-01	Portable Generator Rehabilitation Phase 1	PG-02, PG-04, PG-05, PG-07	$440,000
	WWRF	RR-WWRF-01 through 14	WWRF Rehabilitation Phase 1	WWRF-01, WWRF-02, WWRF-03, WWRF-04, WWRF-05, WWRF-06, WWRF-07, WWRF-08, WWRF-09, WWRF-10, WWRF-11, WWRF-12, WWRF-13, WWRF-14	$34,496,000
Facility Improvement	Lift Stations	FI-PG-01	Portable Generator Improvements	Purchase of Additional Portable Generators	$990,000

Type of Improvement	Asset Type	Project ID Number	Project Name	Project Description	Project Cost
Planning Period: 5 to 10 years (Total: $81,705,000)					
Regulatory	WWRF	REG-WWRF-02	WWRF Regulatory Improvement Phase 2	Power Outage Contingency Plan, O&M Manual Updates, Needs Analysis Updates, and Collection System Action Plan	$40,000
Capacity	Force Mains	CAP-FM-11 and 12	Force Main Capacity Improvement Phase 2	CAP-FM-11, CAP-FM-12	$2,020,000
	WWRF	CAP-WWRF-02	Aeration Basin No. 6	Sixth aeration basin to provide secondary biological treatment capacity. Includes RAS pump upgrades.	$16,688,000
Renewal and Replacement	Force Mains	RR-FM-02	Force Main Rehabilitation Phase 2	In situ assessments, point repairs, and pipe replacements	$19,462,000
	Gravity System	RR-GS-02	Gravity System Rehabilitation Phase 2	Sewer inspection and rehabilitation	$5,311,000
	Lift Stations	RR-LS-02	Lift Station Rehabilitation Phase 2	LS-085, LS-086, LS-087, LS-089, LS-090, LS-091, LS-092, LS-093, LS-094, LS-095, LS-096, LS-097, LS-098, LS-099, LS-100, LS-101, LS-102, LS-103, LS-104, LS-111, LS-00B, LS-00H, LS-00M, LS-MBPS	$23,031,000
		RR-PG-02	Portable Generator Rehabilitation Phase 2	PG-08, PG-09, PG-10, PG-12	$440,000
	WWRF	RR-WWRF-15 through 26	WWRF Rehabilitation Phase 2	WWRF-15, WWRF-16, WWRF-17, WWRF-18, WWRF-19, WWRF-20, WWRF-21, WWRF-22, WWRF-23, WWRF-24, WWRF-25, WWRF-26	$14,713,000
Planning Period: 10 to 15 years (Total: $34,485,000)					
Regulatory	WWRF	REG-WWRF-03	WWRF Regulatory Improvement Phase 3	Power Outage Contingency Plan, O&M Manual Updates, Needs Analysis Updates, and Collection System Action Plan	$40,000
Renewal and Replacement	Force Mains	RR-FM-03	Force Main Rehabilitation Phase 3	In situ assessments, point repairs, and pipe replacements	$18,888,000
	Gravity System	RR-GS-03	Gravity System Rehabilitation Phase 3	Sewer inspection and rehabilitation	$5,311,000
	Lift Stations	RR-LS-03	Lift Station Rehabilitation Phase 3	LS-105, LS-106, LS-107, LS-108, LS-109, LS-110, LS-112, LS-00J, LS-00K, LS-00L	$8,620,000
		RR-PG-03	Portable Generator Rehabilitation Phase 3	PG-13, PG-14, PG-20, PG-21	$440,000
	WWRF	RR-WWRF-27 through 32	WWRF Rehabilitation Phase 3	WWRF-27, WWRF-28, WWRF-29, WWRF-30, WWRF-31, WWRF-32	$1,186,000

Type of Improvement	Asset Type	Project ID Number	Project Name	Project Description	Project Cost
Planning Period: 15 to 20 years (Total: $40,516,000)					
Regulatory	WWRF	REG-WWRF-04	WWRF Regulatory Improvement Phase 4	Power Outage Contingency Plan, O&M Manual Updates, Needs Analysis Updates, and Collection System Action Plan	$40,000
Capacity	Lift Stations	CAP-LS-07	Lift Station Capacity Improvement Phase 4	LS-113	$862,000
Renewal and Replacement	Force Mains	RR-FM-04	Force Main Rehabilitation Phase 4	In situ assessments, point repairs, and pipe replacements	$18,111,000
	Gravity System	RR-GS-04	Gravity System Rehabilitation Phase 4	Sewer inspection and rehabilitation	$5,311,000
	Lift Stations	RR-LS-04	Lift Station Rehabilitation Phase 4	LS-114, LS-115, LS-116, LS-117, LS-021, LS-024	$3,246,000
		RR-PG-04	Portable Generator Rehabilitation Phase 4	PG-22, PG-23, PG-25, PG-26	$440,000
	WWRF	RR-WWRF-33 through 40	WWRF Rehabilitation Phase 4	WWRF-33, WWRF-34, WWRF-35, WWRF-36, WWRF-37, WWRF-38, WWRF-39, WWRF-40	$12,506,000
Planning Period: 20+ years (Total: $50,945,000)					
Capacity	Force Mains	CAP-FM-13 through 15	Force Main Capacity Improvement Phase 5	CAP-FM-13, CAP-FM-14, CAP-FM-15	$10,360,000
	Lift Stations	CAP-LS-08 through 13	Lift Station Capacity Improvement Phase 5	LS-038, LS-049, LS-052, LS-053, LS-057, LS-090	$4,716,000
Regulatory	WWRF	REG-WWRF-05	WWRF Regulatory Improvement Phase 5	Power Outage Contingency Plan, O&M Manual Updates, Needs Analysis Updates, and Collection System Action Plan	$40,000
Renewal and Replacement	Force Mains	RR-FM-05	Force Main Rehabilitation Phase 5	In situ assessments, point repairs, and pipe replacements	$17,110,000
	Gravity System	RR-GS-05	Gravity System Rehabilitation Phase 5	Sewer inspection and rehabilitation	$5,311,000
	Lift Stations	RR-LS-05	Lift Station Rehabilitation Phase 5	LS-002, LS-003, LS-015, LS-016, LS-017, LS-018, LS-023, LS-048, LS-055, LS-083, LS-118, LS-119, LS-120, LS-121	$11,260,000
		RR-PG-05	Portable Generator Rehabilitation Phase 5	PG-27, PG-28, PG-29, PG-30, PG-31, PG-32, PG-33, PG-34, PG-35, PG-36, PG-37, PG-38	$1,320,000
	WWRF	RR-WWRF-41	WWRF Rehabilitation Phase 5	WWRF-41	$828,000

Table 6-2 through Table 6-4 present the total estimated cost of all Capital Improvement Program projects by planning period, project type and project location.

Table 6-2: Capital Improvement Program Project Costs by Planning Period

Planning Period (Years)	Total Estimated Cost
0 to 5	$184,082,000
5 to 10	$81,705,000
10 to 15	$34,485,000
15 to 20	$40,516,000
20+	$50,945,000
Total CIP Cost	**$391,733,000**

Table 6-3: Capital Improvement Program Project Costs by Project Type

Project Type	0 to 5	5 to 10	10 to 15	15 to 20	20+	Total Estimated Cost
Capacity	$72,099,000	$18,708,000	-	$862,000	$15,076,000	**$106,745,000**
Facility Improvement	$990,000	-	-	-	-	**$990,000**
Regulatory	$150,000	$40,000	$40,000	$40,000	$40,000	**$310,000**
Renewal and Replacement	$110,843,000	$62,957,000	$34,445,000	$39,614,000	$35,829,000	**$283,688,000**
Total CIP Cost	**$184,082,000**	**$81,705,000**	**$34,485,000**	**$40,516,000**	**$50,945,000**	**$391,733,000**

Table 6-4: Capital Improvement Program Project Costs by Project Location

Asset Type	0 to 5	5 to 10	10 to 15	15 to 20	20+	Total Estimated Cost
Force Mains	$48,628,000	$21,482,000	$18,888,000	$18,111,000	$27,470,000	**$134,579,000**
Gravity System	$5,311,000	$5,311,000	$5,311,000	$5,311,000	$5,311,000	**$26,555,000**
Lift Stations	$76,820,000	$23,471,000	$9,060,000	$4,548,000	$17,296,000	**$131,195,000**
WWRF	$53,323,000	$31,441,000	$1,226,000	$12,546,000	$868,000	**$99,404,000**
Total CIP Cost	**$184,082,000**	**$81,705,000**	**$34,485,000**	**$40,516,000**	**$50,945,000**	**$391,733,000**







APPENDIX

A Project Cost Estimates

Appendix A: Project Cost Estimates

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Lift Station Improvement Project Cost Breakdowns……A-20

WWRF Renewal and Replacement Project Cost Breakdowns……..……A-24

Order-of-Magnitude 5-Year Cost Estimate for Sewer Assessment and Rehabilitation / I-I Reduction Program
City of Miramar Wastewater Master Plan

	Task	Quantity	Unit	Average Unit Cost	Estimated Cost	Basis for Quantity Estimate	Note
	Inspection						
1	Preliminary Evaluation and Prioritization	34	BASIN	$2,000.00	$68,000	25% of system	A,B
2	Smoke Testing	106,803	LF	$0.45	$48,000	7.5% of system	C
3	Manhole Inspection	530	EA	$100.00	$53,000	7.5% of system	C
4	Cleaning and Video Inspection of Mains	106,803	LF	$1.90	$203,000	7.5% of system	C
5	Cleaning and Video Inspection of Laterals	356	EA	$330.00	$117,000	7.5% of system	C,D
6	Program Management and Reporting	20%			$98,000		
				Subtotal	**$587,000**		
	Renewal and Replacement						
7	Lining – Manhole to Manhole	42,721	LF	$32.00	$1,367,000	3% of system	E
8	Lining – Sectional	45	EA	$3,000.00	$134,000	Estimated based on South Florida experience	F
9	Lining – Lateral	178	EA	$4,000.00	$712,000	Estimated based on South Florida experience	F
10	Excavation Points Repair	45	EA	$7,000.00	$312,000	Estimated based on South Florida experience	F
11	Excavation Line Replacement	320	LF	$100.00	$32,000	Estimated based on South Florida experience	F
12	Manhole Liners – Cementitious	79	EA	$2,500.00	$199,000	Estimated based on South Florida experience	F
13	Manhole Liners – Cementitious/Epoxy or Polyethylene	26	EA	$2,800.00	$74,000	Estimated based on South Florida experience	F
14	Manholes Repairs – Miscellaneous	106	EA	$800.00	$85,000	Estimated based on South Florida experience	F
15	Engineering and Construction Management	20%			$583,000		
				Subtotal	**$3,498,000**		
				ESTIMATED TOTAL OVER 5 YEARS	**$4,085,000**		
				CONTINGENCY (30%)	**$1,226,000**		
				5-YR TOTAL	**$5,311,000**		
				APPROXIMATE ANNUAL COST	**$1,062,000**		

Notes:

A Proposed rule FAC 62-600.705 Collection and Transmission Systems would require Florida ulilities to screen 25% of the system every 5 years. System screening can include flow data analysis, pump runtime analysis, and/or operations personnel knowledge concerning repair history and system performance.

B There are a total of 145 lift stations in Miramar; however, 8 are privately owned and maintained and the in-line Booster Pump Station does not have a gravity system. Therefore, the total number of lift station basins is 136.

C Assumes some mains are known or determined to be in good condition and are not smoke tested or televised.

D Number of laterals estimated based on South Florida experience. The actual number may vary depending on land use in the inspected areas.

E About 80% of the City's gravity sewers are PVC, which are not rehabiltated by lining. About 20% of the gravity sewers are vitrified clay; of these 20% have already been lined. Clay pipes are expected to require lining 50 years after installation. Because of the age of the City's clay pipes, all the remaining unlined clay pipes (approximately 16% of all gravity sewer) should be lined before the end of the 25-year planning period. This will require lining of approximately 43,000 linear feet of gravity sewer every 5 years.

F Renewal and replacement quantities are based on South Florida experience and provided for budgetary guidance. Actual quantities should be determined based on the results of inspection activities.

OPINION OF PROBABLE PROJECT COST

City of Miramar Wastewater Master Plan
Facility: Wastewater Transmission System
Project Name: Upgrade 18" MPS Discharge Force Main to 24"
Project Number: CAP-FM-01A
Project Type: Capacity
Project Timeframe: 0-5 Years

GENERAL INFORMATION

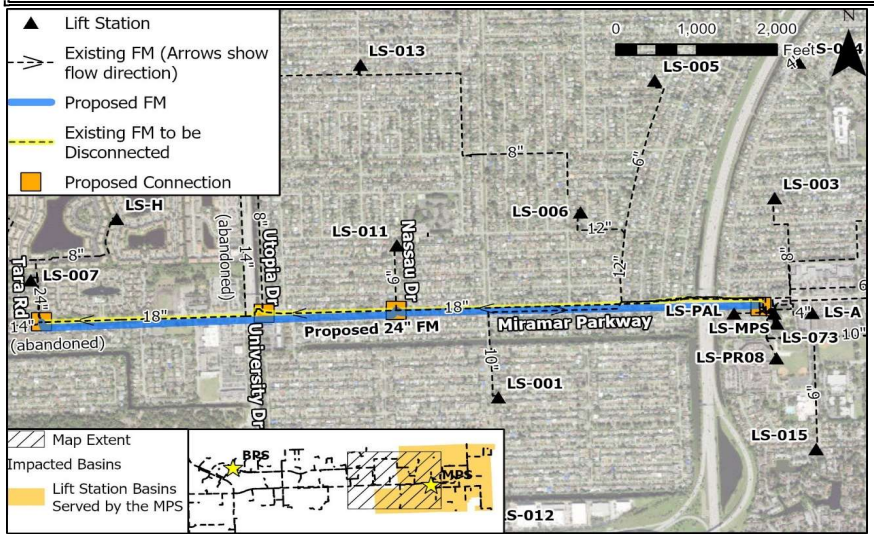
BRIEF PROJECT DESCRIPTION:		
Construct approximately 9,000 feet of 24" force main along Miramar Parkway from the MPS to the 24" force main on Tara Road. Construct connections to the 6" force main on Nassau Drive and the 8" force main on Utopia Drive. Abandon the existing 18" force main on Miramar Parkway.	**Date Estimate was prepared:**	3/7/2023
	Prepared By:	R. Warier
	Checked By:	J. McMahon

COST ESTIMATE

Item	Description	Quantity	Unit	Installed Unit Cost	Total	Comments/Reference
1	24" force main (open cut)	8,100	LF	$408	$3,304,800	
2	Connection to MPS discharge	1	LS	$25,000	$25,000	
3	Connection to 6" FM (LS-011)	1	LS	$25,000	$25,000	
4	Connection to 8" FM (LS-013)	1	LS	$25,000	$25,000	
5	Connection to 24" FM on Tara Rd	1	LS	$25,000	$25,000	
6	HDD under the Turnpike - 24" FM with 30" casing	500	LF	$750	$375,000	
7	HDD under University Dr - 24" FM with 30" casing	400	LF	$750	$300,000	
8	Boring/receiving pits for HDD	4	EA	$20,000	$80,000	
9	Cut and cap 18" force main	2	EA	$10,000	$20,000	
	SUBTOTAL				**$4,180,000**	
	Mobilization	1	LS	10%	$418,000	
	Contractor Overhead and Profit	1	LS	15%	$627,000	
	Permit Fee Allowance	1	LS	8%	$334,400	
	Contingency	1	LS	30%	$1,254,000	
	SUBTOTAL				**$6,814,000**	
	Engineering, Permitting, and CMS	1	EA	20%	$1,363,000	
	TOTAL PROJECT COST				**$8,180,000**	

Notes:

1. Installed unit costs for pipeline infrastructure includes pipe with 3 feet of cover, fittings, excavation, backfill, compaction, and one lane of asphalt restoration.
2. This estimate has been prepared based upon Master Planning level information. Because of the level of scope development at this stage, the estimate is a Class 5 estimate as defined by the Association for the Advancement of Cost Engineering International (AACE). The expected range of accuracy for this type of estimate is +100% to - 50%. This cost estimate has been prepared for guidance in project evaluation and implementation from the information available at this stage of the estimate. The final costs of the project will depend on actual labor and material cost, competitive market conditions, final project scope, implementation schedule, and other variable conditions. As a result, the final project costs will vary from the estimate presented herein.
3. This estimate was prepared for year 2023 dollars and does not include a factor for escalation.



OPINION OF PROBABLE PROJECT COST

City of Miramar Wastewater Master Plan
Facility: Wastewater Transmission System
Project Name: Force Main for Second Master Pump Station
Project Number: CAP-FM-01B
Project Type: Capacity
Project Timeframe: 0-5 Years

GENERAL INFORMATION

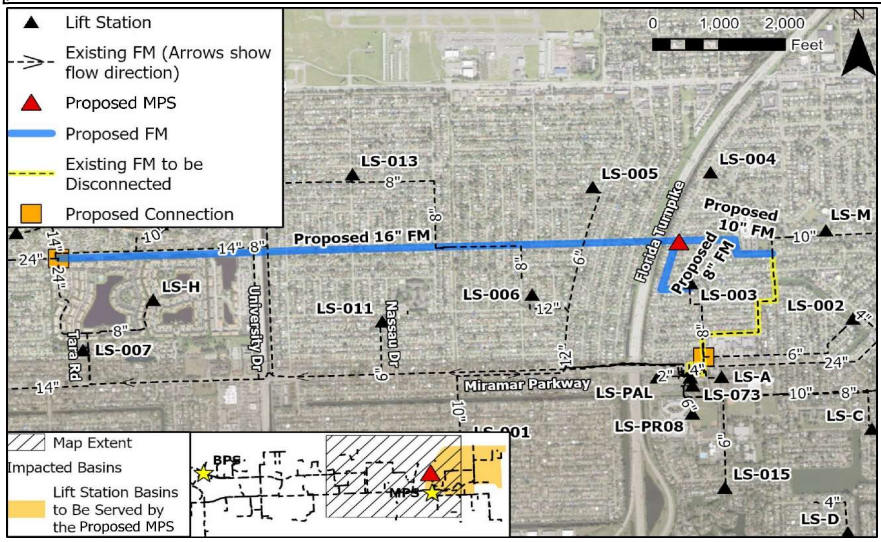
BRIEF PROJECT DESCRIPTION:		
Construct approximately 1,300 feet of 8" force main along SW 27th Street and Sunshine Boulevard from the LS-003 force main to the proposed MPS and approximately 1,700 feet of 10" force main along SW 26th Street, SW 69th Avenue, and Miramar Boulevard from the LS-M force main to the wet well of the proposed MPS. Connect the LS-002 force main to the LS-003 force main north of Miramar Parkway to direct the flow to the wet well of the proposed MPS. Construct approximately 9,400 feet of 16" force main along Miramar Boulevard from the proposed MPS to the existing 24" force main at Tara Road.	**Date Estimate was prepared:**	4/30/2024
	Prepared By:	R. Warier
	Checked By:	J. McMahon

COST ESTIMATE

Item	Description	Quantity	Unit	Installed Unit Cost	Total	Comments/Reference
1	8" force main (open cut)	1,300	LF	$136	$176,800	
2	10" force main (open cut)	1,700	LF	$170	$289,000	
3	16" force main (open cut)	8,500	LF	$408	$3,468,000	
4	Connection to discharge of proposed MPS	1	LS	$25,000	$25,000	
5	Connection to 24" FM on Tara Rd	1	LS	$25,000	$25,000	
6	HDD under the Turnpike - 16" FM with 24" casing	500	LF	$500	$250,000	
7	HDD under University Dr - 16" FM with 24" casing	400	LF	$500	$200,000	
8	Boring/receiving pits for HDD	4	EA	$10,000	$40,000	
	SUBTOTAL				**$4,474,000**	
	Mobilization	1	LS	10%	$447,400	
	Contractor Overhead and Profit	1	LS	15%	$671,100	
	Permit Fee Allowance	1	LS	8%	$358,000	
	Contingency	1	LS	30%	$1,342,200	
	SUBTOTAL				**$7,293,000**	
	Engineering, Permitting, and CMS	1	EA	20%	$1,459,000	
	TOTAL PROJECT COST				**$8,760,000**	

Notes:

1. Installed unit costs for pipeline infrastructure includes pipe with 3 feet of cover, fittings, excavation, backfill, compaction, and one lane of asphalt restoration.
2. This estimate has been prepared based upon Master Planning level information. Because of the level of scope development at this stage, the estimate is a Class 5 estimate as defined by the Association for the Advancement of Cost Engineering International (AACE). The expected range of accuracy for this type of estimate is +100% to - 50%. This cost estimate has been prepared for guidance in project evaluation and implementation from the information available at this stage of the estimate. The final costs of the project will depend on actual labor and material cost, competitive market conditions, final project scope, implementation schedule, and other variable conditions. As a result, the final project costs will vary from the estimate presented herein.
3. This estimate was prepared for year 2023 dollars and does not include a factor for escalation.



OPINION OF PROBABLE PROJECT COST

City of Miramar Wastewater Master Plan
Facility: Wastewater Transmission System
Project Name: Redirections to 30" Force Main on Red Road
Project Number: CAP-FM-02A
Project Type: Capacity
Project Timeframe: 0-5 Years

GENERAL INFORMATION

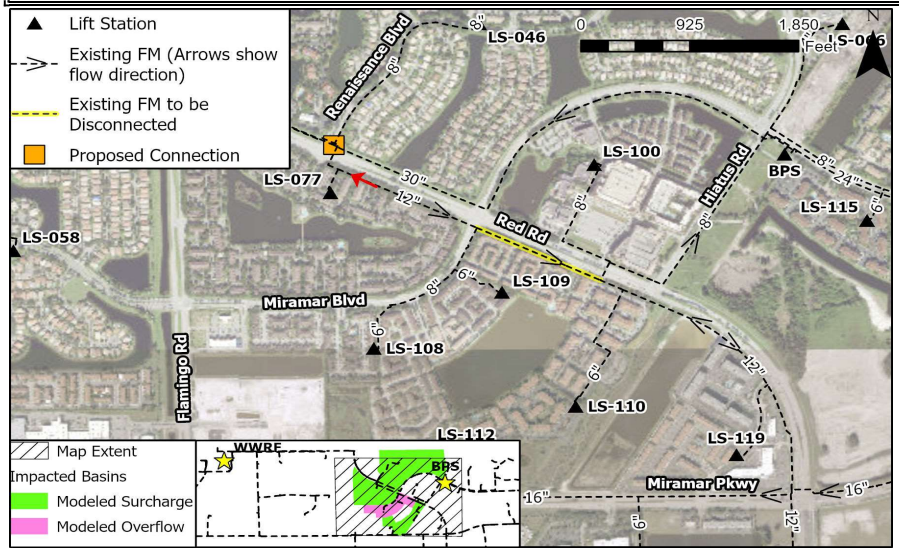
BRIEF PROJECT DESCRIPTION:		
Connect the existing 8" force main from LS-046 and the 12" force main from LS-077, LS-108, LS-109, and LS-110 to the 30" force main on Red Road. Disconnect the 12" force main along Red Road shown in yellow. Due to their proximity, this project can be combined with CAP-FM-02B as practical.	**Date Estimate was prepared:**	3/7/2023
	Prepared By:	R. Warier
	Checked By:	J. McMahon

COST ESTIMATE

Item	Description	Quantity	Unit	Installed Unit Cost	Total	Comments/Reference
1	Connection on Red Rd and Renaissance Blvd	1	LS	$25,000	$25,000	
2	Install 12" plug valve	2	EA	$9,000	$18,000	
	SUBTOTAL				**$43,000**	
	Mobilization	1	LS	10%	$4,300	
	Contractor Overhead and Profit	1	LS	15.0%	$6,500	
	Permit Fee Allowance	1	LS	8.0%	$3,500	
	Contingency	1	LS	30.0%	$12,900	
	SUBTOTAL				**$71,000**	
	Engineering, Permitting, and CMS	1	EA	20.0%	$15,000	
	TOTAL PROJECT COST				**$90,000**	

Notes:

1. Installed unit costs for pipeline infrastructure includes pipe with 3 feet of cover, fittings, excavation, backfill, compaction, and one lane of asphalt restoration.
2. This estimate has been prepared based upon Master Planning level information. Because of the level of scope development at this stage, the estimate is a Class 5 estimate as defined by the Association for the Advancement of Cost Engineering International (AACE). The expected range of accuracy for this type of estimate is +100% to - 50%. This cost estimate has been prepared for guidance in project evaluation and implementation from the information available at this stage of the estimate. The final costs of the project will depend on actual labor and material cost, competitive market conditions, final project scope, implementation schedule, and other variable conditions. As a result, the final project costs will vary from the estimate presented herein.
3. This estimate was prepared for year 2023 dollars and does not include a factor for escalation.



OPINION OF PROBABLE PROJECT COST

City of Miramar Wastewater Master Plan
Facility: Wastewater Transmission System
Project Name: Redirections to 30" Force Main on Red Road
Project Number: CAP-FM-02B
Project Type: Capacity
Project Timeframe: 0-5 Years

GENERAL INFORMATION

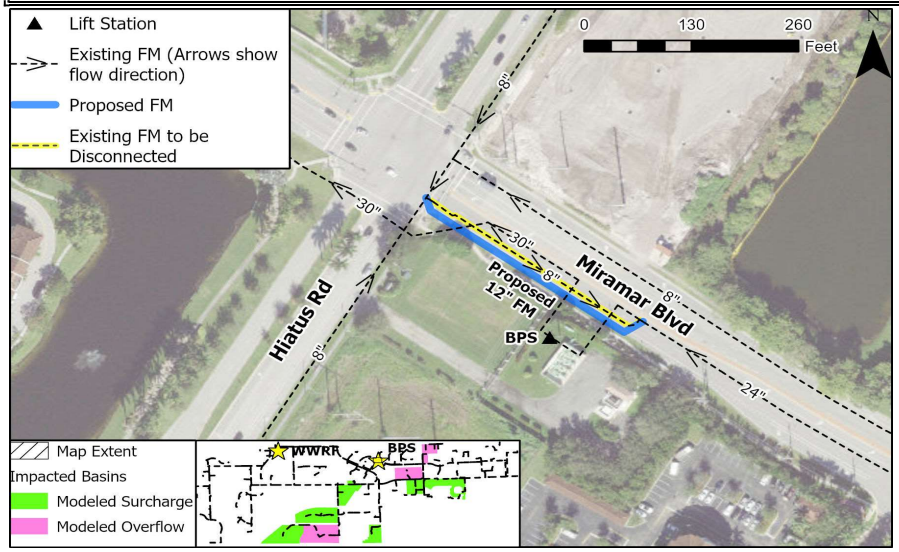
BRIEF PROJECT DESCRIPTION:		
Construct approximately 300 feet of 12" force main along Miramar Boulevard from Hiatus Road to the 24" force main upstream of the BPS. Disconnect the existing 8" force main. Due to their proximity, this project can be combined with CAP-FM-02A as practical.	**Date Estimate was prepared:**	3/31/2024
	Prepared By:	R. Warier
	Checked By:	J. McMahon

COST ESTIMATE

Item	Description	Quantity	Unit	Installed Unit Cost	Total	Comments/Reference
1	8" FM Connection	2	LS	$25,000	$50,000	
2	Install 12" Force Main	300	EA	$204	$61,200	
	SUBTOTAL				**$112,000**	
	Mobilization	1	LS	10%	$11,200	
	Contractor Overhead and Profit	1	LS	15.0%	$16,800	
	Permit Fee Allowance	1	LS	8.0%	$9,000	
	Contingency	1	LS	30.0%	$33,600	
	SUBTOTAL				**$183,000**	
	Engineering, Permitting, and CMS	1	EA	20.0%	$37,000	
	TOTAL PROJECT COST				**$220,000**	

Notes:

1. Installed unit costs for pipeline infrastructure includes pipe with 3 feet of cover, fittings, excavation, backfill, compaction, and one lane of asphalt restoration.
2. This estimate has been prepared based upon Master Planning level information. Because of the level of scope development at this stage, the estimate is a Class 5 estimate as defined by the Association for the Advancement of Cost Engineering International (AACE). The expected range of accuracy for this type of estimate is +100% to - 50%. This cost estimate has been prepared for guidance in project evaluation and implementation from the information available at this stage of the estimate. The final costs of the project will depend on actual labor and material cost, competitive market conditions, final project scope, implementation schedule, and other variable conditions. As a result, the final project costs will vary from the estimate presented herein.
3. This estimate was prepared for year 2023 dollars and does not include a factor for escalation.



OPINION OF PROBABLE PROJECT COST

City of Miramar Wastewater Master Plan
Facility: Wastewater Transmission System
Project Name: Redirect LS-024 and LS-027 Discharge to Miramar Boulevard
Project Number: CAP-FM-03
Project Type: Capacity
Project Timeframe: 0-5 Years

GENERAL INFORMATION

BRIEF PROJECT DESCRIPTION:		
Connect the 6" force mains from LS-024 and LS-027 to the 24" force main at Miramar Boulevard and Fairmont Avenue. Disconnect the 8" force main from LS-024 to the 16" force main on Miramar Parkway.	**Date Estimate was prepared:**	3/7/2023
	Prepared By:	R. Warier
	Checked By:	J. McMahon

COST ESTIMATE

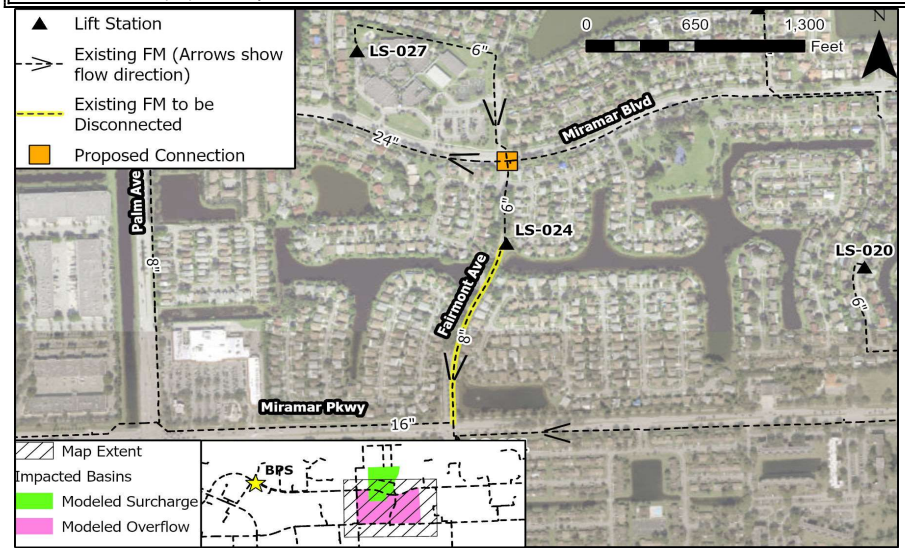
Item	Description	Quantity	Unit	Installed Unit Cost	Total	Comments/Reference
1	Connection Between 6" FM (LS-027) and 24" FM	1	LS	$25,000	$25,000	
2	Connection Between 6" FM (LS-024) and 24" FM	1	LS	$25,000	$25,000	
3	Install 8" plug valve	2	EA	$6,000	$12,000	
	SUBTOTAL				**$62,000**	
	Mobilization	1	LS	10%	$6,200	
	Contractor Overhead and Profit	1	LS	15.0%	$9,300	
	Permit Fee Allowance	1	LS	8.0%	$5,000	
	Contingency	1	LS	30.0%	$18,600	
	SUBTOTAL				**$102,000**	
	Engineering, Permitting, and CMS	1	EA	20.0%	$21,000	
	TOTAL PROJECT COST				**$130,000**	

Notes:

1. Installed unit costs for pipeline infrastructure includes pipe with 3 feet of cover, fittings, excavation, backfill, compaction, and one lane of asphalt restoration.

2. This estimate has been prepared based upon Master Planning level information. Because of the level of scope development at this stage, the estimate is a Class 5 estimate as defined by the Association for the Advancement of Cost Engineering International (AACE). The expected range of accuracy for this type of estimate is +100% to - 50%. This cost estimate has been prepared for guidance in project evaluation and implementation from the information available at this stage of the estimate. The final costs of the project will depend on actual labor and material cost, competitive market conditions, final project scope, implementation schedule, and other variable conditions. As a result, the final project costs will vary from the estimate presented herein.

3. This estimate was prepared for year 2023 dollars and does not include a factor for escalation.



OPINION OF PROBABLE PROJECT COST

City of Miramar Wastewater Master Plan
Facility: Wastewater Transmission System
Project Name: Upgrade Force Main Along Miramar Parkway from Flamingo Road to SW 136th Avenue
Project Number: CAP-FM-04
Project Type: Capacity
Project Timeframe: 0-5 Years

GENERAL INFORMATION

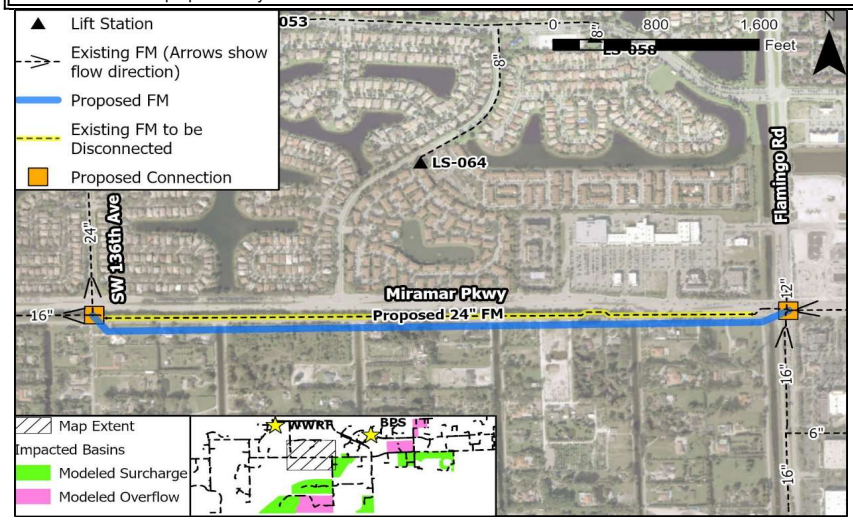
BRIEF PROJECT DESCRIPTION:		
Construct approximately 5,400 feet of 24" force main parallel to the existing 16" force main along Miramar Parkway, connecting to the existing force main at Flamingo Road and SW 136th Avenue. Disconnect the existing 16" force main.	**Date Estimate was prepared:**	3/7/2023
	Prepared By:	R. Warier
	Checked By:	J. McMahon

COST ESTIMATE

Item	Description	Quantity	Unit	Installed Unit Cost	Total	Comments/Reference
1	Connection to 16-inch FM on Flamingo Rd	1	LS	$25,000	$25,000	
2	24-inch force main	5,400	LF	$408	$2,203,200	$17/inch/foot
3	Connection to 24-inch FM on SW 136th Ave	1	LS	$25,000	$25,000	
4	Install 16" plug valve	2	EA	$18,000	$36,000	
	SUBTOTAL				**$2,290,000**	
	Mobilization	1	LS	10%	$229,000	
	Contractor Overhead and Profit	1	LS	15.0%	$343,500	
	Permit Fee Allowance	1	LS	8.0%	$183,200	
	Contingency	1	LS	30.0%	$687,000	
	SUBTOTAL				**$3,733,000**	
	Engineering, Permitting, and CMS	1	EA	20.0%	$747,000	
	TOTAL PROJECT COST				**$4,480,000**	

Notes:

1. Installed unit costs for pipeline infrastructure includes pipe with 3 feet of cover, fittings, excavation, backfill, compaction, and one lane of asphalt restoration.
2. This estimate has been prepared based upon Master Planning level information. Because of the level of scope development at this stage, the estimate is a Class 5 estimate as defined by the Association for the Advancement of Cost Engineering International (AACE). The expected range of accuracy for this type of estimate is +100% to - 50%. This cost estimate has been prepared for guidance in project evaluation and implementation from the information available at this stage of the estimate. The final costs of the project will depend on actual labor and material cost, competitive market conditions, final project scope, implementation schedule, and other variable conditions. As a result, the final project costs will vary from the estimate presented herein.
3. This estimate was prepared for year 2023 dollars and does not include a factor for escalation.



OPINION OF PROBABLE PROJECT COST

City of Miramar Wastewater Master Plan
Facility: Wastewater Transmission System
Project Name: Upgrade Force Main Along Miramar Parkway from SW 184th Avenue to SW 160th Avenue
Project Number: CAP-FM-05
Project Type: Capacity
Project Timeframe: 0-5 Years

GENERAL INFORMATION

BRIEF PROJECT DESCRIPTION:		
Construct approximately 10,600 feet of 24" force main parallel to the existing force main on Miramar Parkway from SW 184th Avenue to SW 160th Avenue. As shown in the figure, connect to the existing force mains at SW 184th Avenue, SW 178th Avenue, SW 172nd Avenue, and SW 160th Avenue as well as to the force mains from LS-113 and LS-068. Disconnect the existing 12" force main from SW 184th Avenue to SW 178th Avenue and the existing 20" force main from SW 178th Avenue to SW 160th Avenue.	**Date Estimate was prepared:**	3/7/2023
	Prepared By:	R. Warier
	Checked By:	J. McMahon

COST ESTIMATE

Item	Description	Quantity	Unit	Installed Unit Cost	Total	Comments/Reference
1	24-inch force main	10,600	LF	$340	$3,604,000	$17/inch/foot
2	Connection to 8" FMs on SW 184th Ave	1	LS	$25,000	$25,000	
3	Connection to 8" FMs on SW 178th Ave	1	LS	$25,000	$25,000	
4	Connection to 10"/12" FMs on SW 172nd Ave	1	LS	$25,000	$25,000	
5	Connection to 4" FM from LS-113	1	LS	$25,000	$25,000	
6	Connection to 6" FM from LS-068	1	LS	$25,000	$25,000	
7	Connection to 24" FM on SW 160th Ave	1	LS	$25,000	$25,000	
8	Install 12" plug valve	1	EA	$9,000	$9,000	
9	Install 20" plug valve	3	EA	$27,000	$81,000	
	SUBTOTAL				**$3,844,000**	
	Mobilization	1	LS	10%	$384,400	
	Contractor Overhead and Profit	1	LS	15.0%	$576,600	
	Permit Fee Allowance	1	LS	8.0%	$307,600	
	Contingency	1	LS	30.0%	$1,153,200	
	SUBTOTAL				**$6,266,000**	
	Engineering, Permitting, and CMS	1	EA	20.0%	$1,254,000	
	TOTAL PROJECT COST				**$7,520,000**	

Notes:

1. Installed unit costs for pipeline infrastructure includes pipe with 3 feet of cover, fittings, excavation, backfill, compaction, and one lane of asphalt restoration.

2. This estimate has been prepared based upon Master Planning level information. Because of the level of scope development at this stage, the estimate is a Class 5 estimate as defined by the Association for the Advancement of Cost Engineering International (AACE). The expected range of accuracy for this type of estimate is +100% to - 50%. This cost estimate has been prepared for guidance in project evaluation and implementation from the information available at this stage of the estimate. The final costs of the project will depend on actual labor and material cost, competitive market conditions, final project scope, implementation schedule, and other variable conditions. As a result, the final project costs will vary from the estimate presented herein.

3. This estimate was prepared for year 2023 dollars and does not include a factor for escalation.



OPINION OF PROBABLE PROJECT COST

City of Miramar Wastewater Master Plan
Facility: Wastewater Transmission System
Project Name: Upgrade Force Main from LS-060 Tie-in to Miramar Parkway
Project Number: CAP-FM-06
Project Type: Capacity
Project Timeframe: 0-5 Years

GENERAL INFORMATION

BRIEF PROJECT DESCRIPTION:		
Upon completion of CAP-FM-05, construct approximately 1,800 feet of 16" force main from the LS-060 tie-in on SW 184th Avenue to Miramar Parkway. Disconnect the existing 8" force main.	**Date Estimate was prepared:**	3/7/2023
	Prepared By:	R. Warier
	Checked By:	J. McMahon

COST ESTIMATE

Item	Description	Quantity	Unit	Installed Unit Cost	Total	Comments/Reference
1	Connection to 8-inch FM at LS-60 tie-in	1	LS	$25,000	$25,000	
2	16-inch force main	1,800	LF	$272	$489,600	$17/inch/foot
3	Connection on SW 184th Ave and Miramar Pkwy	1	LS	$25,000	$25,000	
4	8" plug valve	2	EA	$6,000	$12,000	
	SUBTOTAL				**$552,000**	
	Mobilization	1	LS	10%	$55,200	
	Contractor Overhead and Profit	1	LS	15.0%	$82,800	
	Permit Fee Allowance	1	LS	8.0%	$44,200	
	Contingency	1	LS	30.0%	$165,600	
	SUBTOTAL				**$900,000**	
	Engineering, Permitting, and CMS	1	EA	20.0%	$180,000	
	TOTAL PROJECT COST				**$1,080,000**	

Notes:

1. Installed unit costs for pipeline infrastructure includes pipe with 3 feet of cover, fittings, excavation, backfill, compaction, and one lane of asphalt restoration.
2. This estimate has been prepared based upon Master Planning level information. Because of the level of scope development at this stage, the estimate is a Class 5 estimate as defined by the Association for the Advancement of Cost Engineering International (AACE). The expected range of accuracy for this type of estimate is +100% to - 50%. This cost estimate has been prepared for guidance in project evaluation and implementation from the information available at this stage of the estimate. The final costs of the project will depend on actual labor and material cost, competitive market conditions, final project scope, implementation schedule, and other variable conditions. As a result, the final project costs will vary from the estimate presented herein.
3. This estimate was prepared for year 2023 dollars and does not include a factor for escalation.



OPINION OF PROBABLE PROJECT COST

City of Miramar Wastewater Master Plan
Facility: Wastewater Transmission System
Project Name: Proposed 12" Force Main Along Bass Creek Road from Sunrise Avenue to 172nd Avenue
Project Number: CAP-FM-07
Project Type: Capacity
Project Timeframe: 0-5 Years

GENERAL INFORMATION

BRIEF PROJECT DESCRIPTION:		
Upon completion of CAP-FM-05 and CAP-FM-06, construct approximately 6,000 feet of 12" force main along Bass Creek Road from Sunrise Avenue to 172nd Avenue.	**Date Estimate was prepared:**	3/7/2023
	Prepared By:	R. Warier
	Checked By:	J. McMahon

COST ESTIMATE

Item	Description	Quantity	Unit	Installed Unit Cost	Total	Comments/Reference
1	Connection to 12" FMs on Sunrise Avenue	1	LS	$25,000	$25,000	
2	12-inch force main	6,000	LF	$204	$1,224,000	$17/inch/foot
3	Connection to 10" FM on 172nd Ave	1	LS	$25,000	$25,000	
	SUBTOTAL				**$1,274,000**	
	Mobilization	1	LS	10%	$127,400	
	Contractor Overhead and Profit	1	LS	15.0%	$191,100	
	Permit Fee Allowance	1	LS	8.0%	$102,000	
	Contingency	1	LS	30.0%	$382,200	
	SUBTOTAL				**$2,077,000**	
	Engineering, Permitting, and CMS	1	EA	20.0%	$416,000	
	TOTAL PROJECT COST				**$2,500,000**	

Notes:

1. Installed unit costs for pipeline infrastructure includes pipe with 3 feet of cover, fittings, excavation, backfill, compaction, and one lane of asphalt restoration.
2. This estimate has been prepared based upon Master Planning level information. Because of the level of scope development at this stage, the estimate is a Class 5 estimate as defined by the Association for the Advancement of Cost Engineering International (AACE). The expected range of accuracy for this type of estimate is +100% to - 50%. This cost estimate has been prepared for guidance in project evaluation and implementation from the information available at this stage of the estimate. The final costs of the project will depend on actual labor and material cost, competitive market conditions, final project scope, implementation schedule, and other variable conditions. As a result, the final project costs will vary from the estimate presented herein.
3. This estimate was prepared for year 2023 dollars and does not include a factor for escalation.



OPINION OF PROBABLE PROJECT COST

City of Miramar Wastewater Master Plan
Facility: Wastewater Transmission System
Project Name: Upgrade Force Main Along Sunrise Avenue from LS-083 Tie-in to SW 40th Street
Project Number: CAP-FM-08
Project Type: Capacity
Project Timeframe: 0-5 Years

GENERAL INFORMATION

BRIEF PROJECT DESCRIPTION:		
Upon completion of CAP-FM-05, -06, and -07, construct approximately 4,200 feet of 12" force main along Sunrise Avenue from the LS-083 tie-in to the existing 6" force main on SW 40th Street. Disconnect the existing 6" force main on Sunrise Avenue.	**Date Estimate was prepared:**	3/7/2023
	Prepared By:	R. Warier
	Checked By:	J. McMahon

COST ESTIMATE

Item	Description	Quantity	Unit	Installed Unit Cost	Total	Comments/Reference
1	Connection to 6-inch FM at LS-83 tie-in	1	LS	$25,000	$25,000	
2	12-inch force main	4,200	LF	$204	$856,800	$17/inch/foot
3	Connection to 6-inch FM on SW 40th St	1	LS	$25,000	$25,000	
4	6" plug valve	2	LS	$4,500	$9,000	
	SUBTOTAL				**$916,000**	
	Mobilization	1	LS	10%	$91,600	
	Contractor Overhead and Profit	1	LS	15.0%	$137,400	
	Permit Fee Allowance	1	LS	8.0%	$73,300	
	Contingency	1	LS	30.0%	$274,800	
	SUBTOTAL				**$1,494,000**	
	Engineering, Permitting, and CMS	1	EA	20.0%	$299,000	
	TOTAL PROJECT COST				**$1,800,000**	

Notes:

1. Installed unit costs for pipeline infrastructure includes pipe with 3 feet of cover, fittings, excavation, backfill, compaction, and one lane of asphalt restoration.
2. This estimate has been prepared based upon Master Planning level information. Because of the level of scope development at this stage, the estimate is a Class 5 estimate as defined by the Association for the Advancement of Cost Engineering International (AACE). The expected range of accuracy for this type of estimate is +100% to - 50%. This cost estimate has been prepared for guidance in project evaluation and implementation from the information available at this stage of the estimate. The final costs of the project will depend on actual labor and material cost, competitive market conditions, final project scope, implementation schedule, and other variable conditions. As a result, the final project costs will vary from the estimate presented herein.
3. This estimate was prepared for year 2023 dollars and does not include a factor for escalation.



OPINION OF PROBABLE PROJECT COST

City of Miramar Wastewater Master Plan
Facility: Wastewater Transmission System
Project Name: Upgrade Force Main Along SW 40th Street from LS-080 Tie-in to Sunrise Avenue
Project Number: CAP-FM-09
Project Type: Capacity
Project Timeframe: 0-5 Years

GENERAL INFORMATION

BRIEF PROJECT DESCRIPTION:		
Upon completion of CAP-FM-05, -06, and -07, construct approximately 4,000 feet of 12" force main along SW 40th Street from the LS-080 tie-in to the existing 6" pipe at the intersection with Sunrise Avenue. Disconnect the existing 4" and 6" force main along SW 40th Street.	**Date Estimate was prepared:**	3/7/2023
	Prepared By:	R. Warier
	Checked By:	J. McMahon

COST ESTIMATE

Item	Description	Quantity	Unit	Installed Unit Cost	Total	Comments/Reference
1	Connection to 4-inch FM at LS-80 tie-in	1	LS	$25,000	$25,000	
2	12-inch force main	4,000	LF	$204	$816,000	$17/inch/foot
3	Connection to 6-inch FM at Sunrise Ave	1	LS	$25,000	$25,000	
4	Install 4" plug valve	1	LS	$2,500	$2,500	
5	Install 6" plug valve	1	LS	$4,500	$4,500	
	SUBTOTAL				**$873,000**	
	Mobilization	1	LS	10%	$87,300	
	Contractor Overhead and Profit	1	LS	15.0%	$131,000	
	Permit Fee Allowance	1	LS	8.0%	$69,900	
	Contingency	1	LS	30.0%	$261,900	
	SUBTOTAL				**$1,424,000**	
	Engineering, Permitting, and CMS	1	EA	20.0%	$285,000	
	TOTAL PROJECT COST				**$1,710,000**	

Notes:

1. Installed unit costs for pipeline infrastructure includes pipe with 3 feet of cover, fittings, excavation, backfill, compaction, and one lane of asphalt restoration.
2. This estimate has been prepared based upon Master Planning level information. Because of the level of scope development at this stage, the estimate is a Class 5 estimate as defined by the Association for the Advancement of Cost Engineering International (AACE). The expected range of accuracy for this type of estimate is +100% to - 50%. This cost estimate has been prepared for guidance in project evaluation and implementation from the information available at this stage of the estimate. The final costs of the project will depend on actual labor and material cost, competitive market conditions, final project scope, implementation schedule, and other variable conditions. As a result, the final project costs will vary from the estimate presented herein.
3. This estimate was prepared for year 2023 dollars and does not include a factor for escalation.



OPINION OF PROBABLE PROJECT COST

City of Miramar Wastewater Master Plan
Facility: Wastewater Transmission System
Project Name: Redirect LS-047 Discharge to 30-Inch Force Main
Project Number: CAP-FM-10
Project Type: Capacity
Project Timeframe: 0-5 Years

GENERAL INFORMATION

BRIEF PROJECT DESCRIPTION:		
Connect the 6" discharge from LS-047 directly to the 30" force main on Red Road. Disconnect the 6" force main on Red Road (shown in yellow) parallel to the 30" line.	**Date Estimate was prepared:**	3/7/2023
	Prepared By:	R. Warier
	Checked By:	J. McMahon

COST ESTIMATE

Item	Description	Quantity	Unit	Installed Unit Cost	Total	Comments/Reference
1	Connection between 6" and 30" force mains	1	LS	$25,000	$25,000	
2	6" plug valve	2	EA	$4,500	$9,000	
	SUBTOTAL				**$34,000**	
	Mobilization	1	LS	10%	$3,400	
	Contractor Overhead and Profit	1	LS	15.0%	$5,100	
	Permit Fee Allowance	1	LS	8.0%	$2,800	
	Contingency	1	LS	30.0%	$10,200	
	SUBTOTAL				**$56,000**	
	Engineering, Permitting, and CMS	1	EA	20.0%	$12,000	
	TOTAL PROJECT COST				**$70,000**	

Notes:

1. Installed unit costs for pipeline infrastructure includes pipe with 3 feet of cover, fittings, excavation, backfill, compaction, and one lane of asphalt restoration.
2. This estimate has been prepared based upon Master Planning level information. Because of the level of scope development at this stage, the estimate is a Class 5 estimate as defined by the Association for the Advancement of Cost Engineering International (AACE). The expected range of accuracy for this type of estimate is +100% to - 50%. This cost estimate has been prepared for guidance in project evaluation and implementation from the information available at this stage of the estimate. The final costs of the project will depend on actual labor and material cost, competitive market conditions, final project scope, implementation schedule, and other variable conditions. As a result, the final project costs will vary from the estimate presented herein.
3. This estimate was prepared for year 2023 dollars and does not include a factor for escalation.



OPINION OF PROBABLE PROJECT COST

City of Miramar Wastewater Master Plan
Facility: Wastewater Transmission System
Project Name: Upgrade Force Main on 172nd Avenue and New 6" Force Main on 37th Court
Project Number: CAP-FM-11
Project Type: Capacity
Project Timeframe: 5-10 Years

GENERAL INFORMATION

BRIEF PROJECT DESCRIPTION:		
Construct approximately 2,600 feet of 16" force main along SW 172nd Avenue from SW 48th Court to Miramar Parkway. Construct approximately 1,100 feet of 6" force main along 37th Court from LS-065 to the new 16" force main. Disconnect the existing 10" force main along SW 172nd Avenue.	**Date Estimate was prepared:**	3/7/2023
	Prepared By:	R. Warier
	Checked By:	J. McMahon

COST ESTIMATE

Item	Description	Quantity	Unit	Installed Unit Cost	Total	Comments/Reference
1	Connection to 10-inch FM on 172nd Ave	1	LS	$25,000	$25,000	
2	16-inch force main	1,800	LF	$272	$489,600	$17/inch/foot
3	Connection to 24-inch FM on Miramar Pkwy	1	LS	$25,000	$25,000	
4	6-inch force main	1,100	LF	$102	$112,200	$17/inch/foot
5	Connection between new 6" and 16" force mains	1	LS	$25,000	$25,000	
6	Install 10" plug valve	2	LS	$7,500	$15,000	
	SUBTOTAL				**$692,000**	
	Mobilization	1	LS	10%	$69,200	
	Contractor Overhead and Profit	1	LS	15.0%	$103,800	
	Permit Fee Allowance	1	LS	8.0%	$55,400	
	Contingency	1	LS	30.0%	$207,600	
	SUBTOTAL				**$1,128,000**	
	Engineering, Permitting, and CMS	1	EA	20.0%	$226,000	
	TOTAL PROJECT COST				**$1,360,000**	

Notes:

1. Installed unit costs for pipeline infrastructure includes pipe with 3 feet of cover, fittings, excavation, backfill, compaction, and one lane of asphalt restoration.

2. This estimate has been prepared based upon Master Planning level information. Because of the level of scope development at this stage, the estimate is a Class 5 estimate as defined by the Association for the Advancement of Cost Engineering International (AACE). The expected range of accuracy for this type of estimate is +100% to - 50%. This cost estimate has been prepared for guidance in project evaluation and implementation from the information available at this stage of the estimate. The final costs of the project will depend on actual labor and material cost, competitive market conditions, final project scope, implementation schedule, and other variable conditions. As a result, the final project costs will vary from the estimate presented herein.

3. This estimate was prepared for year 2023 dollars and does not include a factor for escalation.



OPINION OF PROBABLE PROJECT COST

City of Miramar Wastewater Master Plan
Facility: Wastewater Transmission System
Project Name: Proposed 8" Force Main from LS-076 to 172nd Avenue
Project Number: CAP-FM-12
Project Type: Capacity
Project Timeframe: 5-10 Years

GENERAL INFORMATION

BRIEF PROJECT DESCRIPTION: Construct approximately 2,100 feet of 8" force main along SW 49th Street and SW 50th Place from the LS-076 tie-in to the 8" force main on 172nd Avenue.	**Date Estimate was prepared:**	3/7/2023
	Prepared By:	R. Warier
	Checked By:	J. McMahon

COST ESTIMATE

Item	Description	Quantity	Unit	Installed Unit Cost	Total	Comments/Reference
1	Connection to 8-inch FM at LS-76 tie-in	1	LS	$25,000	$25,000	
2	8-inch force main	2,100	LF	$136	$285,600	$17/inch/foot
3	Connection to 8-inch FM on 172nd Ave	1	LS	$25,000	$25,000	
	SUBTOTAL				**$336,000**	
	Mobilization	1	LS	10%	$33,600	
	Contractor Overhead and Profit	1	LS	15.0%	$50,400	
	Permit Fee Allowance	1	LS	8.0%	$26,900	
	Contingency	1	LS	30.0%	$100,800	
	SUBTOTAL				**$548,000**	
	Engineering, Permitting, and CMS	1	EA	20.0%	$110,000	
	TOTAL PROJECT COST				**$660,000**	

Notes:

1. Installed unit costs for pipeline infrastructure includes pipe with 3 feet of cover, fittings, excavation, backfill, compaction, and one lane of asphalt restoration.
2. This estimate has been prepared based upon Master Planning level information. Because of the level of scope development at this stage, the estimate is a Class 5 estimate as defined by the Association for the Advancement of Cost Engineering International (AACE). The expected range of accuracy for this type of estimate is +100% to - 50%. This cost estimate has been prepared for guidance in project evaluation and implementation from the information available at this stage of the estimate. The final costs of the project will depend on actual labor and material cost, competitive market conditions, final project scope, implementation schedule, and other variable conditions. As a result, the final project costs will vary from the estimate presented herein.
3. This estimate was prepared for year 2023 dollars and does not include a factor for escalation.



OPINION OF PROBABLE PROJECT COST

City of Miramar Wastewater Master Plan
Facility: Wastewater Transmission System
Project Name: Upgrade Force Main Along SW 160th Avenue and SW 25th Street
Project Number: CAP-FM-13
Project Type: Capacity
Project Timeframe: 20+ Years

GENERAL INFORMATION

BRIEF PROJECT DESCRIPTION:		
Construct approximately 2,700 feet of 30" force main parallel to the existing 24" force main along SW 160th Street from Miramar Parkway to SW 25th Street, including connections for the force mains from LS-062, LS-086 and LS-066. Construct approximately 5,200 feet of 30" force main parallel to the existing 24" force main on SW 25th Street from SW 160th Street to the end of SW 148th Street (near Fire Rescue Station 84). Abandon the existing 24" force main. This project includes about 600 feet of HHD under I-75.	**Date Estimate was prepared:**	3/7/2023
	Prepared By:	R. Warier
	Checked By:	J. McMahon

COST ESTIMATE

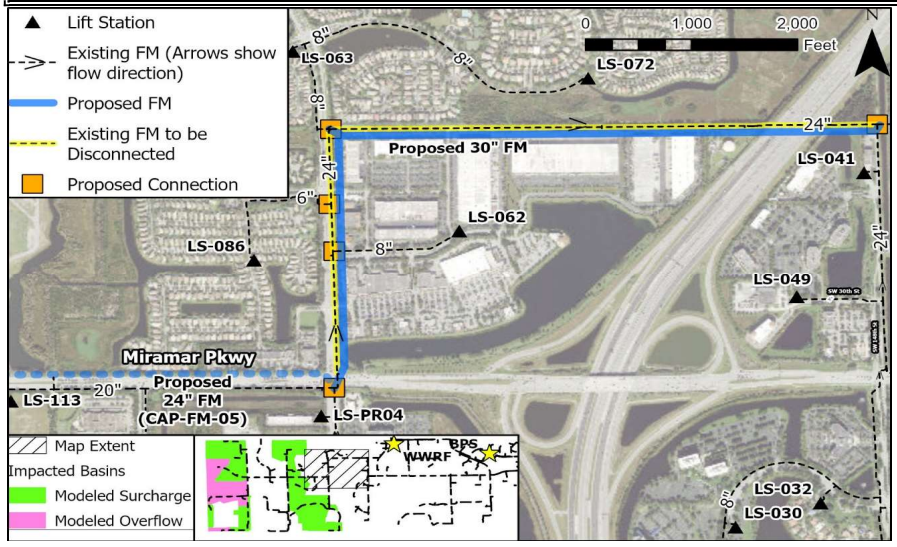
Item	Description	Quantity	Unit	Installed Unit Cost	Total	Comments/Reference
1	Connection to 24-inch FM on Miramar Pkwy	1	LS	$25,000	$25,000	
2	30-inch force main (open cut)	7,300	LF	$510	$3,723,000	$17/inch/foot
3	Connection to 8" force main from LS-062	1	LS	$25,000	$25,000	
4	Connection to 6" force main from LS-086	1	LS	$25,000	$25,000	
5	Connection to 12" force main from LS-063	1	LS	$25,000	$25,000	
6	HDD under I-75 - 24" FM with 30" casing	600	LF	$750	$450,000	
7	Boring/receiving pits for HDD	2	EA	$20,000	$40,000	
8	Connection to 24-inch FM at the end of SW 148th St	1	LS	$25,000	$25,000	
9	Cut and cap 24" force main	2	LS	$10,000	$20,000	
	SUBTOTAL				**$4,358,000**	
	Mobilization	1	LS	10%	$435,800	
	Contractor Overhead and Profit	1	LS	15.0%	$653,700	
	Permit Fee Allowance	1	LS	8.0%	$348,700	
	Contingency	1	LS	30.0%	$1,307,400	
	SUBTOTAL				**$7,104,000**	
	Engineering, Permitting, and CMS	1	EA	20.0%	$1,421,000	
	TOTAL PROJECT COST				**$8,530,000**	

Notes:

1. Installed unit costs for pipeline infrastructure includes pipe with 3 feet of cover, fittings, excavation, backfill, compaction, and one lane of asphalt restoration.

2. This estimate has been prepared based upon Master Planning level information. Because of the level of scope development at this stage, the estimate is a Class 5 estimate as defined by the Association for the Advancement of Cost Engineering International (AACE). The expected range of accuracy for this type of estimate is +100% to - 50%. This cost estimate has been prepared for guidance in project evaluation and implementation from the information available at this stage of the estimate. The final costs of the project will depend on actual labor and material cost, competitive market conditions, final project scope, implementation schedule, and other variable conditions. As a result, the final project costs will vary from the estimate presented herein.

3. This estimate was prepared for year 2023 dollars and does not include a factor for escalation.



OPINION OF PROBABLE PROJECT COST

City of Miramar Wastewater Master Plan
Facility: Wastewater Transmission System
Project Name: Upgrade Force Main Along SW 25th Street from SW 130th Avenue to SW 136th Avenue
Project Number: CAP-FM-14
Project Type: Capacity
Project Timeframe: 20+ Years

GENERAL INFORMATION

BRIEF PROJECT DESCRIPTION:
Construct approximately 3,200 feet of 12" force main along SW 25th Street from SW 130th Ave to the existing 24" force main on SW 136th Avenue. Include a connection on SW 132nd Terrace to the LS-053 tie-in. Abandon the existing 8" force main along SW 25th Street.

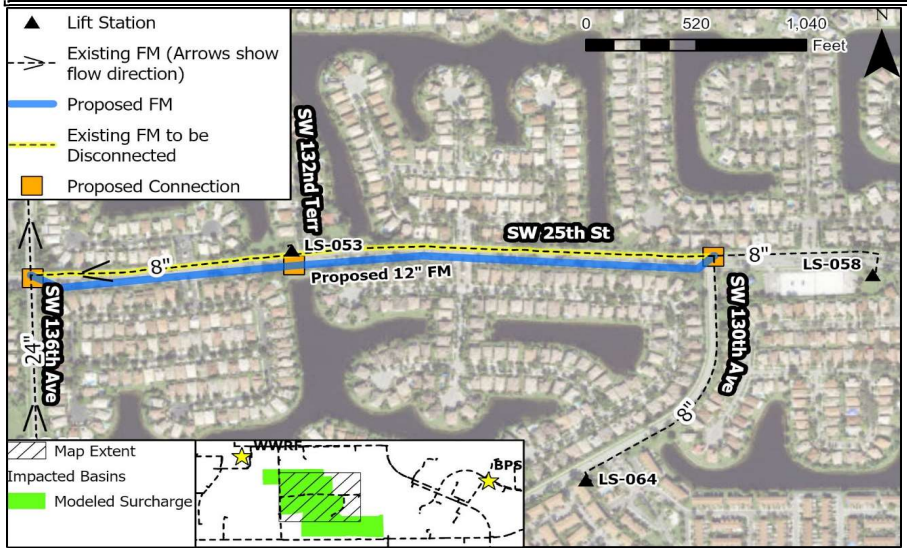
Date Estimate was prepared:	3/7/2023
Prepared By:	R. Warier
Checked By:	J. McMahon

COST ESTIMATE

Item	Description	Quantity	Unit	Installed Unit Cost	Total	Comments/Reference
1	Connection to 8" FM at 130th Ave	1	LS	$25,000	$25,000	
2	Connection to 8" FM from LS-053	1	LS	$25,000	$25,000	
3	12-inch force main	3,200	LF	$204	$652,800	$17/inch/foot
4	Connection to 24" FM on 136th Ave	1	LS	$25,000	$25,000	
5	Install 8" plug valve	2	EA	$6,000	$12,000	
	SUBTOTAL				**$740,000**	
	Mobilization	1	LS	10%	$74,000	
	Contractor Overhead and Profit	1	LS	15.0%	$111,000	
	Permit Fee Allowance	1	LS	8.0%	$59,200	
	Contingency	1	LS	30.0%	$222,000	
	SUBTOTAL				**$1,207,000**	
	Engineering, Permitting, and CMS	1	EA	20.0%	$242,000	
	TOTAL PROJECT COST				**$1,450,000**	

Notes:

1. Installed unit costs for pipeline infrastructure includes pipe with 3 feet of cover, fittings, excavation, backfill, compaction, and one lane of asphalt restoration.
2. This estimate has been prepared based upon Master Planning level information. Because of the level of scope development at this stage, the estimate is a Class 5 estimate as defined by the Association for the Advancement of Cost Engineering International (AACE). The expected range of accuracy for this type of estimate is +100% to - 50%. This cost estimate has been prepared for guidance in project evaluation and implementation from the information available at this stage of the estimate. The final costs of the project will depend on actual labor and material cost, competitive market conditions, final project scope, implementation schedule, and other variable conditions. As a result, the final project costs will vary from the estimate presented herein.
3. This estimate was prepared for year 2023 dollars and does not include a factor for escalation.



OPINION OF PROBABLE PROJECT COST

City of Miramar Wastewater Master Plan
Facility: Wastewater Transmission System
Project Name: Upgrade Force Main from LS-049 to SW 148th Avenue
Project Number: CAP-FM-15
Project Type: Capacity
Project Timeframe: 20+ Years

GENERAL INFORMATION

BRIEF PROJECT DESCRIPTION:
Construct approximately 870 feet of 8" force main on SW 30th Street from LS-049 to the existing 24" force main along SW 148th Avenue. Abandon the existing 4" force main.

Date Estimate was prepared:	3/7/2023
Prepared By:	R. Warier
Checked By:	J. McMahon

COST ESTIMATE

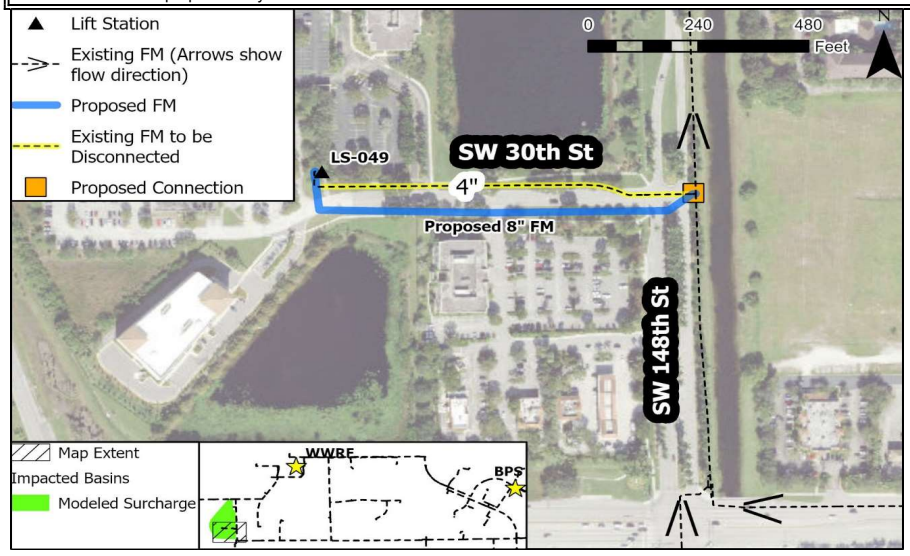
Item	Description	Quantity	Unit	Installed Unit Cost	Total	Comments/Reference
1	Connection to LS-049 discharge	1	LS	$25,000	$25,000	
2	8-inch force main	870	LF	$136	$118,400	$17/inch/foot
3	HDD under SW 148th Ave	150	LF	$80	$12,000	
4	Boring/receiving pits for HDD - 16-inch ID	2	EA	$4,000	$8,000	
5	Connection to 24-inch FM on 148th Ave	1	LS	$25,000	$25,000	
6	Install 6" plug valve	1	EA	$4,500	$4,500	
	SUBTOTAL				**$193,000**	
	Mobilization	1	LS	10%	$19,300	
	Contractor Overhead and Profit	1	LS	15.0%	$29,000	
	Permit Fee Allowance	1	LS	8.0%	$15,500	
	Contingency	1	LS	30.0%	$57,900	
	SUBTOTAL				**$315,000**	
	Engineering, Permitting, and CMS	1	EA	20.0%	$63,000	
	TOTAL PROJECT COST				**$380,000**	

Notes:

1. Installed unit costs for pipeline infrastructure includes pipe with 3 feet of cover, fittings, excavation, backfill, compaction, and one lane of asphalt restoration.

2. This estimate has been prepared based upon Master Planning level information. Because of the level of scope development at this stage, the estimate is a Class 5 estimate as defined by the Association for the Advancement of Cost Engineering International (AACE). The expected range of accuracy for this type of estimate is +100% to - 50%. This cost estimate has been prepared for guidance in project evaluation and implementation from the information available at this stage of the estimate. The final costs of the project will depend on actual labor and material cost, competitive market conditions, final project scope, implementation schedule, and other variable conditions. As a result, the final project costs will vary from the estimate presented herein.

3. This estimate was prepared for year 2023 dollars and does not include a factor for escalation.



OPINION OF PROBABLE PROJECT COST

City of Miramar Wastewater Master Plan
Facility: Wastewater System
Project Name: Small Lift Station
Project Number:
Project Type: Renewal & Replacement

GENERAL INFORMATION

BRIEF PROJECT DESCRIPTION:

Rehabillitation of a small or FRP type lift station for submersible pumps that are up to 3 hp in size. This assumes 120V/240V, single phase electrical service with no upgrades required.

Date Estimate was prepared:	10/17/2022
ENR Construction Cost Index:	
Prepared by:	N. Lucado
Checked by:	J. McMahon

COST ESTIMATE

Renewal and Replacement/Capacity Related Improvements

Item	Description	Quantity	Unit	Unit Cost	Installation Factor	Total	Comments/Reference
1	Replace submersible pumps, motors and accessories (1 - 3 hp pumps)	2	EA	$3,000	2.0	$12,000	
2	Replace discharge plug valves	2	EA	$500	2.0	$2,000	
3	Replace discharge check valves	2	EA	$250	2.0	$1,000	
4	Replace PVC discharge piping (in wet well)	1	LS	$2,500	2.0	$5,000	
5	Repairs to FRP wet well	1	LS	$5,000	1.0	$5,000	
6	Misc. site improvements - lighting, water service, fencing	1	LS	$15,000	1.0	$15,000	
7	Local Control Panel	1	LS	$20,000	1.2	$24,000	
8	RTU Panel	1	LS	$30,000	1.2	$36,000	
9	Instrumentation (floats, level control, gauges, etc)	1	LS	$2,000	1.0	$2,000	
10	Hatches	2	EA	$5,000	1.3	$13,000	
11	Demolition	1	LS	$25,000	1.0	$25,000	
12	Bypass pumping	1	LS	$20,000	1.0	$20,000	
	SUBTOTAL					**$160,000**	
	Bonds and Insurance			3%		$5,000	
	Mobilization / Demobilizarion			5%		$8,000	
	OH&P			15%		$24,000	
	General Conditions			5%		$8,000	
	Permit Fee Allowance			5%		$8,000	
	Contingency			30%		$48,000	
	SUBTOTAL					**$261,000**	
	Engineering, Permitting, and CMS			20%		$52,200	
	TOTAL PROJECT COST					**$314,000**	**$314,000**

Notes:

1. This estimate has been prepared based upon Master Planning level information. Because of the level of scope development at this stage, the estimate is an "Order Of Magnitude" estimate as defined by the Association for the Advancement of Cost Engineering International (AACE). The expected range of accuracy for this type of estimate is +100% to - 50%.
2. This cost estimate has been prepared for guidance in project evaluation and implementation from the information available at this stage of the estimate. The final costs of the project will depend on actual labor and material cost, competitive market conditions, final project scope, implementation schedule, and other variable conditions. As a result, the final project costs will vary from the estimate presented herein.
3. This estimate has been prepared based on 2023 dollars and does not include a factor for escalation.

OPINION OF PROBABLE PROJECT COST

City of Miramar Wastewater Master Plan
Facility: Wastewater System
Project Name: Medium Lift Station
Project Number:
Project Type: Renewal & Replacement or Capacity Upgrade

GENERAL INFORMATION

BRIEF PROJECT DESCRIPTION:

Rehabillitation or upgrade of a medium, duplex submersible lift station less than 20 hp in size. This assumes 120V/240V, single phase electrical service with no upgrades required.

Date Estimate was prepared:	10/17/2022
ENR Construction Cost Index:	
Prepared by:	N. Lucado
Checked by:	J. McMahon

COST ESTIMATE

Renewal and Replacement/Capacity Related Improvements

Item	Description	Quantity	Unit	Unit Cost	Installation Factor	Total	Comments/Reference
1	Replace submersible pumps, motors, rails, and accessories (>3 to <20 hp pumps)	2	EA	$20,000	1.8	$72,000	
2	Replace discharge plug valves (up to 6")	2	EA	$3,000	2.0	$12,000	
3	Replace discharge swing check valves (up to 6")	2	EA	$3,500	2.0	$14,000	
4	Replace DI discharge piping (in wet well)	1	LS	$5,000	2.0	$10,000	
5	Coat wet well (assume 8' diameter, 20' depth)	500	SF	$50	1.0	$25,000	
6	Misc. site improvements - lighting, water service, fencing, etc	1	LS	$20,000	1.0	$20,000	
7	Local Control Panel	1	LS	$20,000	1.2	$24,000	
8	RTU Panel	1	LS	$30,000	1.2	$36,000	
9	Instrumentation (floats, level control, gauges, etc)	1	LS	$10,000	1.0	$10,000	
10	Miscellaneous electrical work	1	LS	$25,000	1.0	$25,000	
11	Hatches	2	EA	$5,000	1.3	$13,000	
12	Demolition	1	LS	$25,000	1.0	$25,000	
13	Bypass pumping	1	LS	$50,000	1.0	$50,000	$40K for LS 309 (2/2021)
	SUBTOTAL					**$336,000**	
	Bonds and Insurance			3%		$11,000	
	Mobilization / Demobilizarion			5%		$17,000	
	OH&P			15%		$51,000	
	General Conditions			5%		$17,000	
	Permit Fee Allowance			5%		$17,000	
	Contingency			30%		$101,000	
	SUBTOTAL					**$550,000**	
	Engineering, Permitting, and CMS			20%		$110,000	
	TOTAL PROJECT COST					**$660,000**	
							$660,000

Notes:

1. This estimate has been prepared based upon Master Planing level information. Because of the level of scope development at this stage, the estimate is an "Order Of Magnitude" estimate as defined by the Association for the Advancement of Cost Engineering International (AACE). The expected range of accuracy for this type of estimate is +100% to - 50%.
2. This cost estimate has been prepared for guidance in project evaluation and implementation from the information available at this stage of the estimate. The final costs of the project will depend on actual labor and material cost, competitive market conditions, final project scope, implementation schedule, and other variable conditions. As a result, the final project costs will vary from the estimate presented herein.
3. This estimate has been prepared based on 2023 dollars and does not include a factor for escalation.

OPINION OF PROBABLE PROJECT COST

City of Miramar Wastewater Master Plan
Facility: Wastewater System
Project Name: Large Lift Station
Project Number:
Project Type: Renewal & Replacement or Capacity Upgrade

GENERAL INFORMATION

BRIEF PROJECT DESCRIPTION:

Rehabillitation or upgrade of a large sized, duplex submersible lift station with pumps that are 20 hp to less than 50 hp. This assumes 480V, 3 phase electrical service with no upgrades required.

Date Estimate was prepared:	10/17/2022
ENR Construction Cost Index:	
Prepared by:	N. Lucado
Checked by:	J. McMahon

COST ESTIMATE

Renewal and Replacement/Capacity Related Improvements

Item	Description	Quantity	Unit	Unit Cost	Installation Factor	Total	Comments/Reference
1	Replace submersible pumps, motors, rails, and accessories (20 to <50 hp pumps)	2	EA	$30,000	1.8	$108,000	
2	Replace discharge plug valves (up to 10")	2	EA	$4,000	2.0	$16,000	
3	Replace discharge swing check valves (up to 10")	2	EA	$9,000	2.0	$36,000	
4	Replace DI discharge piping (in wet well)	1	LS	$6,000	2.0	$12,000	
5	Coat wet well (assume 8' diameter, 25' depth)	650	SF	$50	1.0	$33,000	
6	Misc. site improvements - lighting, water service, fencing, etc	1	LS	$25,000	1.0	$25,000	
7	Local Control Panel	1	LS	$20,000	1.2	$24,000	
8	RTU Panel	1	LS	$30,000	1.2	$36,000	
9	Instrumentation (floats, level control, gauges, etc)	1	LS	$10,000	1.0	$10,000	
10	Miscellaneous electrical work	1	LS	$30,000	1.0	$30,000	
11	Hatches	2	EA	$7,500	1.3	$20,000	
12	Demolition	1	LS	$30,000	1.0	$30,000	
13	Bypass pumping	1	LS	$60,000	1.0	$60,000	$40K for LS 309 (2/2021)
	SUBTOTAL					**$440,000**	
	Bonds and Insurance			3%		$14,000	
	Mobilization / Demobilizarion			5%		$22,000	
	OH&P			15%		$66,000	
	General Conditions			5%		$22,000	
	Permit Fee Allowance			5%		$22,000	
	Contingency			30%		$132,000	
	SUBTOTAL					**$718,000**	
	Engineering, Permitting, and CMS			20%		$143,600	
	TOTAL PROJECT COST					**$862,000**	
							$862,000

Notes:

1. This estimate has been prepared based upon Master Planning level information. Because of the level of scope development at this stage, the estimate is an "Order Of Magnitude" estimate as defined by the Association for the Advancement of Cost Engineering International (AACE). The expected range of accuracy for this type of estimate is +100% to - 50%.
2. This cost estimate has been prepared for guidance in project evaluation and implementation from the information available at this stage of the estimate. The final costs of the project will depend on actual labor and material cost, competitive market conditions, final project scope, implementation schedule, and other variable conditions. As a result, the final project costs will vary from the estimate presented herein.
3. This estimate has been prepared based on 2023 dollars and does not include a factor for escalation.

OPINION OF PROBABLE PROJECT COST

City of Miramar Wastewater Master Plan
Facility: Wastewater System
Project Name: Master Pump Station
Project Number:
Project Type: Renewal & Replacement or Capacity Upgrade

GENERAL INFORMATION

BRIEF PROJECT DESCRIPTION:

Rehabillitation or upgrade of a master pump station, including building hardending, pump replacement, variable frequency drives, generator, site work and yard piping. For additional detail, refer to W-27 Sample OPCC worksheet.

Date Estimate was prepared:	10/17/2022
ENR Construction Cost Index:	
Prepared by:	N. Lucado
Checked by:	J. McMahon

COST ESTIMATE

Renewal and Replacement/Capacity Related Improvements

Item	Description	Quantity	Unit	Unit Cost	Installation Factor	Total	Comments/Reference
1	ITEM 2 - DEMOLITION OF EXISTING FACILITIES	1	LS	$100,000	1.0	$100,000	
2	ITEM 3 - TEMPORARY BY-PASS	1	LS	$100,000	1.0	$100,000	
3	ITEM 4 - SITE WORK AND YARD PIPING	1	LS	$204,000	1.0	$204,000	
4	ITEM 5 - MECHANICAL AND VENTILATION UPGRADES	1	LS	$1,141,000	1.0	$1,141,000	
5	ITEM 6 - STRUCTURAL AND ARCHITECTURAL UPGRADES	1	LS	$435,000	1.0	$435,000	
6	ITEM 7 - ELECTRICAL UPGRADES	1	LS	$874,000	1.0	$874,000	
7	ITEM 8 - INSTRUMENTATION	1	LS	$215,000	1.0	$215,000	
	SUBTOTAL					**$3,069,000**	
	Bonds and Insurance			3%		$93,000	
	Mobilization / Demobilizarion			5%		$154,000	
	OH&P			15%		$461,000	
	General Conditions			5%		$154,000	
	Permit Fee Allowance			5%		$154,000	
	Contingency			30%		$921,000	
	SUBTOTAL					**$5,006,000**	
	Engineering, Permitting, and CMS			20%		$1,001,200	
	TOTAL PROJECT COST					**$6,008,000**	
							$6,008,000

Notes:

1. This estimate has been prepared based upon Master Planning level information. Because of the level of scope development at this stage, the estimate is an "Order Of Magnitude" estimate as defined by the Association for the Advancement of Cost Engineering International (AACE). The expected range of accuracy for this type of estimate is +100% to - 50%.
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3. This estimate has been prepared based on 2023 dollars and does not include a factor for escalation.

Project ID Number	Process Area	Building	Asset Description	Cost
<5 years				
RR-WWRF-01	Solids Handling	Digesters and Ancillary Equipment	DIGESTER BOILER #1 ASSEMBLY	$1,065,000
			DIGESTER BOILER #2 ASSEMBLY	$1,065,000
			GENERATOR/DIGESTER BOILER DIESEL TANK #1	$532,000
			GENERATOR/DIGESTER BOILER DIESEL TANK #2	$532,000
			DIGESTER HEAT EXCHANGER #2 ASSEMBLY	$53,000
			DIGESTER STANDBY HEAT EXCHANGER (#3)	$53,000
			DIGESTER BOILER CIRCULATION PUMP # 1	$67,000
			DIGESTER BOILER CIRCULATION PUMP # 2	$67,000
			WASTE GAS BURNER SYSTEM	$399,000
			DIGESTER #2 MIXER #1	$740,000
			DIGESTER #2 MIXER #2	$740,000
			DIGESTER #2 MIXER #3	$740,000
			DIGESTER #2 MIXER #4	$740,000
			DIGESTER #1 and 2 GAS PRESSURE VALVES	$228,000
			DIGESTER #2 COVER ELEVATION	$740,000
			DIGESTER BUILDING EXHAUST FAN #3 / NORTH WALL	$27,000
			DIGESTER BUILDING EXHAUST FAN #4 / SOUTH WALL	$27,000
RR-WWRF-02	Hypochlorite Building	Hypochlorite Building	METERING SKID 2 (PUMP 4-5)	$53,000
			HYPOCHLORITE TANK 1	$129,000
			HYPOCHLORITE TANK 2	$129,000
			HYPOCHLORITE TANK 3	$129,000
			HYPOCHLORITE TANK 5	$129,000
			HYPOCHLORITE TANK 6	$129,000
RR-WWRF-03	Generator Building	Generator Building	GENERATOR 3	$1,836,000
RR-WWRF-04	Aeration System	Aeration Basin Assemblies and Mixers	AERATION BASIN #1 INFLUENT (MIXER)	$133,000
			AERATION BASIN #2 INFLUENT MIXER ASSEMBLY	$133,000
			AERATION BASIN #3 INFLUENT (MIXER)	$133,000
			AERATION BASIN #4 INFLUENT MIXER ASSEMBLY	$133,000
			AERATION BASIN #5I (INFLUENT END)	$133,000
			AERATION BASIN #1 DIFUSER ASSEMBLY	$130,000
			AERATION BASIN #2 DIFUSER ASSEMBLY	$130,000
			AERATION BASIN #3 DIFUSER ASSEMBLY	$130,000
			AERATION BASIN #4 DIFUSER ASSEMBLY	$130,000
			AERATION BASIN #5 DIFUSER ASSEMBLY	$130,000
			AERATION BASIN #5E (EFFLUENT END)	$133,000
RR-WWRF-05	Aeration System	Blower Assemblies and Ancillary Equipment	BLOWER PROCESS AIR BLOWER #4 ASSEMBLY	$1,331,000
			BLOWER PROCESS AIR BLOWER #5 ASSEMBLY	$1,331,000
			BLOWER BUILDING EXHAUST FAN #3/ WEST WALL	$27,000
			BLOWER BUILDING EXHAUST FAN #4/ EAST WALL	$27,000
			BLOWER BUILDING EXHAUST FAN #5/ SWITCH GEAR ROOM	$27,000
RR-WWRF-06	Injection Well Pump System	Injection Well Pump Strainers	INJECTION WELL STRAINER #1	$373,000
			INJECTION WELL STRAINER #2	$373,000
			INJECTION WELL STRAINER #3	$373,000
			INJECTION WELL STRAINER #4	$373,000
		IWPS and Ancillary Equipment	INJECTION WELL EFFLUENT PUMP SYSTEM #2	$666,000
RR-WWRF-07	Injection Wells	Injection Wells	MONITORING WELL 1 WELLHEAD PIPING AND APPURTENANCES	$1,550,000
RR-WWRF-08	Reclaimed Treatment System	Effluent Filters	EFFLUENT FILTERS NO. 1	$466,000
			CHLORINE CONTACT BASIN #1 FILL VALVE ACTUATOR	$31,000
			CHLORINE CONTACT BASIN #1 REJECT VALVE ACTUATOR	$31,000
			RE-USE WEST EFFLUENT AUTOMATIC COMPOSITE SAMPLER	$23,000
RR-WWRF-09	Reclaimed Treatment System	Reclaimed Water High Service Pump Assemblies	REUSE DISTRIBUTION PUMP ASSEMBLY #1	$399,000
			REUSE DISTRIBUTION PUMP ASSEMBLY #2	$399,000

Project ID Number	Process Area	Building	Asset Description	Cost
RR-WWRF-10	Secondary Clarification	RAS Pump Assemblies	RAS PUMP SYSTEM #1 PUMP	$160,000
			RAS PUMP SYSTEM #2 PUMP	$160,000
			RAS PUMP SYSTEM #3 PUMP	$160,000
			RAS PUMP SYSTEM #4 PUMP	$160,000
			RAS PUMP SYSTEM #5 PUMP	$160,000
			RAS PUMP SYSTEM #6 PUMP	$160,000
RR-WWRF-11	Secondary Clarification	Secondary Clarifiers	CLARIFIER #1	$3,227,000
			CLARIFIER #2	$3,227,000
			CLARIFIER #3	$3,227,000
RR-WWRF-12	Solids Handling	Belt Filter Presses	SOLIDS BP POLYMER DAY TANK	$43,000
			SOLIDS POLYMER BULK STORAGE TANK	$133,000
		Gravity Belt Thickeners	SOLIDS BT #1	$760,000
			SOLIDS BT #1 WASHWATER PUMP	$760,000
			SOLIDS BT #2	$760,000
			SOLIDS BT-POLYMER SYSTEM #1 (TRANSFER)	$110,000
			SOLIDS BT-POLYMER SYSTEM #2 (TRANSFER)	$110,000
			SOLIDS BT POLYMER DAY TANK	$134,000
RR-WWRF-13	Solids Handling	Solids Handling Odor Control System	SOLIDS PROC SCRUBBER TOWER #1	$285,000
			SOLIDS PROC SCRUBBER TOWER #2	$285,000
			SOLIDS SCRUBBER FAN ASSEMBLY #1	$53,000
			SOLIDS CAUSTIC STORAGE TANK	$240,000
			SOLIDS TOWER #1 CHEM FEED PUMP ASSEMBLY #1	$13,000
			SOLIDS TOWER #1 CHEM FEED PUMP ASSEMBLY #2	$13,000
			SOLIDS TOWER #1 CHEM FEED PUMP ASSEMBLY #3	$13,000
			SOLIDS TOWER #1 CHEM FEED PUMP ASSEMBLY #4	$13,000
RR-WWRF-14	Pretreatment	Pretreatment Odor Control System	PRE-TREATMENT SCRUBBER TOWER #1	$114,000
			PRE-TREATMENT SCRUBBER TOWER #2	$114,000
			PRE-TREATMENT ODOR CONTROL SCRUBBER FAN	$53,000
			PRE-TREATMENT CAUSTIC STORAGE TANK	$240,000
			PRE-TREATMENT TOWER #2 RECIRC PMP SYSTEM #1	$12,000
5-10 years				
RR-WWRF-15	Aeration System	Aeration Basin Assemblies and Mixers	AERATION BASIN #1 EFFLUENT MIXER	$133,000
			AERATION BASIN #2 EFFLUENT (MIXER)	$133,000
			AERATION BASIN #4 EFFLUENT MIXER ASSEMBLY	$133,000
RR-WWRF-16	Aeration System	Blower Assemblies and Ancillary Equipment	BLOWER PROCESS AIR BLOWER #1 ASSEMBLY	$1,331,000
			BLOWER PROCESS AIR BLOWER #2 ASSEMBLY	$1,331,000
			BLOWER PROCESS AIR BLOWER #3 ASSEMBLY	$1,331,000
RR-WWRF-17	Generator Building	Generator Building	GENERATOR 1	$1,836,000
			GENERATOR 2	$1,836,000
			DIESEL DAY TANK 1	$27,000
			DIESEL DAY TANK 2	$27,000
			DIESEL DAY TANK 3	$27,000
RR-WWRF-18	Hypochlorite Building	Hypochlorite Building	METERING SKID 1 (PUMP 1-3)	$53,000
			METERING SKID 3 (PUMP 6-7)	$53,000
RR-WWRF-19	Injection Well Pump System	IWPS and Ancillary Equipment	INJECTION BUILDING EXHAUST FAN #3 / NORTH WALL	$20,000
			INJECTION WELL EFFLUENT PUMP SYSTEM #1	$666,000
			INJECTION WELL EFFLUENT PUMP SYSTEM #4	$666,000
			AUTOMATIC COMPOSITE SAMPLER INJECTION WET WELL	$23,000
			INJECTION BUILDING EXHAUST FAN #4 / SOUTHEAST WALL	$20,000
RR-WWRF-20	Pretreatment	Grit System Assemblies	PRE-TREATMENT GRIT COLLECTOR #1 ASSEMBLY	$307,000
RR-WWRF-21	Reclaimed Treatment System	Effluent Filters	EFFLUENT FILTERS NO. 2	$466,000
			CHLORINE CONTACT BASIN #2 FILL VALVE ACTUATOR	$31,000
			CHLORINE CONTACT BASIN #2 REJECT VALVE ACTUATOR	$31,000
			RE-USE EAST EFFLUENT AUTOMATIC COMPOSITE SAMPLER	$23,000
			RE-USE 5-6 EFFLUENT AUTOMATIC COMPOSITE SAMPLER	$23,000
RR-WWRF-22	Reclaimed Treatment System	Reclaimed Water High Service Pump Assemblies	REUSE DISTRIBUTION PUMP ASSEMBLY #3	$399,000
			REUSE BUILDING EXHAUST FAN / NORTH WALL	$20,000
RR-WWRF-23	Secondary Clarification	Secondary Clarifiers	CLARIFIER #4	$3,227,000

Project ID Number	Process Area	Building	Asset Description	Cost
RR-WWRF-24	Solids Handling	Belt Filter Presses	SOLIDS BP POLYBLEND FEED ASSEMBLY #1	$13,000
			SOLIDS BP POLYBLEND FEED ASSEMBLY #2	$13,000
			SOLIDS BP POLYBLEND FEED ASSEMBLY #3	$13,000
		Gravity Belt Thickeners	SOLIDS BT POLYBLEND FEED ASSEMBLY #1	$13,000
			SOLIDS BT POLYBLEND FEED ASSEMBLY #2	$13,000
			SOLIDS BT POLYBLEND FEED ASSEMBLY #3	$13,000
RR-WWRF-25	Solids Handling	Digesters and Ancillary Equipment	DIGESTER HOT WATER PUMP SYS #1	$27,000
			DIGESTER HOT WATER PUMP SYS #2	$27,000
RR-WWRF-26	Solids Handling	Solids Handling Odor Control System	SOLIDS TOWER #1 RECIRC PUMP SYSTEM #1	$102,000
			SOLIDS TOWER #1 RECIRC PUMP SYSTEM #2	$102,000
			SOLIDS TOWER #2 RECIRC PUMP SYSTEM #1	$102,000
			SOLIDS TOWER #2 RECIRC PUMP SYSTEM #2	$102,000
10-15 years				
RR-WWRF-27	Aeration System	Aeration Basin Assemblies and Mixers	AERATION BASIN #3 EFFLUENT (MIXER)	$133,000
RR-WWRF-28	Hypochlorite Building	Hypochlorite Building	HYPOCHLORITE TANK 4	$129,000
			HYPOCHLORITE TANK 7	$129,000
			HYPOCHLORITE TANK 8	$129,000
RR-WWRF-29	Pretreatment	Grit System Assemblies	PRE-TREATMENT GRIT COLLECTOR #2 ASSEMBLY	$307,000
RR-WWRF-30	Pretreatment	Pretreatment Odor Control System	PRE-TREATMENT TOWER #1 RECIRC PMP SYSTEM #1	$24,000
			PRE-TREATMENT TOWER #1 RECIRC PMP SYSTEM #2	$24,000
			PRE-TREATMENT TOWER #2 RECIRC PMP SYSTEM #2	$24,000
RR-WWRF-31	Secondary Clarification	WAS Pump Assemblies	WAS PUMP SYSTEM #1	$117,000
			WAS PUMP SYSTEM #2	$117,000
RR-WWRF-32	Solids Handling	Digesters and Ancillary Equipment	DIGESTER HEAT EXCHANGER #1 ASSEMBLY	$53,000
15-20 years				
RR-WWRF-33	Generator Building	Generator Building	DIESEL DAY TANK 4	$27,000
			GENERATOR 4	$1,836,000
RR-WWRF-34	Injection Well Pump System	IWPS and Ancillary Equipment	INJECTION WELL EFFLUENT PUMP SYSTEM #3	$666,000
RR-WWRF-35	Pretreatment	Grit System Assemblies	PRE-TREATMENT GRIT PUMP #1 ASSEMBLY	$307,000
			PRE-TREATMENT GRIT PUMP #2 ASSEMBLY	$307,000
			PRE-TREATMENT GRIT CLASSIFIER #1 ASSEMBLY	$307,000
			PRE-TREATMENT GRIT CLASSIFIER #2 ASSEMBLY	$307,000
RR-WWRF-36	Pretreatment	Pretreatment Odor Control System	PRE-TREATMENT TOWER #1 CHEMICAL FEED PUMP #1 PUMP	$13,000
			PRE-TREATMENT TOWER #1 CHEMICAL FEED PUMP #2 PUMP	$13,000
			PRE-TREATMENT TOWER #1 CHEMICAL FEED PUMP #3 PUMP	$13,000
			PRE-TREATMENT TOWER #1 CHEMICAL FEED PUMP #4 PUMP	$13,000
RR-WWRF-37	Reclaimed Treatment System	Effluent Filters	EFFLUENT FILTERS NO. 3	$466,000
			CHLORINE CONTACT BASIN #3 FILL VALVE ACTUATOR	$31,000
			CHLORINE CONTACT BASIN #3 REJECT VALVE ACTUATOR	$31,000
			REUSE AIR COMPRESSOR #1	$106,000
			REUSE AIR COMPRESSOR #3	$106,000
		Filter Feed Pump Systems	INJECTION WELL FILTER FEED PUMP SYSTEM #1	$333,000
			INJECTION WELL FILTER FEED PUMP SYSTEM #2	$333,000
RR-WWRF-38	Reclaimed Treatment System	Reclaimed Water High Service Pump Assemblies	REUSE DISTRIBUTION PUMP ASSEMBLY #4	$399,000
RR-WWRF-39	Solids Handling	Belt Filter Presses	SOLIDS BP #1 ASSEMBLY	$602,000
			SOLIDS BP #1 WASHWATER BOOSTER PMP SYS	$602,000
			SOLIDS BP #2 ASSEMBLY	$602,000
			SOLIDS BP #2 WASHWATER BOOSTER PMP SYS	$602,000
		Gravity Belt Thickeners	SOLIDS BT #1 THICKENED SLUDGE PMP SYS	$52,000
			SOLIDS BT #2 WASHWATER PUMP (PUMP)	$760,000
			SOLIDS BT #2 THICKENED SLUDGE PMP SYS	$52,000

Project ID Number	Process Area	Building	Asset Description	Cost
RR-WWRF-40	Solids Handling	Digesters and Ancillary Equipment	DIGESTER #1 RECIRC PMP SYSTEM #1	$110,000
			DIGESTER #1 RECIRC PMP SYSTEM #2	$110,000
			DIGESTER #2 RECIRC PMP SYSTEM #1	$110,000
			DIGESTER #2 RECIRC PMP SYSTEM #2	$110,000
			DIGESTER #1 TRANSFER PMP SYSTEM	$110,000
			DIGESTER #2 TRANSFER PMP SYSTEM	$110,000
			DIGESTER #1 MIXER #1	$740,000
			DIGESTER #1 MIXER #2	$740,000
			DIGESTER #1 MIXER #3	$740,000
			DIGESTER #1 MIXER #4	$740,000
20+ years				
RR-WWRF-41	Pretreatment	Bar Screens and Washers	PRE-TREATMENT MECHANICAL BAR SCREEN #1 ASSEMBLY	$414,000
			PRE-TREATMENT MECHANICAL BAR SCREEN #2 ASSEMBLY	$414,000







APPENDIX

B Modeled Lift Station Inflows

Appendix B: Modeled Lift Station Inflows

Table B-1: Modeled Lift Station Inflows

Lift Station Basin	2022			2045		
	Average Base Sanitary Flow (gpd)	Average Dry Weather Flow (gpd)	Peak Hour Wet Weather Flow (gpd)	Average Base Sanitary Flow (gpd)	Average Dry Weather Flow (gpd)	Peak Hour Wet Weather Flow (gpd)
LS-0001	161,382	221,276	566,788	172,500	232,394	582,326
LS-0002	81,876	115,674	306,990	121,200	154,998	362,001
LS-0003	78,108	104,463	259,314	121,000	147,355	319,365
LS-0004	22,773	29,364	69,354	24,250	30,841	71,454
LS-0005	156,314	199,299	463,416	151,250	194,235	456,347
LS-0006	136,970	183,459	456,275	134,150	180,639	452,356
LS-0007	174,655	251,761	683,292	276,400	353,506	825,721
LS-0008	358	2,203	11,004	700	2,545	11,483
LS-0009	56,715	77,275	196,375	77,300	97,860	225,211
LS-0010	97,464	133,370	340,756	122,800	158,706	376,240
LS-0011	105,175	139,344	341,645	103,500	137,669	339,336
LS-0012	1,977	27,337	147,663	2,100	27,460	147,778
LS-0013	139,905	175,549	398,685	135,300	170,944	392,246
LS-0014	83,663	101,217	216,995	98,950	116,504	238,412
LS-0015	63,668	83,732	203,280	109,350	129,414	267,251
LS-0016	88,920	104,693	214,207	93,050	108,823	220,016
LS-0017	28,630	43,758	126,197	30,000	45,128	128,087
LS-0018	65,994	81,158	178,686	69,800	84,964	184,005
LS-0019	90,924	104,183	202,700	95,100	108,359	208,579
LS-0020	25,056	39,850	119,257	32,800	47,594	130,105
LS-0021	66,840	85,317	198,732	79,050	97,527	215,810
LS-0022	21,938	33,433	96,146	31,150	42,645	109,024
LS-0023	1,449	21,000	113,733	7,050	26,601	121,133
LS-0024	80,576	110,805	284,861	105,400	135,629	319,576
LS-0025	12,616	16,456	39,489	14,900	18,740	42,708
LS-0026	9,996	36,388	164,197	48,650	75,042	218,299
LS-0027	18,076	32,254	106,023	25,250	39,428	116,032
LS-0028	4,539	10,008	37,492	4,750	10,219	37,772
LS-0029	23,136	34,300	95,942	32,850	44,014	109,520
LS-0030	8,896	20,646	79,331	8,600	20,350	78,911
LS-0031	11,170	20,173	66,842	10,800	19,803	66,352
LS-0032	12,386	26,072	95,248	12,000	25,686	94,688
LS-0033	32,787	46,765	125,464	46,600	60,578	144,781
LS-0034	19,504	30,921	92,273	34,900	46,317	113,829
LS-0035	33,339	52,528	155,890	32,500	51,689	154,700
LS-0036	17,639	27,119	78,659	17,200	26,680	78,029

Table B-1: Modeled Lift Station Inflows

Lift Station Basin	2022			2045		
	Average Base Sanitary Flow (gpd)	Average Dry Weather Flow (gpd)	Peak Hour Wet Weather Flow (gpd)	Average Base Sanitary Flow (gpd)	Average Dry Weather Flow (gpd)	Peak Hour Wet Weather Flow (gpd)
LS-0037	17,676	26,185	73,202	18,350	26,859	74,112
LS-0038	38,426	56,551	156,975	37,200	55,325	155,225
LS-0039	76,954	116,932	335,234	74,100	114,078	331,244
LS-0040	61,539	90,262	249,621	59,300	88,023	246,471
LS-0041	877	2,003	7,666	900	2,026	7,666
LS-0042	51,668	72,616	191,516	49,350	70,298	188,296
LS-0043	91,862	130,448	348,165	88,850	127,436	343,966
LS-0044	46,412	72,872	215,538	44,700	71,160	213,158
LS-0045	61,905	80,179	190,643	73,100	91,374	206,321
LS-0046	79,764	113,581	304,087	93,200	127,017	322,914
LS-0047	79,500	90,914	176,241	92,900	104,314	194,998
LS-0048	158,394	198,352	449,134	151,900	191,858	440,035
LS-0049	15,591	29,012	98,218	15,600	29,021	98,218
LS-0050	70,834	104,334	289,825	68,150	101,650	286,046
LS-0051	91,175	158,670	511,711	91,150	158,645	511,711
LS-0052	13,249	41,225	177,759	24,750	52,726	193,857
LS-0053	76,111	110,726	303,520	75,700	110,315	302,960
LS-0054	63,164	94,684	267,782	67,050	98,570	273,241
LS-0055	48,138	66,859	173,941	57,250	75,971	186,679
LS-0056	26,928	48,639	161,285	29,100	50,811	164,294
LS-0057	41,943	56,511	141,627	40,600	55,168	139,737
LS-0058	73,491	103,566	274,042	72,150	102,225	272,152
LS-0059	83,680	131,964	391,948	79,850	128,134	386,559
LS-0060	63,404	126,440	447,491	61,300	124,336	444,552
LS-0061	64,027	102,162	306,683	61,100	99,235	302,554
LS-0062	24,656	60,451	238,217	26,400	62,195	240,667
LS-0063	111,904	151,954	384,565	111,400	151,450	383,865
LS-0064	104,024	130,528	296,412	103,400	129,904	295,572
LS-0065	99,271	127,600	300,150	94,200	122,529	293,081
LS-0066	7,389	11,632	34,506	8,700	12,943	36,325
LS-0067	121,991	144,205	297,198	114,850	137,064	287,190
LS-0068	45,816	79,622	256,502	43,450	77,256	253,212
LS-0069	16,390	47,233	198,487	16,950	47,793	199,256
LS-0070	6,096	23,866	109,668	6,300	24,070	109,948
LS-0071	3,900	31,028	160,098	6,550	33,678	163,659
LS-0072	118,464	163,683	423,149	126,900	172,119	434,978

Table B-1: Modeled Lift Station Inflows

Lift Station Basin	2022			2045		
	Average Base Sanitary Flow (gpd)	Average Dry Weather Flow (gpd)	Peak Hour Wet Weather Flow (gpd)	Average Base Sanitary Flow (gpd)	Average Dry Weather Flow (gpd)	Peak Hour Wet Weather Flow (gpd)
LS-0073	264	856	3,717	250	842	3,717
LS-0074	4,905	19,111	87,706	5,800	20,006	88,966
LS-0075	25,364	40,997	124,453	24,250	39,883	122,914
LS-0076	64,376	125,830	439,885	61,550	123,004	435,896
LS-0077	87,417	104,460	219,333	87,400	104,443	219,333
LS-0078	20,455	57,462	239,236	19,500	56,507	237,906
LS-0079	21,413	51,428	200,775	20,400	50,415	199,376
LS-0080	23,251	37,418	113,172	22,300	36,467	111,842
LS-0081	8,618	28,519	125,294	14,500	34,401	133,553
LS-0082	107,609	140,709	338,995	102,600	135,700	331,996
LS-0083	70,387	105,605	298,972	72,600	107,818	302,051
LS-0084	81,602	102,792	234,820	96,700	117,890	255,956
LS-0085	5,795	39,682	201,206	28,250	62,137	232,396
LS-0086	57,900	84,288	231,226	55,600	81,988	228,007
LS-0088	40,132	57,221	153,456	38,400	55,489	151,006
LS-0089	29,473	40,609	104,598	41,800	52,936	121,886
LS-0090	43,788	72,994	227,527	41,850	71,056	224,797
LS-0091	54,742	69,821	162,452	52,000	67,079	158,603
LS-0092	19,789	31,953	96,941	19,000	31,164	95,821
LS-0093	48,060	67,744	179,284	46,100	65,784	176,555
LS-0094	31,436	43,365	111,914	40,600	52,529	124,722
LS-0095	45,772	64,114	168,429	59,050	77,392	187,046
LS-0096	61,823	81,417	198,016	79,750	99,344	223,142
LS-0097	15,865	21,462	54,038	22,500	28,097	63,346
LS-0098	17,768	25,710	70,044	17,050	24,992	69,064
LS-0099	55,280	82,884	234,507	53,050	80,654	231,358
LS-00A	3,625	5,560	16,123	6,300	8,235	19,832
LS-00B	55,710	73,138	177,151	69,350	86,778	196,258
LS-00C	62,653	86,037	220,775	85,650	109,034	252,971
LS-00D	20,422	28,372	73,799	26,350	34,300	82,128
LS-00E	3,392	5,317	15,714	4,200	6,125	16,833
LS-00F	23,082	29,550	69,146	32,950	39,418	82,934
LS-00G	10,172	13,154	31,181	12,800	15,782	34,890
LS-00H	127,539	149,371	302,793	143,350	165,182	324,910
LS-00I	93,846	122,476	294,307	156,700	185,330	382,284
LS-00J	76,686	102,550	254,560	128,800	154,664	327,489

Table B-1: Modeled Lift Station Inflows

Lift Station Basin	2022			2045		
	Average Base Sanitary Flow (gpd)	Average Dry Weather Flow (gpd)	Peak Hour Wet Weather Flow (gpd)	Average Base Sanitary Flow (gpd)	Average Dry Weather Flow (gpd)	Peak Hour Wet Weather Flow (gpd)
LS-00K	5,267	13,765	55,711	6,200	14,698	57,040
LS-00L	15,476	19,880	46,759	18,350	22,754	50,749
LS-00M	107,378	138,770	328,994	141,250	172,642	376,377
LS-0100	63,536	76,826	164,593	74,900	88,190	180,481
LS-0101	60,144	91,956	265,240	57,300	89,112	261,250
LS-0102	35,204	53,536	153,604	33,600	51,932	151,364
LS-0103	10,223	14,415	38,132	14,500	18,692	44,152
LS-0104	10,023	13,082	31,405	10,000	13,059	31,405
LS-0105	13,056	18,353	48,412	13,050	18,347	48,412
LS-0106	14,931	20,971	55,300	14,950	20,990	55,300
LS-0107	25,824	33,553	80,098	25,800	33,529	80,098
LS-0108	33,999	38,933	75,672	34,000	38,934	75,672
LS-0109	21,474	26,447	58,325	21,450	26,423	58,325
LS-0110	80,360	89,703	165,647	80,350	89,693	165,647
LS-0111	18,353	44,058	171,977	17,600	43,305	170,928
LS-0112	2,268	4,589	16,358	2,250	4,571	16,358
LS-0113	2,763	6,991	27,910	2,600	6,828	27,700
LS-0114	9,318	13,864	38,888	15,750	20,296	47,917
LS-0115	41,828	44,962	76,418	75,750	78,884	123,871
LS-0116	63,506	71,796	136,064	108,900	117,190	199,614
LS-0117	48,933	54,288	98,997	83,950	89,305	147,990
LS-0118	112,439	119,123	195,446	112,450	119,134	195,446
LS-0119	64,288	70,884	127,545	64,300	70,896	127,545
LS-0120	77,472	102,543	251,095	77,450	102,521	251,095
LS-0121	80,360	86,722	148,682	80,350	86,712	148,682
LS-0MPS	1,459	1,960	4,882	2,500	3,001	6,352
LS-0PAL	264	1,451	7,110	450	1,637	7,384
LS-PR01	502	854	2,700	600	952	2,840
LS-PR02	1,828	3,928	14,542	2,350	4,450	15,242
LS-PR03	755	5,358	27,278	900	5,503	27,481
LS-PR04	348	783	2,965	350	785	2,965
LS-PR05	1,942	3,422	11,154	2,050	3,530	11,294
LS-PR06	23,150	24,958	42,692	23,150	24,958	42,692
LS-PR07	636	3,767	18,747	650	3,781	18,747
LS-PR08	1,083	5,318	25,653	1,900	6,135	26,761
LS-PR09	15,433	17,825	35,238	15,450	17,842	35,238







APPENDIX

C Hydraulic Impact of Proposed Miramar Development

Appendix C: Technical Memorandum - Hydraulic Impact of Proposed Miramar Development

Hazen *Technical Memorandum*

March 31, 2024

To: Ronnie Navarro, P.E.

From: Hazen and Sawyer

cc: F. Domond, P.E.

Hydraulic Impact of Proposed Miramar Development

Background

MPV VI (The Park at Miramar) is a proposed mixed-use development that will be located at Miramar Pkwy and Red Rd, within the Miramar Regional Activity Center (RAC). The development is expected to generate approximately 0.6 mgd of average daily wastewater flow. Due to the size of the development, the City has requested a hydraulic model evaluation to determine its impact on the existing wastewater system.

It is noted that the City has recently passed amendments to its Land Use Plan allowing for higher land use densities in three designated areas: the RAC in central Miramar as well as the Miramar Innovation and Technology Activity Center (MITAC) and Transit Oriented Corridor (TOC) in eastern Miramar. Planned development in these areas will lead to significant increases in water demand and wastewater flows. Therefore, the model evaluation assumed that all planned development in these areas will be implemented along with MPV VI.

This memorandum summarizes the results of the model simulations and provides recommended improvements to accommodate future flows.

Projected Wastewater Flows

Estimates for additional wastewater flows resulting from proposed developments in the RAC, MITAC, and TOC total approximately 2.1 mgd as summarized in Table 1. These estimates were provided by the City as determined by the Utilities, Engineering & Strategic Development, and Building, Planning & Zoning Departments. With the exception of MPV VI, all future flows are assumed to discharge to existing lift stations.

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Job no. 45024-007

Table 1: Estimated Additional Wastewater Flows Due to Proposed Developments

Development	Anticipated Completion Date	Impacted Lift Station Basin(s)	Average Daily Wastewater Flow (gpd)
Regional Activity Center (RAC)			
Miramar Station Phase II (332 Apartment Units)	2024 (Under Construction)	LS 121	49,800
Miramar Town Center (897 Apartment Units; 473,917 sq ft Commercial Space; 295,062 sq ft Institutional Space)	2024 (Under Construction)	LS 100	261,810[1]
MPV VI – The Park at Miramar (Mixed Use Development)	2024-2028 (Under Design/Permitting)	Three New Lift Stations	597,575
WSVN Channel 7 (71,212 sq ft Office)	2024-2028 (Under Design/Permitting)	LS 085	14,250
Hotel (160 Rooms)	2024-2028 (Under Design/Permitting)	LS 085	15,360
Memorial Free Standing Emergency Department (16,000 sq ft Building)	2024-2028 (Under Design/Permitting)	LS 034	3,200
Vacant Land (26 acres) (Assuming 10,000 sq ft Commercial/Office/Industrial Use per Acre)	2025-2035	LS 016, LS 026, LS 034, LS 085	52,000
RAC Total			**993,995**
Miramar Innovation and Technology Activity Center (MITAC)			
Residential Development (450 Apartment/Townhome Units)	2025-2040	MPS, LS C	71,500
Commercial/Office Development (81,000 sq ft Commercial Space; 200,000 sq ft Office Space)	2025-2040	LS A, LS 003	56,200
City Municipal Use (58,000 sq ft Community Centers or Other)	2025-2040	MPS, LS 002	11,600
MITAC Total			**139,300**
Transit Oriented Corridor (TOC)			
Residential Development (125 Single Family Units and 1,776 Multifamily Scattered Throughout the TOC)	2025-2040	LS-B, LS-F, LS-G, LS-I, LS-J, LS-M, LS-10	270,780
Non-Residential Development (1.6M sq ft Commercial Space, 1.8M sq ft Office Space, and 236 Hotel Rooms Mostly Along SR-7, Miramar Pkwy, and Pembroke Rd)	2025-2040	LS-F, LS-I, LS-J, LS-M, LS-10	702,656
TOC Total			**973,436**
Proposed Development Total			**2,106,731**

A location map of the proposed developments in the RAC is presented in Figure 1.

[1] The City provided an estimate of 350,000 gpd for Miramar Town Center. Based on the City's water service area population projections and Broward County's 2017 Population Forecast and Allocation Model (PFAM), the estimated 2045 average flow would be 88,190 gpd. Therefore, the proposed development accounts for an additional 261,810 gpd.

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Figure 1: Proposed Developments in the RAC

Model Evaluation

Using the City's InfoWorks ICM hydraulic model, two scenarios were developed to evaluate the impact of the proposed developments on the wastewater system. The first scenario used baseline flows that were developed based on population projections provided by the City and previously presented in the Wastewater Master Plan (Draft; Hazen and Sawyer, March 2023). The second scenario included the addition of all flows associated with the proposed developments listed in Table 1. The MPV VI lift stations and force mains were added to the model based on the layout provided by the City (Figure 2).

Capacity requirements for the proposed lift stations were not evaluated. The model assumed a fixed discharge flowrate for each of these stations when the pumps were running (see Table 2).

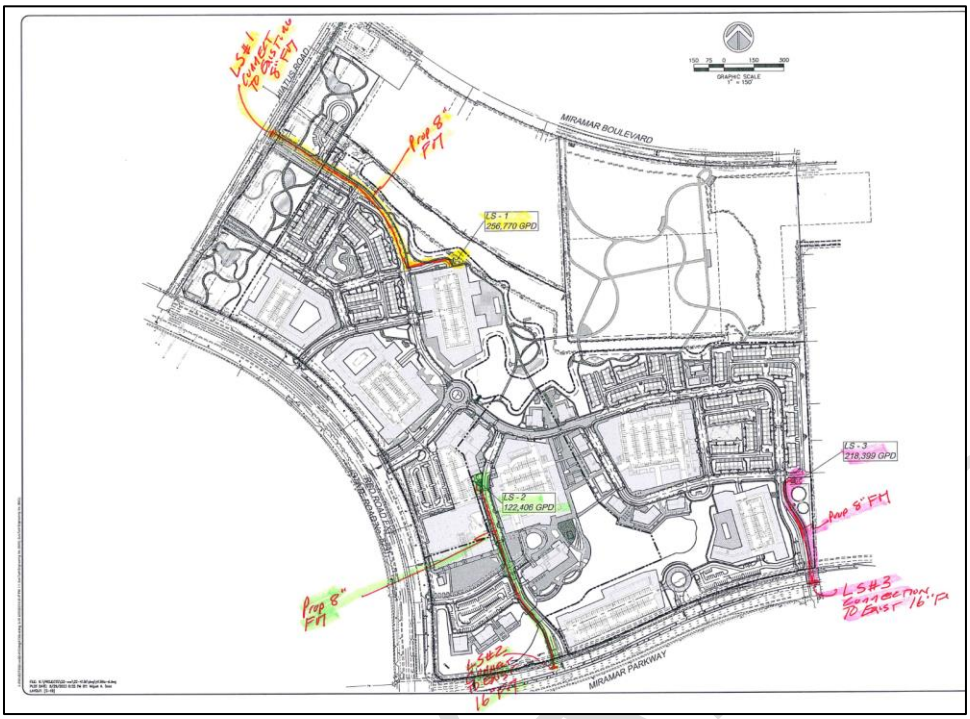


Figure 2: MPV VI – The Park at Miramar Lift Station and Force Main Layout

Table 2: MPV VI – The Park at Miramar Modeled Lift Station Discharge Flowrates

Lift Station	Modeled Discharge Flowrate (mgd)
LS-1	0.62
LS-2	0.30
LS-3	0.53

In both scenarios, the performance of the existing system was assessed based on simulated wet weather flow conditions corresponding to a two-year, 24-hour (4.5-inch) design storm. System performance was evaluated based on criteria established under the Wastewater Master Plan (Draft; Hazen and Sawyer, March 2023), which include the following:

- No wet well surcharges or overflows
- Maximum force main flow velocity of eight feet per second (fps)
- Minimum force main flow velocity of two fps

Results

Lift Station Wet Well Surcharges and Overflows

Under baseline flow conditions, 40 lift stations are predicted to surcharge or overflow. With all proposed developments connected to the existing system, the number increases to 55 lift stations. The impact from proposed development is primarily seen in the vicinity of the RAC. Figures 3 and 4 show the locations of lift stations exhibiting modeled surcharges and overflows in this area under wet weather flow conditions for the baseline and proposed development scenarios, respectively. All modeled surcharges and overflows are listed in Table 3.

Most of these lift stations will not receive any wastewater flow from the proposed developments. Increased surcharging and overflows in the second scenario are due to increased pressures in the force main network. Upgrading this number of lift stations would be impractical and would likely cause surcharging at additional lift stations. Instead, it is recommended that the City implement improvements to the force main network, which will reduce head loss and improve conditions for all the below lift stations.

Table 3: Modeled Wet Well Surcharges and Overflows – 2045 Wet Weather Conditions

Lift Station	Baseline Scenario	Proposed Developments Scenario
LS-002	No Deficiency	**Surcharge**
LS-009	No Deficiency	**Surcharge**
LS-011	**Overflow**	**Overflow**
LS-013	No Deficiency	**Surcharge**
LS-014	No Deficiency	**Surcharge**
LS-020	**Overflow**	**Overflow**
LS-021	**Surcharge**	**Overflow**
LS-023	No Deficiency	**Surcharge**
LS-024	**Overflow**	**Overflow**
LS-034	No Deficiency	**Surcharge**
LS-038	**Surcharge**	**Surcharge**
LS-044	**Surcharge**	**Surcharge**
LS-045	No Deficiency	**Surcharge**
LS-046	**Surcharge**	**Surcharge**
LS-047	**Overflow**	**Overflow**
LS-048	**Surcharge**	**Overflow**
LS-049	**Surcharge**	**Surcharge**
LS-051	**Surcharge**	**Surcharge**
LS-052	**Overflow**	**Overflow**
LS-053	**Surcharge**	**Surcharge**
LS-054	No Deficiency	**Surcharge**
LS-056	No Deficiency	**Surcharge**

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Lift Station	Baseline Scenario	Proposed Developments Scenario
LS-057	Overflow	Overflow
LS-058	Surcharge	Surcharge
LS-059	Surcharge	Surcharge
LS-060	Overflow	Overflow
LS-061	Overflow	Overflow
LS-064	Surcharge	Surcharge
LS-065	Surcharge	Surcharge
LS-071	Surcharge	Surcharge
LS-076	Surcharge	Surcharge
LS-078	Surcharge	Surcharge
LS-079	Surcharge	Surcharge
LS-080	Overflow	Overflow
LS-081	No Deficiency	Surcharge
LS-082	Surcharge	Surcharge
LS-083	Surcharge	Surcharge
LS-085	No Deficiency	Surcharge
LS-089	Surcharge	Overflow
LS-090	Surcharge	Surcharge
LS-091	Surcharge	Surcharge
LS-092	Surcharge	Surcharge
LS-093	Surcharge	Surcharge
LS-094	Surcharge	Surcharge
LS-096	No Deficiency	Surcharge
LS-097	Surcharge	Overflow
LS-098	Overflow	Overflow
LS-099	Surcharge	Surcharge
LS-101	Surcharge	Surcharge
LS-108	Surcharge	Overflow
LS-109	Surcharge	Overflow
LS-110	No Deficiency	Surcharge
LS-112	No Deficiency	Surcharge
LS-113	Surcharge	Surcharge
LS-118	No Deficiency	Surcharge

Note:
Lift stations not predicted to surcharge under either scenario are not shown.

Force Main Flow Velocity

Force main velocity was evaluated to identify potential capacity bottlenecks. However, when not accompanied by lift station surcharging, it was not necessarily considered a reason for improvement. In the baseline scenario, a 300-foot 8” force main segment upstream of the booster pump station is predicted

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to exhibit a flow velocity of approximately 10 fps, exceeding the recommended maximum of 8 fps (see Figure 3), although this occurs only while the booster pump station is in operation. Because of the short length of this force main, it was not identified for improvement.

Under the proposed developments scenario, the modeled velocity in the same force main is approximately 12 fps. In addition, the modeled velocity in the directly upstream 700-foot 8" force main segment on Hiatus Rd is approximately 8 fps (see Figure 4). While the pipeline velocity is at the pre-defined maximum, due to the relatively short length (700-ft) this segment was not identified for improvement. The 300-foot segment, which conveys significantly more flow at the same diameter, was identified as a capacity bottleneck impacting upstream lift stations. To resolve modeled surcharging under the proposed developments scenario, it is recommended that this segment be upgraded.

Recommended Improvements

Tables 4 and 5 list the improvements identified to resolve all modeled capacity deficiencies under the baseline and proposed scenarios, respectively. These projects are not prioritized and should all be completed to resolve modeled deficiencies. They have been identified for planning purposes only; further analysis during design is required. All the improvements in Table 4 were presented in the Wastewater Master Plan (Draft; Hazen and Sawyer, March 2023) and are recommended to be completed within the next five years. The additional improvements in Table 5 should also be completed prior to connection of the MPV VI development.

Recommended improvements are illustrated in Figure 5. The recommendations primarily consist of improvements to the force main network to increase capacity downstream of the RAC as well as rerouting of flows to pipes with available capacity. In addition, LS-056, located south of the WWRF on Monarch Lakes Blvd, requires a pump upgrade to accommodate higher discharge pressures. Based on the age of this lift station, it was previously recommended for rehabilitation within the next five years. Pump upgrades should be completed simultaneously with lift station rehabilitation to reduce overall costs to the City.

In total, improvements to resolve all modeled deficiencies are expected to cost approximately $5,580,000. Of this, the cost attributed to the proposed developments is $1,560,000. This is due to more extensive force main upgrades that would be necessary to accommodate increased flows as well as the pump upgrade at LS-056. It should be noted that these costs are exclusive of the new pump stations and force mains that will serve the MPV VI development.

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Table 4: Recommended Improvements Under the Baseline 2045 Scenario

Improvement	Opinion of Probable Cost
Construct approximately 5,400 feet of 20” force main parallel to the existing 16” force main along Miramar Parkway, connecting to the existing force main at Flamingo Road and SW 136th Avenue. Disconnect the existing 16” force main.	$3,760,000
Connect the existing 8” force main from LS-046 and the 12” force main from LS-077, LS-108, LS-109, and LS-110 to the 30” force main on Red Road and Renaissance Blvd. Disconnect the 12” force main on Red Rd between Hiatus Rd and Miramar Blvd to prevent recirculation through the booster pump station.	$90,000
Connect the 6” discharge from LS-047 directly to the 30” force main on Red Road. Disconnect the existing 6” force main along Red Road.	$70,000
Connect the 6” force mains from LS-024 and LS-027 to the 24” force main at Miramar Boulevard and Fairmont Avenue.	$100,000
Total Cost	**$4,020,000**

Table 5: Recommended Improvements Under the Proposed Developments Scenario

Improvement	Opinion of Probable Cost
Construct approximately 5,400 feet of **24”** force main parallel to the existing 16” force main along Miramar Parkway, connecting to the existing force main at Flamingo Road and SW 136th Avenue. Disconnect the existing 16” force main.	**$4,480,000**
Construct approximately 300 feet of 12” force main to replace the existing 8” force main on Miramar Blvd between Hiatus Rd and the connection to the 24” force main by the booster pump station.	**$180,000**
Connect the existing 8” force main from LS-046 and the 12” force main from LS-077, LS-108, LS-109, and LS-110 to the 30” force main on Red Road and Renaissance Blvd. Disconnect the 12” force main on Red Rd between Hiatus Rd and Miramar Blvd.	$90,000
Connect the 6” discharge from LS-047 directly to the 30” force main on Red Road. Disconnect the existing 6” force main along Red Road	$70,000
Connect the 6” force mains from LS-024 and LS-027 to the 24” force main at Miramar Boulevard and Fairmont Avenue.	$100,000
Upgrade LS-056 from 10 hp to 15 hp pumps.	**$660,000**
Total Cost	**$5,580,000**

Note: Differences from the improvements listed in Table 4 are shown in bold.

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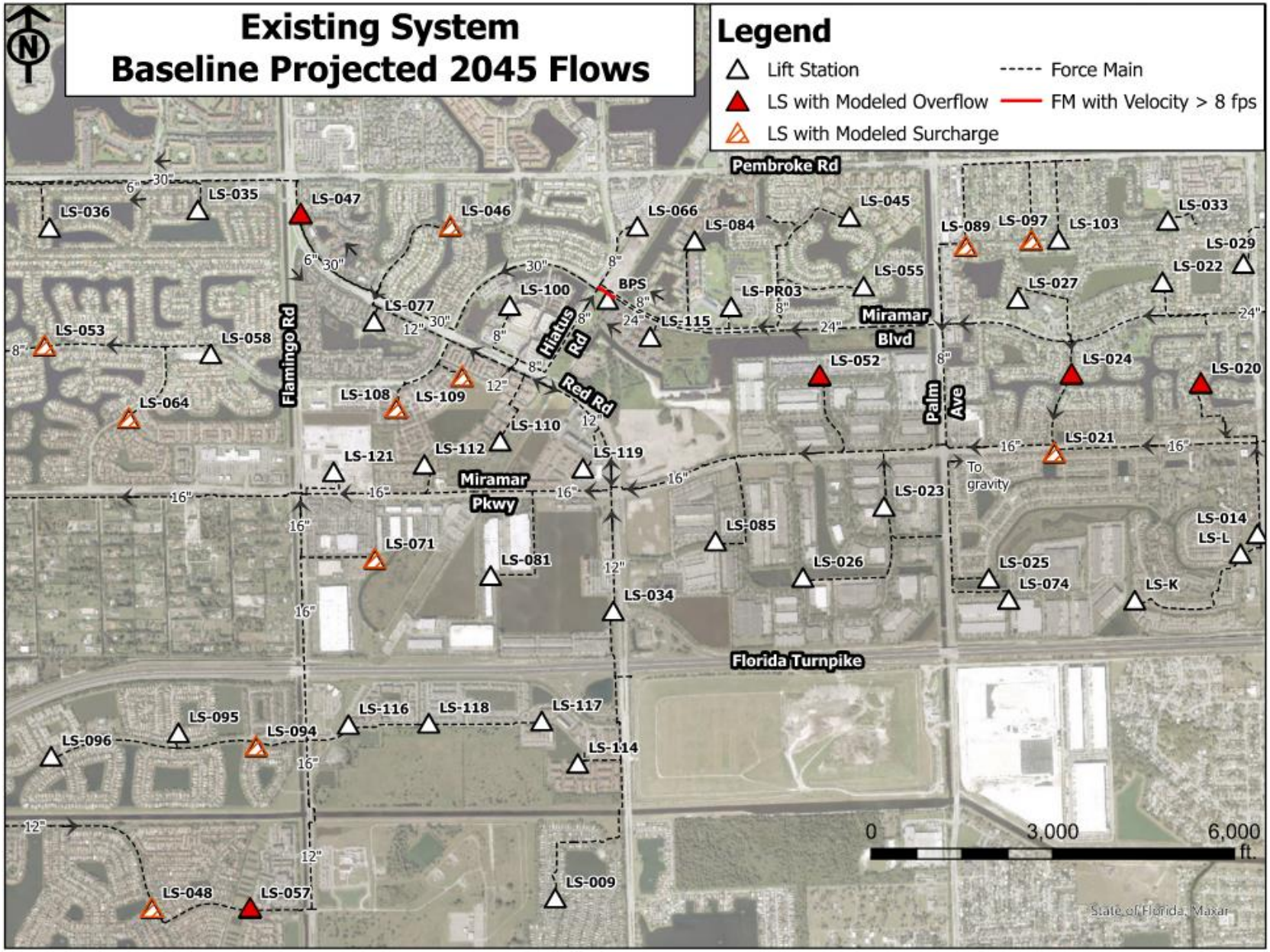


Figure 3: Baseline 2045 Wet Weather Flow Model Results for the Existing System

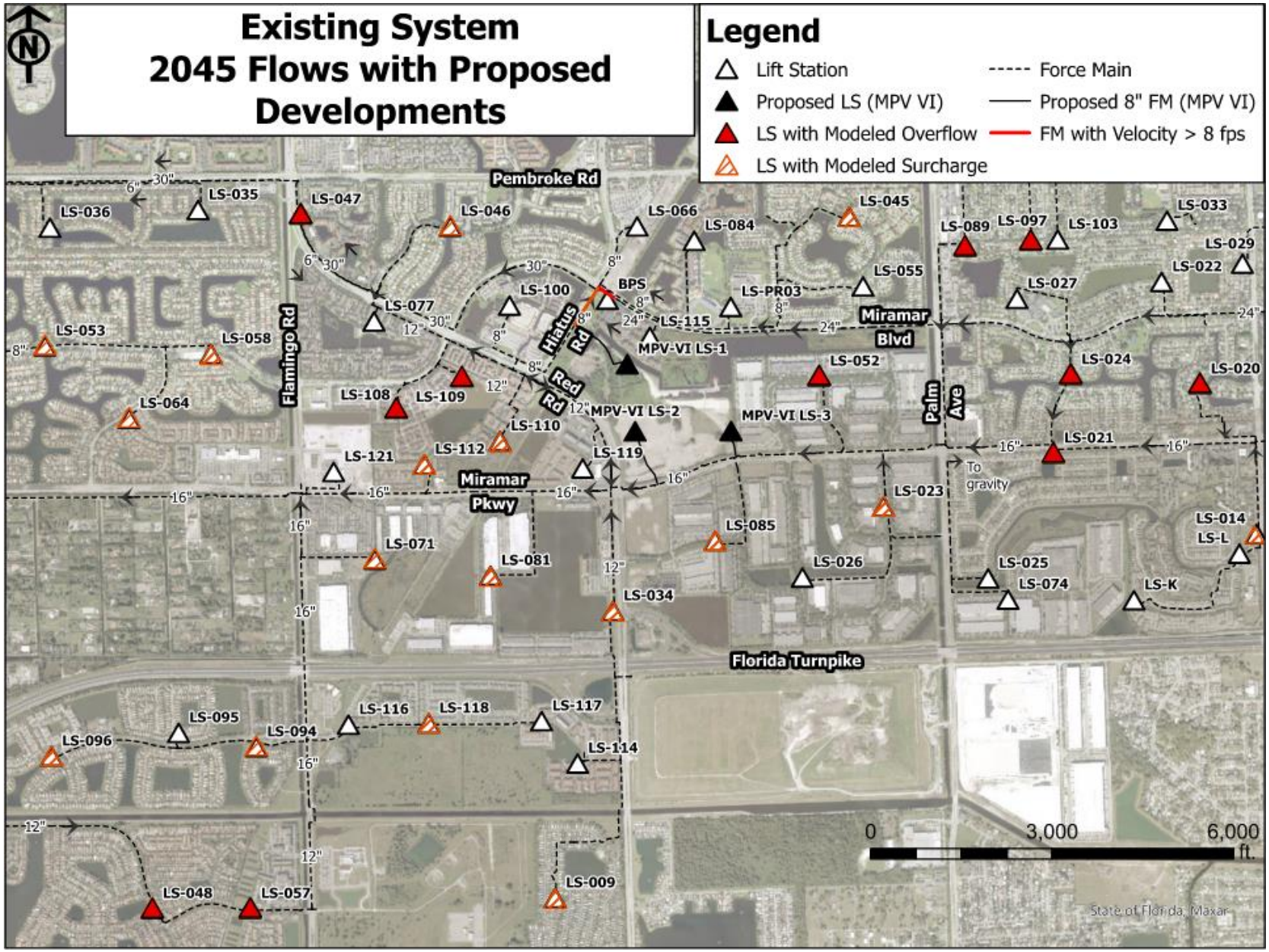


Figure 4: 2045 Wet Weather Flow Model Results for the Existing System with Proposed Developments

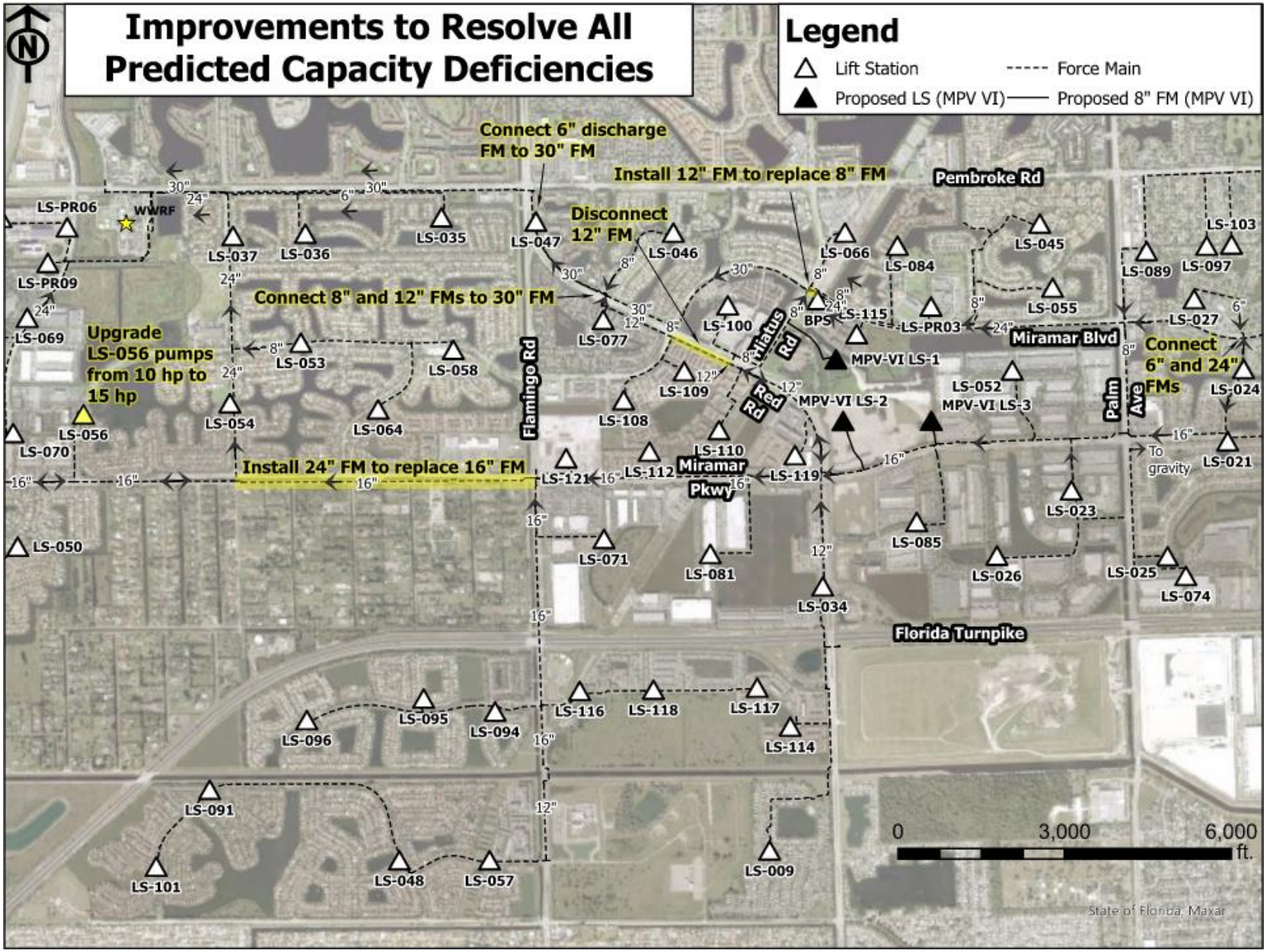


Figure 5: Recommended Improvements Under 2045 Wet Weather Flow Conditions with Proposed Developments







APPENDIX

D Condition Assessment Results for High-Risk Pipe Segments

Appendix D: Condition Assessment Results for High-Risk Pipe Segments

Table D-1: Condition Assessment Results for High-Risk Pipe Segments

FM Identifier	Pipe Length (ft)	Pipe Diameter (inches)	Material	Pipe Age (years)	POF Score	COF Score	Risk Score
10752	20	10	<Null>	Null	4.3	3.2	13.8
10755	30	18	<Null>	Null	4.1	3.8	15.6
10061	3	18	<Null>	Null	4.1	3.6	14.8
10064	5	16	<Null>	Null	3.9	3.2	12.5
10096	1,537	6	<Null>	Null	4.1	3	12.3
10218	165	18	<Null>	Null	4.1	3.8	15.6
10847	6	12	<Null>	Null	4.1	3.2	13.1
10848	4	12	<Null>	Null	4.1	3.2	13.1
10875	4	6	<Null>	Null	4.5	2.8	12.6
10436	6	12	<Null>	Null	3.9	3.2	12.5
10437	5	12	<Null>	Null	3.9	3.2	12.5
10438	13	12	<Null>	Null	3.9	3.2	12.5
10442	3	6	<Null>	Null	4.5	2.8	12.6
10443	1	6	<Null>	Null	4.5	2.8	12.6
10444	2,089	6	<Null>	Null	4.5	3	13.5
10565	5	10	<Null>	Null	3.9	3.2	12.5
10576	5	8	<Null>	Null	4.3	3	12.9
10860	55	12	<Null>	Null	3.9	3.4	13.3
10581	6	8	<Null>	Null	4.3	3	12.9
10582	29	8	<Null>	Null	4.3	3	12.9
10906	228	8	<Null>	Null	4.5	2.8	12.6
10634	4	18	<Null>	Null	4.1	3.8	15.6
10635	18	18	<Null>	Null	3.9	3.6	14
10636	28	18	<Null>	Null	3.9	3.6	14
10637	31	18	<Null>	Null	3.9	3.4	13.3
10638	6	24	<Null>	Null	3.9	3.2	12.5
10639	24	24	<Null>	Null	3.9	3.2	12.5
10640	6	24	<Null>	Null	3.9	3.2	12.5
10641	8	24	<Null>	Null	3.9	3.2	12.5
10642	10	24	<Null>	Null	3.9	3.2	12.5
10643	6	24	<Null>	Null	3.9	3.2	12.5
10644	86	12	<Null>	Null	3.9	3.2	12.5
10645	5	24	<Null>	Null	3.9	3.2	12.5
10646	6	24	<Null>	Null	3.9	3.2	12.5
10647	11	24	<Null>	Null	3.9	3.2	12.5
10648	5	24	<Null>	Null	3.9	3.2	12.5
10649	10	24	<Null>	Null	3.9	3.2	12.5

Table D-1: Condition Assessment Results for High-Risk Pipe Segments

FM Identifier	Pipe Length (ft)	Pipe Diameter (inches)	Material	Pipe Age (years)	POF Score	COF Score	Risk Score
10653	13	8	<Null>	Null	3.9	3.2	12.5
10658	4	16	<Null>	Null	3.9	3.2	12.5
10659	4	16	<Null>	Null	3.9	3.2	12.5
10660	3	16	<Null>	Null	3.9	3.2	12.5
10668	5	12	<Null>	Null	3.9	3.2	12.5
10669	20	12	<Null>	Null	3.9	3.2	12.5
10724	2	10	<Null>	Null	3.9	3.2	12.5
10725	2	10	<Null>	Null	3.9	3.2	12.5
10726	4	10	<Null>	Null	3.9	3.2	12.5
10727	2	10	<Null>	Null	3.9	3.2	12.5
10737	50	10	<Null>	Null	3.9	3.4	13.3
10775	764	6	<Null>	Null	4.3	3	12.9
10777	4	6	<Null>	Null	4.3	3	12.9
10778	4	8	<Null>	Null	4.1	3.2	13.1
10779	1	8	<Null>	Null	4.1	3.2	13.1
10780	5	8	<Null>	Null	4.1	3.2	13.1
10781	2.326907	8	<Null>	Null	4.1	3.2	13.1
10782	2.013332	8	<Null>	Null	4.1	3.2	13.1
10783	18.724862	8	<Null>	Null	4.1	3.2	13.1
10784	2.69094	8	<Null>	Null	4.1	3.2	13.1
10786	1.952096	8	<Null>	Null	4.1	3.2	13.1
10787	2.322119	8	<Null>	Null	4.1	3.2	13.1
10788	2.004917	8	<Null>	Null	4.1	3.2	13.1
10789	1429.2789	8	<Null>	Null	3.9	3.2	12.5
10796	1.870601	16	<Null>	Null	4.3	3.4	14.6
10938	5.553316	4	<Null>	Null	4.1	3	12.3
10958	2.654836	8	<Null>	Null	4.5	3	13.5
10960	19.060605	12	<Null>	Null	4.5	3	13.5
10864	20.518482	18	DI	57	4.5	3.4	15.3
10863	6.088863	24	CIP	Null	3.6	3.8	13.7
10623	26.771843	6	DI	Null	4.5	3	13.5
10611	1561.8259	18	DI	48	3.8	3.4	12.9
10747	868.77839	10	CIP	57	4	3.4	13.6
10514	156.78689	18	DI	Null	4.5	3.4	15.3
10731	712.81966	10	DI	Null	3.9	3.4	13.3
10865	58.756387	18	DI	Null	4.1	3.2	13.1
10730	1334.3252	8	DI	Null	3.9	3.6	14

Table D-1: Condition Assessment Results for High-Risk Pipe Segments

FM Identifier	Pipe Length (ft)	Pipe Diameter (inches)	Material	Pipe Age (years)	POF Score	COF Score	Risk Score
10620	1.379249	6	DI	Null	4.5	3	13.5
10566	7.006751	30	DI	Null	4.3	4.2	18.1
10858	7.277986	12	DI	57	3.9	3.2	12.5
<Null>	5.450145	12	DI	Null	4.3	3	12.9
10616	1988.2116	12	DI	Null	4.5	3.4	15.3
10619	5.085879	8	DI	Null	4.5	3	13.5
<Null>	8.251513	12	DI	Null	4.3	3	12.9
10950	107.30923	8	CIP	57	3.6	3.4	12.2
10855	5.007675	20	DI	57	4.1	3.6	14.8
10497	8.458784	10	DI	Null	4.5	3	13.5
10621	4.24831	6	DI	Null	4.5	3	13.5
10626	475.67641	6	DI	Null	4.5	3	13.5
10746	34.910549	10	CIP	57	4	3.2	12.8
10732	3215.6432	10	DI	Null	3.9	3.4	13.3
10742	1941.27	12	CIP	Null	3.6	3.6	13
10877	648.542	8	DI	Null	4.5	3.2	14.4
10834	8430.9098	24	CIP	Null	3.6	4.2	15.1
10961	727.51302	8	DI	Null	4.5	3	13.5
10630	540.45472	6	DI	Null	4.5	2.8	12.6
10874	432.41622	8	DI	Null	4.5	3.2	14.4
10498	20.774364	10	DI	Null	4.5	3	13.5
10880	4.388459	6	DI	Null	4.5	2.8	12.6
10879	2.612555	8	DI	Null	4.5	3.2	14.4
10937	1365.2032	4	DI	Null	4.3	3	12.9
10882	461.35976	6	DI	Null	4.5	2.8	12.6
10505	931.72146	16	DI	48	4	3.4	13.6
10629	6.651762	6	DI	Null	4.5	2.8	12.6
10495	7.429167	10	DI	Null	4.5	3	13.5
10196	32.385131	24	DI	Null	4.3	3.2	13.8
10496	9.149866	10	DI	Null	4.5	3	13.5
10044	1967.8837	10	CIP	57	3.6	3.6	13
10954	4.295708	24	DI	Null	4.3	3.6	15.5
10878	5.166012	8	DI	Null	4.5	3.2	14.4
10192	48.865992	30	DI	Null	4.3	3.4	14.6
10618	1.0106	6	DI	Null	4.5	2.8	12.6
10225	4.956449	24	DI	Null	4.3	3.2	13.8
10068	2324.8726	10	CIP	53	3.6	3.6	13

Table D-1: Condition Assessment Results for High-Risk Pipe Segments

FM Identifier	Pipe Length (ft)	Pipe Diameter (inches)	Material	Pipe Age (years)	POF Score	COF Score	Risk Score
10883	11.528122	18	DI	Null	4.1	3.2	13.1
10628	159.47063	6	DI	Null	4.5	2.8	12.6
10862	2.430335	24	CIP	Null	3.6	3.8	13.7
10530	4.101153	36	DI	Null	4.3	3.4	14.6
10589	51.378997	24	DI	Null	4.3	3.2	13.8
10861	4.198043	16	CIP	Null	3.6	3.8	13.7
10939	322.42633	6	DI	Null	4.3	3.2	13.8
10754	31.102934	18	CIP	57	3.6	3.8	13.7
10873	0.102691	6	DI	Null	4.5	2.8	12.6
10622	23.314482	6	DI	Null	4.5	3	13.5
10477	5.677787	10	DI	Null	4.5	3	13.5
10872	1.604083	6	DI	Null	4.5	2.8	12.6
10650	24.240714	20	DI	57	4.1	3.6	14.8
10881	483.58508	6	DI	Null	4.5	2.8	12.6
10664	24.963231	8	CIP	57	3.6	3.4	12.2
10588	1341.3066	24	DI	Null	4.3	3.4	14.6
10940	5.387244	6	DI	Null	4.3	3	12.9
10625	16.469221	6	DI	Null	4.5	3	13.5
10624	53.664771	6	DI	Null	4.5	3	13.5
10499	53.158871	16	DI	Null	4.5	2.8	12.6
10627	12.160095	6	DI	Null	4.5	2.8	12.6
10856	3.821872	20	DI	57	4.1	3.6	14.8
10021	6287.3064	18	DI	57	4.1	4	16.4
10866	66.79664	18	DI	Null	4.1	3.4	13.9
10876	3.958613	8	DI	Null	4.5	3.2	14.4
10857	10.929298	16	DI	57	3.9	3.8	14.8
10500	5.218979	16	DI	Null	4.5	2.8	12.6
<Null>	6.978706	20	DI	Null	4.3	3.4	14.6
<Null>	7.716931	24	DI	Null	4.3	3.4	14.6
10052	2822.4352	8	CIP	57	4	3.6	14.4
10859	13.54453	12	DI	Null	3.9	3.2	12.5
10047	422.40089	8	CIP	57	3.6	3.4	12.2
10736	736.99746	10	<Null>	Null	4.1	3.2	13.1







APPENDIX

E Condition Assessment Results for All Pipe Segments

Appendix E: Condition Assessment Results for All Pipe Segments

Table E-1: Condition Assessment Results for All Pipe Segments

FM Identifier	Pipe Length (ft)	Pipe Diameter (inches)	Material	Pipe Age (years)	POF Score	COF Score	Risk Score
10749	1,093	4	<Null>	Null	4.1	1.4	5.7
10750	448	4	<Null>	Null	4.1	1.4	5.7
10751	118	4	<Null>	Null	4.1	1.4	5.7
10752	20	10	<Null>	Null	4.3	3.2	13.8
10753	6	2	<Null>	Null	3.9	2.8	10.9
10755	30	18	<Null>	Null	4.1	3.8	15.6
10759	479	6	<Null>	Null	3.9	2.8	10.9
10767	50	2	<Null>	Null	4.1	2.2	9
10768	3	6	<Null>	Null	4.1	2.2	9
10769	95	6	<Null>	Null	4.1	2.4	9.8
10770	8	6	<Null>	Null	4.1	2.4	9.8
10061	3	18	<Null>	Null	4.1	3.6	14.8
10064	5	16	<Null>	Null	3.9	3.2	12.5
10888	3	6	<Null>	Null	4.3	2.4	10.3
10096	1,537	6	<Null>	Null	4.1	3	12.3
10809	3	8	<Null>	Null	4.1	2.8	11.5
10895	16	8	<Null>	Null	4.1	2.2	9
10896	26	4	<Null>	Null	4.1	2.4	9.8
10897	14	4	<Null>	Null	4.1	2.4	9.8
10898	476	6	<Null>	Null	4.3	2.4	10.3
10899	596	6	<Null>	Null	4.1	2.4	9.8
10218	165	18	<Null>	Null	4.1	3.8	15.6
10219	3	8	<Null>	Null	3.9	2.8	10.9
10220	2	10	<Null>	Null	3.9	2.8	10.9
10830	4	12	<Null>	Null	4.3	2.8	12
10831	5	12	<Null>	Null	4.3	2.8	12
10847	6	12	<Null>	Null	4.1	3.2	13.1
10848	4	12	<Null>	Null	4.1	3.2	13.1
10875	4	6	<Null>	Null	4.5	2.8	12.6
10402	5	6	<Null>	Null	4.1	2.4	9.8
10403	5	6	<Null>	Null	4.1	2.4	9.8
10436	6	12	<Null>	Null	3.9	3.2	12.5
10437	5	12	<Null>	Null	3.9	3.2	12.5
10438	13	12	<Null>	Null	3.9	3.2	12.5
10439	5	6	<Null>	Null	4.1	2	8.2
10442	3	6	<Null>	Null	4.5	2.8	12.6
10443	1	6	<Null>	Null	4.5	2.8	12.6

Table E-1: Condition Assessment Results for All Pipe Segments

FM Identifier	Pipe Length (ft)	Pipe Diameter (inches)	Material	Pipe Age (years)	POF Score	COF Score	Risk Score
10444	2,089	6	<Null>	Null	4.5	3	13.5
10465	18	6	<Null>	Null	4.3	1.8	7.7
10466	10	6	<Null>	Null	4.3	1.8	7.7
10467	63	6	<Null>	Null	4.3	1.8	7.7
10470	6	6	<Null>	Null	4.3	1.8	7.7
10564	28	4	<Null>	Null	3.9	2.8	10.9
10565	5	10	<Null>	Null	3.9	3.2	12.5
10569	5	8	<Null>	Null	4.3	2.2	9.5
10574	98	12	<Null>	Null	4.1	2.4	9.8
10576	5	8	<Null>	Null	4.3	3	12.9
10860	55	12	<Null>	Null	3.9	3.4	13.3
10581	6	8	<Null>	Null	4.3	3	12.9
10582	29	8	<Null>	Null	4.3	3	12.9
10586	3	6	<Null>	19	2.3	1.8	4.1
10614	50	6	<Null>	Null	4.1	2.4	9.8
10615	3	6	<Null>	Null	4.1	2.4	9.8
10884	3	8	<Null>	Null	4.1	2.2	9
10885	2,330	8	<Null>	Null	4.1	2.2	9
10886	2,331	8	<Null>	Null	3.9	2.8	10.9
10887	3	8	<Null>	Null	4.1	2.8	11.5
10893	128	6	<Null>	Null	4.3	2.4	10.3
10906	228	8	<Null>	Null	4.5	2.8	12.6
10907	1	8	<Null>	Null	4.5	2.2	9.9
10911	9	8	<Null>	Null	4.5	2.2	9.9
10634	4	18	<Null>	Null	4.1	3.8	15.6
10635	18	18	<Null>	Null	3.9	3.6	14
10636	28	18	<Null>	Null	3.9	3.6	14
10637	31	18	<Null>	Null	3.9	3.4	13.3
10638	6	24	<Null>	Null	3.9	3.2	12.5
10639	24	24	<Null>	Null	3.9	3.2	12.5
10640	6	24	<Null>	Null	3.9	3.2	12.5
10641	8	24	<Null>	Null	3.9	3.2	12.5
10642	10	24	<Null>	Null	3.9	3.2	12.5
10643	6	24	<Null>	Null	3.9	3.2	12.5
10644	86	12	<Null>	Null	3.9	3.2	12.5
10645	5	24	<Null>	Null	3.9	3.2	12.5
10646	6	24	<Null>	Null	3.9	3.2	12.5

Table E-1: Condition Assessment Results for All Pipe Segments

FM Identifier	Pipe Length (ft)	Pipe Diameter (inches)	Material	Pipe Age (years)	POF Score	COF Score	Risk Score
10647	11	24	<Null>	Null	3.9	3.2	12.5
10648	5	24	<Null>	Null	3.9	3.2	12.5
10649	10	24	<Null>	Null	3.9	3.2	12.5
10653	13	8	<Null>	Null	3.9	3.2	12.5
10654	4	8	<Null>	Null	3.9	2.8	10.9
10655	2	8	<Null>	Null	3.9	2.8	10.9
10656	4	8	<Null>	Null	3.9	2.8	10.9
10657	3	8	<Null>	Null	3.9	3	11.7
10658	4	16	<Null>	Null	3.9	3.2	12.5
10659	4	16	<Null>	Null	3.9	3.2	12.5
10660	3	16	<Null>	Null	3.9	3.2	12.5
10661	9	10	<Null>	Null	3.9	2.8	10.9
10662	5	10	<Null>	Null	3.9	2.8	10.9
10665	287	10	<Null>	Null	3.9	2.8	10.9
10667	28	8	<Null>	Null	3.9	2.8	10.9
10668	5	12	<Null>	Null	3.9	3.2	12.5
10669	20	12	<Null>	Null	3.9	3.2	12.5
10671	6	6	<Null>	Null	4.3	1.8	7.7
10676	12	8	<Null>	Null	4.3	2.2	9.5
10701	0	24	<Null>	Null	4.3	2.6	11.2
10724	2	10	<Null>	Null	3.9	3.2	12.5
10725	2	10	<Null>	Null	3.9	3.2	12.5
10726	4	10	<Null>	Null	3.9	3.2	12.5
10727	2	10	<Null>	Null	3.9	3.2	12.5
10737	50	10	<Null>	Null	3.9	3.4	13.3
10745	122	8	<Null>	Null	4.1	2.4	9.8
10775	764	6	<Null>	Null	4.3	3	12.9
10776	3	6	<Null>	Null	4.3	2.8	12
10777	4	6	<Null>	Null	4.3	3	12.9
10778	4	8	<Null>	Null	4.1	3.2	13.1
10779	1	8	<Null>	Null	4.1	3.2	13.1
10780	5	8	<Null>	Null	4.1	3.2	13.1
10781	2	8	<Null>	Null	4.1	3.2	13.1
10782	2	8	<Null>	Null	4.1	3.2	13.1
10783	19	8	<Null>	Null	4.1	3.2	13.1
10784	3	8	<Null>	Null	4.1	3.2	13.1
10785	3	4	<Null>	Null	4.1	2.8	11.5

Table E-1: Condition Assessment Results for All Pipe Segments

FM Identifier	Pipe Length (ft)	Pipe Diameter (inches)	Material	Pipe Age (years)	POF Score	COF Score	Risk Score
10786	2	8	<Null>	Null	4.1	3.2	13.1
10787	2	8	<Null>	Null	4.1	3.2	13.1
10788	2	8	<Null>	Null	4.1	3.2	13.1
10789	1,429	8	<Null>	Null	3.9	3.2	12.5
10790	5	6	<Null>	Null	4.5	2.4	10.8
10793	2	6	<Null>	Null	4.1	1.8	7.4
10796	2	16	<Null>	Null	4.3	3.4	14.6
10798	3	4	<Null>	Null	4.3	1.8	7.7
10800	3	12	<Null>	Null	4.3	2	8.6
10801	109	12	<Null>	Null	4.3	2.2	9.5
10802	4	12	<Null>	Null	4.3	2.2	9.5
10806	15	8	<Null>	Null	4.3	2.2	9.5
10826	2	4	<Null>	Null	4.1	2.6	10.7
10827	2	4	<Null>	Null	4.1	2.6	10.7
10828	84	4	<Null>	Null	4.1	2.6	10.7
10914	5	8	<Null>	Null	4.3	2.2	9.5
10917	83	6	<Null>	Null	4.3	1.8	7.7
10938	6	4	<Null>	Null	4.1	3	12.3
10957	3	6	<Null>	Null	4.5	2	9
10958	3	8	<Null>	Null	4.5	3	13.5
10960	19	12	<Null>	Null	4.5	3	13.5
<Null>	5	8	<Null>	Null	4.5	2	9
<Null>	130	12	<Null>	Null	4.1	2.8	11.5
<Null>	5	12	<Null>	Null	4.1	2.8	11.5
10413	5	8	PVC	33	2	2.4	4.8
10846	3	16	PVC	33	2	3.6	7.2
10494	5	6	PVC	21	1.7	1.8	3.1
10152	382	6	PVC	20	1.5	2.4	3.6
10864	21	18	DI	57	4.5	3.4	15.3
10395	7	8	PVC	21	1.5	2.2	3.3
10795	3	16	DI	24	2.2	3.4	7.5
<Null>	144	20	DI	Null	4.3	2.8	12
10863	6	24	CIP	Null	3.6	3.8	13.7
10527	1,232	8	PVC	39	2	2.2	4.4
10408	4	8	PVC	Null	3	2	6
10348	3	8	PVC	23	1.5	2.2	3.3
10757	27	10	CIP	57	3.6	2.8	10.1

Table E-1: Condition Assessment Results for All Pipe Segments

FM Identifier	Pipe Length (ft)	Pipe Diameter (inches)	Material	Pipe Age (years)	POF Score	COF Score	Risk Score
10623	27	6	DI	Null	4.5	3	13.5
10210	77	16	PVC	33	2	3.4	6.8
10171	1,277	6	PVC	28	1.5	2.2	3.3
10139	3	8	PVC	Null	3.2	3	9.6
10262	4	6	PVC	Null	3.2	2.4	7.7
10148	5	12	PVC	Null	3	3	9
10928	741	6	CIP	52	3.6	2.4	8.6
10453	33	4	DI	Null	4.5	1.8	8.1
10666	4	8	CIP	Null	3.6	2.8	10.1
10333	8	24	PVC	Null	3	3.4	10.2
10502	872	10	PVC	39	2	2.2	4.4
10371	75	24	PVC	33	2	3.4	6.8
10933	313	2	PVC	Null	3	2.8	8.4
10611	1,562	18	DI	48	3.8	3.4	12.9
10692	53	6	PVC	Null	3.2	1.8	5.8
10178	1,228	6	PVC	23	1.5	3	4.5
10418	5	8	PVC	Null	3.2	2	6.4
<Null>	18	12	DI	Null	4.3	2.4	10.3
10167	228	6	PVC	21	1.7	2.4	4.1
10272	538	4	PVC	19	1	2	2
10539	215	12	PVC	26	1.5	2.8	4.2
10290	1,607	8	PVC	25	1.5	2.2	3.3
10747	869	10	CIP	57	4	3.4	13.6
10850	7	6	PVC	25	1.5	2.8	4.2
10331	1,244	24	PVC	33	2	3.4	6.8
10404	6	12	PVC	25	1.5	2.2	3.3
10269	14	4	PVC	Null	3.2	2	6.4
<Null>	7	12	DI	Null	4.3	2.4	10.3
10514	157	18	DI	Null	4.5	3.4	15.3
10383	110	12	PVC	26	1.5	2.2	3.3
10375	884	8	PVC	26	1.5	2.2	3.3
10357	1,235	12	PVC	26	1.5	3	4.5
10943	4	6	DI	Null	4.3	2.4	10.3
10504	2,317	6	DI	35	3.5	2	7
10335	11	24	PVC	Null	3	3.4	10.2
10731	713	10	DI	Null	3.9	3.4	13.3
10087	150	16	PVC	33	2.2	3.2	7

Table E-1: Condition Assessment Results for All Pipe Segments

FM Identifier	Pipe Length (ft)	Pipe Diameter (inches)	Material	Pipe Age (years)	POF Score	COF Score	Risk Score
10074	60	4	PVC	Null	3	2.2	6.6
10690	146	6	PVC	Null	3.2	1.8	5.8
10865	59	18	DI	Null	4.1	3.2	13.1
10805	203	24	DI	18	1.7	2.6	4.4
10482	1,341	8	PVC	26	1.5	2.8	4.2
10758	3	10	CIP	57	3.6	2.8	10.1
10599	18	8	PVC	23	1.5	3.2	4.8
10561	2,570	14	CIP	48	3.7	3	11.1
10417	243	8	PVC	33	2.2	2.2	4.8
10078	13	8	PVC	33	2.2	2.8	6.2
10144	7	8	PVC	Null	3	3	9
10487	8	8	PVC	21	1.5	2.2	3.3
10165	707	30	DI	18	1.7	3.6	6.1
10213	1,601	16	PVC	35	2.2	3.2	7
10946	313	4	PVC	Null	3	3	9
<Null>	4	12	PVC	23	1.5	2.2	3.3
10238	4	12	PVC	Null	3	3.4	10.2
10024	10	12	PVC	Null	3	2.2	6.6
10923	5	8	PVC	Null	3	3.4	10.2
10004	107	6	PVC	28	1.5	2.2	3.3
10730	1,334	8	DI	Null	3.9	3.6	14
<Null>	7	12	DI	Null	4.3	2.4	10.3
10330	43	24	PVC	33	2	3.4	6.8
10728	221	4	CIP	53	3.6	2.4	8.6
10620	1	6	DI	Null	4.5	3	13.5
10296	230	12	PVC	26	1.5	2.6	3.9
10027	1,074	6	PVC	25	1.5	2.4	3.6
10535	1,248	30	DI	18	1.7	3.4	5.8
10566	7	30	DI	Null	4.3	4.2	18.1
10814	515	24	DI	18	1.7	3.2	5.4
10063	8	8	DI	10	1.3	3.2	4.2
<Null>	1,224	8	PVC	26	1.7	2.2	3.7
10813	975	24	DI	18	1.7	3	5.1
10858	7	12	DI	57	3.9	3.2	12.5
10326	147	20	PVC	33	2	2.8	5.6
10248	17	16	PVC	33	2	2.6	5.2
10699	108	8	DI	Null	4.5	2.2	9.9

Table E-1: Condition Assessment Results for All Pipe Segments

FM Identifier	Pipe Length (ft)	Pipe Diameter (inches)	Material	Pipe Age (years)	POF Score	COF Score	Risk Score
10870	102	12	PVC	Null	3	2.8	8.4
10908	37	8	DI	Null	4.5	2.2	9.9
10079	11	8	PVC	33	2	2.8	5.6
10517	794	8	DI	32	3.3	2.4	7.9
10098	1,398	8	PVC	25	1.5	2.8	4.2
10579	121	8	PVC	19	1	2.2	2.2
10150	1,117	8	PVC	25	1.5	3	4.5
10570	21	8	DI	Null	4.3	2.2	9.5
10472	961	6	PVC	26	1.7	1.8	3.1
10250	7	16	PVC	Null	3.2	3.2	10.2
10163	417	8	PVC	25	1.5	3.2	4.8
<Null>	5	12	DI	Null	4.3	3	12.9
10289	1,817	8	PVC	19	1.2	2.8	3.4
10020	662	4	CIP	63	3.6	3	10.8
10674	89	8	CIP	Null	4.2	2.2	9.2
10616	1,988	12	DI	Null	4.5	3.4	15.3
<Null>	4	12	PVC	23	1.5	2.2	3.3
10542	1,956	6	PVC	25	1.5	2.8	4.2
10223	1,219	8	PVC	35	2.2	2.2	4.8
10485	2,686	8	PVC	21	1.5	3	4.5
10688	12	6	PVC	Null	3.2	1.8	5.8
10032	318	12	PVC	25	1.7	3.2	5.4
10132	87	8	PVC	25	1.5	3	4.5
10142	126	24	DI	18	1.7	3.2	5.4
10720	173	10	DI	Null	4.3	2.2	9.5
10040	626	8	DI	Null	4.3	2.4	10.3
10839	4	6	PVC	21	1.7	2.2	3.7
10461	82	6	PVC	Null	3.2	1.8	5.8
10679	71	6	PVC	Null	3.2	1.8	5.8
10147	173	12	PVC	25	1.5	3.4	5.1
10591	22	8	PVC	19	1.2	3	3.6
10760	8	12	DI	Null	4.3	2.4	10.3
10412	4	8	PVC	33	2	2.4	4.8
10187	14	16	PVC	33	2	2.6	5.2
<Null>	10	8	DI	33	3.3	2.6	8.6
10424	147	8	PVC	23	1.7	2.2	3.7
10374	89	12	PVC	33	2	3	6

Table E-1: Condition Assessment Results for All Pipe Segments

FM Identifier	Pipe Length (ft)	Pipe Diameter (inches)	Material	Pipe Age (years)	POF Score	COF Score	Risk Score
10390	37	8	PVC	21	1.5	2.2	3.3
10384	37	8	PVC	21	1.7	2.2	3.7
<Null>	5	6	DI	Null	4.5	2	9
10388	3,054	8	PVC	21	1.5	2.2	3.3
10207	128	16	DI	24	2.2	3.4	7.5
10680	511	6	PVC	Null	3.2	1.8	5.8
10314	25	24	PVC	23	1.5	3.8	5.7
10619	5	8	DI	Null	4.5	3	13.5
10691	46	6	PVC	Null	3.2	1.8	5.8
10183	794	8	CIP	33	2.8	2.2	6.2
10807	490	24	DI	18	1.7	3.4	5.8
10140	21	8	PVC	Null	3.2	3	9.6
10843	2	14	DI	48	3.4	2.4	8.2
<Null>	8	12	DI	Null	4.3	3	12.9
10425	4	8	PVC	Null	3.2	2.2	7
10373	562	12	PVC	26	1.5	3	4.5
10346	2	8	PVC	23	1.5	2.2	3.3
10266	431	6	PVC	19	1.2	2	2.4
10208	155	12	DI	33	3.3	3	9.9
10247	3	16	PVC	Null	3	2.8	8.4
10211	75	16	PVC	33	2	2.6	5.2
10411	2,902	12	PVC	33	2	2.4	4.8
10360	28	12	PVC	33	2	3.2	6.4
10808	13	8	PVC	19	1.2	3	3.6
10181	25	4	PVC	33	2.2	1.8	4
10322	57	6	PVC	23	1.5	1.8	2.7
10950	107	8	CIP	57	3.6	3.4	12.2
10281	10	12	DI	Null	4.5	2.6	11.7
10440	965	16	PVC	33	2.2	4	8.8
10922	51	8	DI	10	1.3	2.8	3.6
10122	1,106	10	PVC	39	2	2.2	4.4
10414	1,396	8	PVC	33	2	2.4	4.8
10327	295	12	PVC	Null	3	3	9
10715	49	4	DI	Null	4.5	1.8	8.1
10106	139	6	PVC	33	2	2.4	4.8
10337	49	24	DI	33	3.3	3.6	11.9
10524	482	6	DI	39	3.3	2	6.6

Table E-1: Condition Assessment Results for All Pipe Segments

FM Identifier	Pipe Length (ft)	Pipe Diameter (inches)	Material	Pipe Age (years)	POF Score	COF Score	Risk Score
10202	1,277	6	DI	35	3.3	2.4	7.9
10607	4,320	6	PVC	19	1.2	1.8	2.2
10031	1,720	24	DI	18	1.7	2.6	4.4
10136	515	6	DI	48	4	2.4	9.6
10652	8	8	CIP	57	3.6	2.8	10.1
10803	683	24	DI	18	1.7	2.6	4.4
10257	3	16	PVC	Null	3	2.8	8.4
10355	1,224	8	PVC	23	1.5	3.2	4.8
10855	5	20	DI	57	4.1	3.6	14.8
10026	583	4	PVC	25	1.5	2.4	3.6
10093	224	8	PVC	18	1	2.2	2.2
10066	2,285	12	PVC	25	1.5	2.2	3.3
10756	10	10	CIP	57	3.6	2.8	10.1
10546	1,409	4	PVC	23	1.7	1.8	3.1
10464	75	6	PVC	Null	3.2	1.8	5.8
10929	386	6	CIP	52	3.6	2.6	9.4
10129	14	8	PVC	Null	3.2	3	9.6
10259	5	16	PVC	Null	3	2.6	7.8
10492	3,162	6	PVC	21	1.7	1.8	3.1
10497	8	10	DI	Null	4.5	3	13.5
10709	98	4	PVC	Null	3.2	1.8	5.8
10252	245	16	PVC	33	2.2	3.8	8.4
10015	965	24	DI	28	2.2	3	6.6
10554	10	12	PVC	25	1.5	2.2	3.3
10587	2,115	8	PVC	19	1	2.2	2.2
10945	336	6	DI	Null	4.3	2.4	10.3
10133	8	24	PVC	Null	3	3.4	10.2
10621	4	6	DI	Null	4.5	3	13.5
10364	789	24	PVC	33	2	3.4	6.8
10001	144	8	PVC	24	1.5	2.6	3.9
10738	156	10	CIP	57	3.6	2.8	10.1
10186	855	16	DI	24	2.2	3.4	7.5
10571	105	8	PVC	Null	3	2.2	6.6
10563	37	12	CIP	57	3.6	2	7.2
10354	13	8	PVC	Null	3	2.8	8.4
10810	100	24	DI	18	1.7	3.2	5.4
10833	1,355	6	PVC	Null	3.2	2.4	7.7

Table E-1: Condition Assessment Results for All Pipe Segments

FM Identifier	Pipe Length (ft)	Pipe Diameter (inches)	Material	Pipe Age (years)	POF Score	COF Score	Risk Score
10201	1,330	12	PVC	24	1.5	2.4	3.6
10228	372	16	PVC	33	2.2	3.2	7
10153	1,605	8	PVC	25	1.5	2.8	4.2
10433	263	8	PVC	26	1.7	2.2	3.7
10386	8	6	PVC	21	1.5	1.8	2.7
10273	27	8	PVC	Null	3	3	9
10306	9	4	PVC	23	1.5	1.6	2.4
10351	9	6	PVC	Null	3	2.2	6.6
10700	27	8	DI	Null	4.5	2.2	9.9
10105	3,083	6	PVC	28	1.5	2.4	3.6
10593	671	8	PVC	25	1.5	2.8	4.2
10367	26	24	PVC	Null	3	3.2	9.6
10584	42	6	PVC	19	1	1.8	1.8
10141	94	30	DI	18	1.7	3.6	6.1
10707	34	4	DI	Null	4.5	1.8	8.1
10101	1,517	8	PVC	39	2	2.2	4.4
10509	23	18	DI	Null	3.9	2.8	10.9
10451	41	4	PVC	Null	3.2	1.8	5.8
10765	3	8	PVC	19	1	3	3
10033	631	16	PVC	33	2.2	3.2	7
10507	4	18	CIP	48	3.1	2.8	8.7
10280	750	12	DI	33	3.5	2.6	9.1
10560	537	8	DI	33	3.3	2.8	9.2
<Null>	2	12	DI	33	3.5	2	7
10545	3,291	6	PVC	23	1.7	1.8	3.1
10832	42	6	PVC	24	1.7	2.4	4.1
10229	125	16	PVC	33	2.2	3.2	7
10298	968	6	PVC	26	1.5	2.4	3.6
10617	840	12	PVC	25	1.7	3.2	5.4
10092	5	24	DI	Null	4.3	2.6	11.2
10631	2	6	DI	Null	4.3	2.6	11.2
10711	50	4	PVC	Null	3.2	1.8	5.8
10256	5	16	PVC	Null	3	2.8	8.4
10185	1,651	8	CIP	33	3.2	2.8	9
10409	2,875	8	PVC	33	2.2	2.2	4.8
10286	758	8	PVC	19	1.2	3	3.6
10894	110	6	DI	Null	4.5	2.4	10.8

Table E-1: Condition Assessment Results for All Pipe Segments

FM Identifier	Pipe Length (ft)	Pipe Diameter (inches)	Material	Pipe Age (years)	POF Score	COF Score	Risk Score
10772	114	4	DI	Null	4.3	2	8.6
10197	119	24	DI	18	1.7	3.2	5.4
10097	470	6	AC	44	3.4	2.4	8.2
10428	4	6	DI	26	2.2	1.8	4
10342	3	24	PVC	33	2	4.2	8.4
10382	963	12	PVC	26	1.5	3	4.5
10626	476	6	DI	Null	4.5	3	13.5
10501	5	6	DI	Null	4.5	2	9
10274	351	8	PVC	19	1.2	2.8	3.4
10334	7	24	PVC	Null	3	3.4	10.2
10953	39	2	PVC	Null	3	2.4	7.2
10158	190	30	DI	18	1.7	3.8	6.5
10056	1,485	6	CIP	57	3.6	2.8	10.1
10548	4,244	6	PVC	21	1.7	1.8	3.1
10179	76	16	PVC	24	1.5	3.4	5.1
10468	18	6	DI	Null	4.5	1.8	8.1
10081	146	8	PVC	33	2.2	2.8	6.2
10518	7	8	DI	Null	4.3	2.2	9.5
10091	709	24	DI	28	2.2	3.2	7
10090	49	24	DI	28	2.2	3	6.6
10544	1,708	12	PVC	23	1.5	2.2	3.3
10003	8	6	PVC	Null	3	2.4	7.2
10180	614	16	PVC	24	1.5	3.2	4.8
10385	3,249	6	PVC	21	1.5	1.8	2.7
10005	66	8	PVC	24	1.5	2.6	3.9
10818	4	8	PVC	25	1.7	2.8	4.8
10475	147	8	PVC	26	1.5	2.4	3.6
10452	184	4	DI	Null	4.5	1.8	8.1
10612	975	18	DI	48	3.4	2.8	9.5
10242	5	16	PVC	33	2	3.4	6.8
10556	1,257	6	DI	21	2.2	2.4	5.3
10041	221	12	PVC	24	1.5	2.4	3.6
10300	224	6	DI	26	2.2	2.4	5.3
10746	35	10	CIP	57	4	3.2	12.8
<Null>	1,669	20	PVC	33	2	2.8	5.6
10955	5	6	DI	Null	4.5	2	9
10732	3,216	10	DI	Null	3.9	3.4	13.3

Table E-1: Condition Assessment Results for All Pipe Segments

FM Identifier	Pipe Length (ft)	Pipe Diameter (inches)	Material	Pipe Age (years)	POF Score	COF Score	Risk Score
10454	13	4	DI	Null	4.5	1.8	8.1
10544	6	12	PVC	23	1.5	2.8	4.2
10182	430	8	CIP	33	2.8	2.2	6.2
10297	8	6	PVC	26	1.5	2	3
10742	1,941	12	CIP	Null	3.6	3.6	13
10083	1,568	8	DI	30	2.7	2.8	7.6
10130	165	8	PVC	Null	3.2	3	9.6
10457	4	4	DI	Null	4.5	1.8	8.1
10299	407	8	DI	26	2.2	2.8	6.2
10523	718	6	DI	31	3.3	2	6.6
10277	36	4	PVC	Null	3.2	1.8	5.8
10362	191	12	PVC	26	1.5	3.4	5.1
10483	4	8	PVC	26	1.5	2.2	3.3
10835	1,542	4	CIP	Null	4	2.8	11.2
10877	649	8	DI	Null	4.5	3.2	14.4
10729	927	4	CIP	53	3.6	2.8	10.1
10305	61	24	PVC	Null	3	3.6	10.8
10407	44	8	PVC	33	2	2.4	4.8
10696	72	6	PVC	Null	3.2	1.8	5.8
10221	1,264	4	PVC	19	1.2	2	2.4
10304	1,203	16	PVC	33	2	3.2	6.4
10697	85	6	PVC	Null	3.2	1.8	5.8
10392	2,054	8	PVC	21	1.5	2.2	3.3
10311	188	8	PVC	23	1.5	2.8	4.2
10892	3	6	DI	Null	4.3	2.4	10.3
10446	25	4	PVC	Null	3.2	1.8	5.8
10474	2,170	20	DI	33	3.3	2.8	9.2
10609	22	8	DI	Null	4.3	2.2	9.5
10017	50	12	PVC	Null	3	2.2	6.6
10323	297	6	PVC	23	1.5	1.8	2.7
10111	5	24	DI	Null	4.3	2.6	11.2
10926	378	8	PVC	Null	3	3.4	10.2
10420	833	8	PVC	23	1.7	2.2	3.7
10681	20	6	DI	Null	4.5	1.8	8.1
10151	1,504	6	PVC	20	1.7	2.4	4.1
10378	583	24	PVC	33	2	4.2	8.4
10176	3	8	PVC	Null	3	2.4	7.2

Table E-1: Condition Assessment Results for All Pipe Segments

FM Identifier	Pipe Length (ft)	Pipe Diameter (inches)	Material	Pipe Age (years)	POF Score	COF Score	Risk Score
10597	6	4	PVC	28	1.5	2.2	3.3
10672	34	6	PVC	Null	3.2	1.8	5.8
10512	12	24	DI	33	3.3	2.6	8.6
10109	12	6	PVC	Null	3	2.2	6.6
10834	8,431	24	CIP	Null	3.6	4.2	15.1
10080	29	8	PVC	33	2.2	2.8	6.2
10126	718	24	DI	18	1.7	3.2	5.4
10774	11	16	PVC	33	2	3.8	7.6
10522	6	6	DI	Null	4.3	1.8	7.7
10246	116	16	PVC	33	2	3.4	6.8
10961	728	8	DI	Null	4.5	3	13.5
10630	540	6	DI	Null	4.5	2.8	12.6
10874	432	8	DI	Null	4.5	3.2	14.4
10191	1,159	30	DI	18	1.7	3.6	6.1
10189	1,334	16	DI	48	4	2.8	11.2
10489	5	6	PVC	21	1.7	1.8	3.1
10503	5	6	DI	Null	4.5	2	9
10463	88	6	PVC	Null	3.2	1.8	5.8
10912	5	8	DI	Null	4.5	2.2	9.9
10506	1,082	16	DI	48	4	2.8	11.2
10193	511	30	DI	18	1.7	3.4	5.8
10498	21	10	DI	Null	4.5	3	13.5
10030	3	24	DI	Null	4.3	2.6	11.2
10036	211	12	PVC	25	1.7	3	5.1
10529	1,311	24	DI	28	2.2	3	6.6
10520	639	8	DI	32	3.3	2.2	7.3
10057	3,087	6	CIP	53	4	2.6	10.4
10038	1,750	8	PVC	19	1.2	2.2	2.6
10880	4	6	DI	Null	4.5	2.8	12.6
10226	5	16	PVC	33	2	3.6	7.2
10203	20	6	DI	Null	4.3	1.8	7.7
10287	86	16	PVC	33	2.2	3.4	7.5
10764	8	12	PVC	24	1.5	2.4	3.6
10552	3	8	PVC	25	1.5	2.2	3.3
10104	218	30	DI	18	1.7	3.6	6.1
10200	30	12	PVC	24	1.5	2.4	3.6
10486	1,321	8	PVC	21	1.5	2.2	3.3

Table E-1: Condition Assessment Results for All Pipe Segments

FM Identifier	Pipe Length (ft)	Pipe Diameter (inches)	Material	Pipe Age (years)	POF Score	COF Score	Risk Score
10215	7	16	PVC	Null	3.2	3.2	10.2
10879	3	8	DI	Null	4.5	3.2	14.4
10352	936	16	PVC	33	2	3.2	6.4
10244	1	16	PVC	33	2	3.4	6.8
10956	104	6	DI	Null	4.5	2	9
10195	343	8	PVC	25	1.7	2.8	4.8
10677	356	8	DI	Null	4.5	2.2	9.9
10112	610	24	DI	18	1.7	2.8	4.8
10748	44	10	CIP	57	4	2.8	11.2
10282	3	6	DI	Null	4.5	2.2	9.9
10797	5	24	DI	Null	4.3	2.6	11.2
10572	4	8	DI	Null	4.3	2.2	9.5
10937	1,365	4	DI	Null	4.3	3	12.9
10702	1,050	4	PVC	Null	3.2	1.8	5.8
10278	1,746	12	PVC	25	1.7	3.2	5.4
10705	14	4	PVC	Null	3.2	1.8	5.8
10199	1,458	16	PVC	24	1.5	3.6	5.4
10430	4	6	PVC	Null	3	1.8	5.4
10359	4	12	PVC	Null	3	3.2	9.6
10029	18	12	PVC	Null	3	2.2	6.6
10237	790	16	PVC	33	2.2	4	8.8
10544	42	12	PVC	23	1.5	2.8	4.2
10822	6	30	DI	18	1.7	4.2	7.1
10432	8	8	PVC	26	1.5	2.2	3.3
10891	3	6	DI	Null	4.3	2.4	10.3
10585	2	8	PVC	19	1	2.2	2.2
10460	2,073	6	PVC	Null	3.2	1.8	5.8
10941	16	6	PVC	Null	3	2	6
10113	45	12	PVC	48	2.5	2.2	5.5
10006	3	8	PVC	24	1.5	2.6	3.9
10869	1,919	12	PVC	Null	3	2.6	7.8
10013	3	8	PVC	24	1.5	2.6	3.9
10840	634	12	PVC	25	1.7	2.6	4.4
10683	24	6	PVC	Null	3.2	1.8	5.8
10067	78	4	PVC	53	3	2.4	7.2
10761	468	12	HDPE	24	1.5	2.4	3.6
10217	1,227	6	PVC	19	1.2	2.4	2.9

Table E-1: Condition Assessment Results for All Pipe Segments

FM Identifier	Pipe Length (ft)	Pipe Diameter (inches)	Material	Pipe Age (years)	POF Score	COF Score	Risk Score
10188	1,410	24	DI	28	2.2	3.2	7
10450	70	4	PVC	Null	3.2	1.8	5.8
10558	145	8	PVC	19	1.2	3	3.6
10882	461	6	DI	Null	4.5	2.8	12.6
10154	1,365	6	PVC	35	2	1.8	3.6
10243	3	16	PVC	33	2	3.4	6.8
10025	818	12	PVC	24	1.5	2.2	3.3
10042	3	18	DI	48	3.4	2.8	9.5
10007	1,226	8	PVC	24	1.5	2.6	3.9
10927	2	8	PVC	Null	3	3.2	9.6
10744	717	20	PVC	33	2	3.4	6.8
10829	5	16	PVC	Null	3.2	3.2	10.2
10904	1,183	8	DI	Null	3.9	2.2	8.6
10123	430	14	PVC	39	2	2.2	4.4
10890	596	6	DI	Null	4.5	2.4	10.8
10854	22	6	PVC	Null	3	2.4	7.2
10114	612	12	CIP	48	3.5	2.4	8.4
10255	4	16	PVC	Null	3	2.8	8.4
10505	932	16	DI	48	4	3.4	13.6
10629	7	6	DI	Null	4.5	2.8	12.6
10341	8	8	DI	26	2.2	2.8	6.2
10235	3	12	PVC	Null	3.2	2.8	9
10543	2,289	16	PVC	33	2	2.8	5.6
10934	24	4	DI	Null	4.3	2.4	10.3
10053	547	10	CIP	57	3.6	3.2	11.5
10825	21	12	PVC	33	2	3	6
10023	1,460	12	PVC	24	1.5	2.2	3.3
10478	6	8	PVC	Null	3	2.4	7.2
10011	3	8	PVC	24	1.5	2.6	3.9
10495	7	10	DI	Null	4.5	3	13.5
10336	102	24	PVC	21	1.5	3.4	5.1
10559	709	8	PVC	33	2.2	3	6.6
<Null>	4	8	DI	33	3.3	2.6	8.6
10844	4	12	CIP	48	3.5	2.2	7.7
10175	13	8	PVC	Null	3	3	9
10055	6	6	CIP	57	3.6	2.2	7.9
10196	32	24	DI	Null	4.3	3.2	13.8

Table E-1: Condition Assessment Results for All Pipe Segments

FM Identifier	Pipe Length (ft)	Pipe Diameter (inches)	Material	Pipe Age (years)	POF Score	COF Score	Risk Score
10160	1,256	30	DI	18	1.7	3.6	6.1
10538	932	12	CIP	57	4	2.2	8.8
10916	6	6	DI	Null	4.1	1.8	7.4
10496	9	10	DI	Null	4.5	3	13.5
10174	4	24	PVC	Null	3	3.4	10.2
10766	1,027	16	PVC	24	1.5	3.4	5.1
10044	1,968	10	CIP	57	3.6	3.6	13
10456	3	4	DI	Null	4.5	1.8	8.1
10479	6	8	PVC	Null	3	2.4	7.2
10686	21	6	PVC	Null	3.2	1.8	5.8
10421	1,803	8	PVC	23	1.7	2.4	4.1
10427	10	8	PVC	Null	3	2.2	6.6
10125	110	10	PVC	39	2	2.2	4.4
10740	33	10	CIP	57	3.6	3.2	11.5
10012	2,007	8	PVC	24	1.5	2.6	3.9
<Null>	1,015	12	PVC	23	1.5	2.8	4.2
10954	4	24	DI	Null	4.3	3.6	15.5
10343	117	6	PVC	26	1.5	2.4	3.6
10275	608	8	PVC	19	1.2	3	3.6
10350	4	6	PVC	Null	3	2.2	6.6
10878	5	8	DI	Null	4.5	3.2	14.4
10264	1,171	6	PVC	19	1.2	2.6	3.1
10380	4	12	PVC	26	1.5	2.8	4.2
<Null>	75	12	PVC	23	1.5	2.8	4.2
10192	49	30	DI	Null	4.3	3.4	14.6
10469	6	6	DI	Null	4.5	1.8	8.1
10338	492	24	PVC	33	2	3.4	6.8
10377	417	24	PVC	33	2	4	8
10358	314	16	PVC	33	2	3.6	7.2
10010	3	8	PVC	24	1.5	2.6	3.9
10562	26	6	PVC	Null	3	2.2	6.6
10717	2,544	20	DI	33	3.3	2.8	9.2
10551	604	8	PVC	25	1.5	2.2	3.3
10910	4	8	DI	Null	4.5	2.2	9.9
10490	2,579	6	PVC	21	1.7	1.8	3.1
10233	306	16	PVC	33	2.2	3.2	7
10328	156	20	PVC	33	2	3.4	6.8

Table E-1: Condition Assessment Results for All Pipe Segments

FM Identifier	Pipe Length (ft)	Pipe Diameter (inches)	Material	Pipe Age (years)	POF Score	COF Score	Risk Score
10329	112	20	PVC	33	2	3.4	6.8
10704	36	4	PVC	Null	3.2	1.8	5.8
10301	40	6	PVC	26	1.5	2.2	3.3
10406	32	12	PVC	25	1.5	2.2	3.3
10076	29	8	PVC	Null	3	2.2	6.6
10059	1,449	4	CIP	53	3.6	2.8	10.1
10812	21	24	DI	18	1.7	3	5.1
10270	1,256	4	PVC	19	1.2	2	2.4
<Null>	2	20	PVC	33	2	3.4	6.8
10462	87	6	PVC	Null	3.2	1.8	5.8
10673	61	8	DI	Null	4.5	2.2	9.9
<Null>	3	12	PVC	Null	3	3	9
10368	2,559	24	PVC	33	2	3.6	7.2
10094	28	6	PVC	28	1.5	2.2	3.3
10516	3	8	PVC	Null	3	2.2	6.6
10445	22	4	PVC	Null	3.2	1.8	5.8
10583	886	8	PVC	19	1	2.2	2.2
10571	4	8	PVC	Null	3	2.2	6.6
10618	1	6	DI	Null	4.5	2.8	12.6
10455	3	4	DI	Null	4.5	1.8	8.1
10100	89	10	DI	48	4	3	12
10930	4	4	PVC	Null	3	3	9
10225	5	24	DI	Null	4.3	3.2	13.8
10820	5	30	DI	18	1.7	4.2	7.1
10919	772	8	DI	10	1.7	2.6	4.4
10710	66	4	PVC	Null	3.2	1.8	5.8
10313	1,295	24	PVC	23	1.5	3.8	5.7
10670	1,200	10	CIP	57	3.6	2.4	8.6
10534	275	30	DI	18	1.3	4.2	5.5
10068	2,325	10	CIP	53	3.6	3.6	13
10883	12	18	DI	Null	4.1	3.2	13.1
10773	6	4	DI	Null	4.3	2	8.6
10819	26	6	PVC	25	1.7	2.4	4.1
10959	22	16	PVC	24	1.5	3.4	5.1
10227	278	16	PVC	33	2.2	3.2	7
10332	11	24	PVC	Null	3	3.4	10.2
10149	9	12	PVC	Null	3	3.2	9.6

Table E-1: Condition Assessment Results for All Pipe Segments

FM Identifier	Pipe Length (ft)	Pipe Diameter (inches)	Material	Pipe Age (years)	POF Score	COF Score	Risk Score
10230	5	12	PVC	Null	3.2	2.8	9
10143	6	8	PVC	Null	3	3	9
10964	6	4	PVC	19	1.2	1.8	2.2
<Null>	3	12	DI	33	3.3	2.6	8.6
10853	105	6	PVC	25	1.5	2.8	4.2
10868	9	12	PVC	Null	3	2.8	8.4
10222	0	12	PVC	Null	3.2	2.6	8.3
10115	34	24	DI	Null	4.3	2.6	11.2
10429	685	6	PVC	19	1	2.4	2.4
10070	1,527	10	DI	48	4	3	12
10804	743	24	DI	18	1.7	2.8	4.8
10166	2,104	30	DI	18	1.7	4	6.8
10713	9	4	DI	Null	4.5	1.6	7.2
10231	16	12	PVC	Null	3.2	2.8	9
10476	3	8	PVC	21	1.7	2.2	3.7
10416	5	8	PVC	Null	3	2	6
10204	1,970	16	PVC	33	2	4	8
10060	1,624	4	PVC	53	3	2.4	7.2
10918	2,515	6	DI	Null	4.1	1.8	7.4
10156	1,857	30	DI	18	1.7	3.4	5.8
10276	105	4	PVC	Null	3.2	1.8	5.8
10232	600	16	PVC	33	2.2	3.2	7
10370	1,349	24	PVC	33	2	3.6	7.2
10663	3	8	CIP	57	3.6	2.8	10.1
10261	3	16	PVC	Null	3	2.6	7.8
10224	2,321	8	PVC	35	2	2.8	5.6
10107	760	4	PVC	25	1.5	2.8	4.2
10039	2,543	12	PVC	Null	3	2.2	6.6
10721	1,134	10	DI	Null	4.3	2.8	12
10628	159	6	DI	Null	4.5	2.8	12.6
10491	25	4	PVC	21	1.7	1.8	3.1
10162	540	16	PVC	33	2.2	3.2	7
10598	16	8	PVC	23	1.5	3.2	4.8
10347	3	8	PVC	23	1.5	2.2	3.3
10209	91	16	PVC	33	2	3.4	6.8
10398	12	8	PVC	21	1.5	2.2	3.3
10190	40	36	DI	28	2.2	3.4	7.5

Table E-1: Condition Assessment Results for All Pipe Segments

FM Identifier	Pipe Length (ft)	Pipe Diameter (inches)	Material	Pipe Age (years)	POF Score	COF Score	Risk Score
<Null>	18	12	DI	Null	4.3	2.4	10.3
10216	5	6	PVC	Null	3.2	2.4	7.7
10120	235	24	DI	18	1.7	2.6	4.4
10871	932	6	CIP	57	4.2	2	8.4
10077	41	8	PVC	33	2.2	2.8	6.2
10308	1,493	8	DI	26	2.2	2.8	6.2
10481	24	6	DI	26	2.2	1.8	4
10862	2	24	CIP	Null	3.6	3.8	13.7
10284	760	8	PVC	21	1.7	2.4	4.1
10134	28	16	PVC	Null	3.2	3.2	10.2
10381	43	12	PVC	26	1.5	2.8	4.2
10532	130	36	DI	28	2.2	3.4	7.5
10110	6	18	DI	Null	3.9	2.8	10.9
10085	514	6	PVC	25	1.5	2.4	3.6
10811	472	24	DI	18	1.7	3.2	5.4
10099	105	6	PVC	25	1.5	2.4	3.6
10295	88	12	PVC	26	1.5	2.6	3.9
10214	331	16	DI	33	3.5	3.2	11.2
10393	16	8	PVC	Null	3	2.2	6.6
10168	795	24	DI	18	1.7	3.2	5.4
10508	2	18	CIP	48	3.1	2.8	8.7
10271	3	4	PVC	Null	3	2	6
10194	93	4	PVC	Null	3	1.8	5.4
10703	78	4	PVC	Null	3.2	1.8	5.8
10050	188	10	CIP	57	3.6	3.2	11.5
10525	580	10	PVC	39	2	2.2	4.4
10045	887	12	CIP	57	3.6	2.2	7.9
10356	575	4	PVC	28	1.5	2.2	3.3
10841	982	6	DI	35	3.3	2.2	7.3
10553	84	12	PVC	25	1.5	2.2	3.3
10236	509	16	PVC	33	2.2	3.6	7.9
10318	5	8	PVC	Null	3	3.2	9.6
10423	23	8	PVC	Null	3.2	2.2	7
10530	4	36	DI	Null	4.3	3.4	14.6
10239	3	12	PVC	Null	3	3.4	10.2
10249	5,045	16	PVC	33	2	2.8	5.6
10135	51	16	PVC	33	2.2	3.2	7

Table E-1: Condition Assessment Results for All Pipe Segments

FM Identifier	Pipe Length (ft)	Pipe Diameter (inches)	Material	Pipe Age (years)	POF Score	COF Score	Risk Score
10867	1,726	12	PVC	Null	3	2.8	8.4
10471	7	8	PVC	26	1.5	2.2	3.3
10263	5	6	PVC	Null	3.2	2	6.4
10325	1,152	6	PVC	23	1.5	2.6	3.9
10651	4	16	CIP	57	3.6	3.2	11.5
10116	835	24	DI	18	1.3	2.6	3.4
10459	8	6	DI	Null	4.5	1.8	8.1
10838	3	16	PVC	25	1.5	3.4	5.1
10915	3	6	DI	Null	4.1	1.8	7.4
10589	51	24	DI	Null	4.3	3.2	13.8
10952	5	4	CIP	57	3.6	3	10.8
10426	1,131	6	DI	30	2.9	2.8	8.1
10309	1,602	8	DI	26	2.2	2.8	6.2
10861	4	16	CIP	Null	3.6	3.8	13.7
10601	11	24	PVC	23	1.5	3.6	5.4
10842	2	18	DI	Null	3.9	2.8	10.9
10241	5	16	PVC	33	2	3.4	6.8
10008	2	8	PVC	28	1.5	2.6	3.9
<Null>	5	12	DI	33	3.3	2.6	8.6
10799	4	14	PVC	39	2	2	4
10177	4	24	PVC	Null	3	3.4	10.2
10071	1,373	6	DI	35	3.5	1.8	6.3
10054	1,765	10	CIP	57	4	3	12
10939	322	6	DI	Null	4.3	3.2	13.8
<Null>	51	12	DI	33	3.5	2	7
10324	7	6	PVC	Null	3	2	6
10484	2,472	8	PVC	26	1.7	2.2	3.7
10541	821	30	DI	18	1.7	4.2	7.1
10016	3	6	PVC	28	1.5	2.2	3.3
10018	317	12	PVC	24	1.5	2.2	3.3
10316	451	24	PVC	23	1.5	3.6	5.4
10379	6	12	PVC	26	1.5	2.8	4.2
10754	31	18	CIP	57	3.6	3.8	13.7
10944	6	6	DI	Null	4.3	2.4	10.3
10049	268	6	CIP	57	3.6	2.6	9.4
10405	222	12	PVC	25	1.5	2.2	3.3
10816	6	12	PVC	25	1.7	2.8	4.8

Table E-1: Condition Assessment Results for All Pipe Segments

FM Identifier	Pipe Length (ft)	Pipe Diameter (inches)	Material	Pipe Age (years)	POF Score	COF Score	Risk Score
10613	3	12	PVC	26	1.5	2.8	4.2
10131	1,053	24	DI	18	1.7	3.2	5.4
10303	13	12	PVC	26	1.5	2.6	3.9
10743	0	6	DI	Null	4.3	2.6	11.2
10310	897	8	PVC	23	1.5	2.2	3.3
10480	4	8	DI	26	2.2	2.2	4.8
10921	992	8	DI	10	1.3	2.8	3.6
10719	1,647	10	DI	Null	4.3	2.2	9.5
10791	7	4	PVC	19	1.2	1.6	1.9
10488	9	8	PVC	21	1.5	2.2	3.3
10739	455	2	DI	Null	3.9	2.8	10.9
10119	9	24	DI	Null	4.3	2.6	11.2
10723	14	8	DI	Null	4.5	2.2	9.9
10682	190	6	PVC	Null	3.2	1.8	5.8
10913	359	8	DI	Null	4.1	2.8	11.5
10962	1,175	8	DI	Null	4.5	2.4	10.8
10815	4	8	PVC	18	1	2.8	2.8
10762	47	12	PVC	24	1.5	2.4	3.6
10526	9	10	PVC	39	2	2.2	4.4
10086	688	16	PVC	33	2.2	3.2	7
10948	511	8	PVC	25	1.5	2.8	4.2
10531	1,113	36	DI	28	2.2	3.8	8.4
10234	4	12	PVC	Null	3.2	2.8	9
10557	17	8	PVC	33	2	2.8	5.6
10596	144	4	PVC	28	1.5	2.2	3.3
10431	24	6	PVC	26	1.5	1.8	2.7
10555	253	12	DI	33	3.3	2.6	8.6
10590	658	8	PVC	19	1.2	3	3.6
10873	0	6	DI	Null	4.5	2.8	12.6
10608	413	8	PVC	Null	3	2.2	6.6
10062	54	8	DI	10	1.3	3.2	4.2
10817	6	6	PVC	25	1.7	2.4	4.1
10157	129	30	DI	18	1.7	3.6	6.1
10949	3	10	DI	48	4	3	12
10580	57	4	CIP	57	4	2.6	10.4
10084	559	8	PVC	25	1.5	2.8	4.2
10592	2	8	PVC	25	1.5	2.8	4.2

Table E-1: Condition Assessment Results for All Pipe Segments

FM Identifier	Pipe Length (ft)	Pipe Diameter (inches)	Material	Pipe Age (years)	POF Score	COF Score	Risk Score
10320	9	4	PVC	23	1.5	1.6	2.4
10513	13	16	PVC	33	2	2.6	5.2
10684	16	6	PVC	Null	3.2	1.8	5.8
10251	25	6	PVC	Null	3.2	2.4	7.7
10339	7	6	PVC	Null	3	1.8	5.4
10344	5	8	PVC	23	1.5	2	3
10947	6	24	PVC	Null	3	3.2	9.6
10722	721	10	DI	Null	4.5	2.2	9.9
10014	1,498	8	PVC	24	1.5	2.6	3.9
10622	23	6	DI	Null	4.5	3	13.5
10028	61	24	DI	28	2.2	3	6.6
10376	134	24	PVC	33	2	4.2	8.4
10302	9	6	PVC	26	1.5	2.2	3.3
10397	132	8	PVC	21	1.5	2.2	3.3
10073	2,054	24	DI	28	2.2	3.8	8.4
10048	1,456	8	CIP	57	3.6	3.2	11.5
10515	3	8	PVC	Null	3	2.2	6.6
10595	750	4	PVC	23	1.5	2.6	3.9
10741	14	10	CIP	57	4	2.2	8.8
10678	55	6	PVC	Null	3.2	1.8	5.8
10400	8	8	PVC	21	1.5	2.2	3.3
10695	72	6	PVC	Null	3.2	1.8	5.8
10389	1,382	8	PVC	21	1.5	2.2	3.3
10477	6	10	DI	Null	4.5	3	13.5
10293	170	6	PVC	26	1.5	2.2	3.3
10550	550	8	PVC	19	1	3	3
10283	13	24	PVC	33	2	3.4	6.8
10909	4	8	DI	Null	4.5	2.2	9.9
10161	3	6	PVC	19	1	1.8	1.8
10267	9	4	PVC	Null	3.2	2	6.4
10082	1,320	8	PVC	33	2	2.8	5.6
10963	2	8	DI	Null	4.5	2.4	10.8
10128	116	8	PVC	19	1.2	3	3.6
10240	3	16	PVC	33	2	3.4	6.8
10434	7	6	PVC	26	1.5	1.8	2.7
<Null>	2,370	6	CIP	57	3.6	3	10.8
10127	2,902	24	DI	18	1.7	2.6	4.4

Table E-1: Condition Assessment Results for All Pipe Segments

FM Identifier	Pipe Length (ft)	Pipe Diameter (inches)	Material	Pipe Age (years)	POF Score	COF Score	Risk Score
10872	2	6	DI	Null	4.5	2.8	12.6
10435	932	8	PVC	26	1.5	2.4	3.6
10340	1,382	6	PVC	21	1.5	1.8	2.7
10365	328	6	PVC	19	1	1.8	1.8
10650	24	20	DI	57	4.1	3.6	14.8
10931	1	8	PVC	Null	3	3.2	9.6
10159	273	8	PVC	18	1	2.8	2.8
10573	44	20	DI	Null	4.3	2.8	12
10169	755	24	DI	18	1.7	3	5.1
10035	818	12	PVC	25	1.7	3.2	5.4
10881	484	6	DI	Null	4.5	2.8	12.6
10009	775	8	PVC	24	1.5	2.6	3.9
10606	70	6	PVC	19	1.2	1.8	2.2
10415	4	8	PVC	Null	3	2.4	7.2
10849	676	24	DI	33	3.3	3.6	11.9
10399	877	8	PVC	21	1.5	2.2	3.3
10088	353	16	PVC	33	2.2	3.2	7
10345	3,001	8	PVC	23	1.5	2.8	4.2
10837	3	12	PVC	25	1.5	3	4.5
10002	1,418	6	PVC	24	1.5	2.4	3.6
10675	48	8	DI	Null	4.5	2.2	9.9
10954	28	6	DI	Null	4.5	2	9
10920	2,601	8	DI	10	1.7	2.6	4.4
10547	2,327	4	PVC	19	1.2	1.8	2.2
10510	5	16	PVC	Null	3	2.6	7.8
10664	25	8	CIP	57	3.6	3.4	12.2
10718	871	10	DI	Null	4.3	2.4	10.3
10102	156	6	DI	29	2.2	1.8	4
10689	19	6	PVC	Null	3.2	1.8	5.8
10694	1,244	6	PVC	Null	3.2	1.8	5.8
10108	9	4	PVC	Null	3	2.2	6.6
10321	1,792	6	PVC	23	1.5	1.8	2.7
10317	110	8	PVC	23	1.5	3.2	4.8
10588	1,341	24	DI	Null	4.3	3.4	14.6
10936	3	4	DI	Null	4.3	2.4	10.3
<Null>	3	12	DI	33	3.5	2	7
10794	951	16	PVC	24	1.5	3.4	5.1

Table E-1: Condition Assessment Results for All Pipe Segments

FM Identifier	Pipe Length (ft)	Pipe Diameter (inches)	Material	Pipe Age (years)	POF Score	COF Score	Risk Score
10265	5	4	PVC	Null	3.2	2	6.4
10387	6	8	PVC	21	1.5	2.2	3.3
10568	16	12	PVC	24	1.7	2.2	3.7
10951	2	4	CIP	Null	3.6	3	10.8
<Null>	4	12	PVC	Null	3	3	9
10292	603	16	PVC	33	2	3.2	6.4
10708	99	4	PVC	Null	3.2	1.8	5.8
10540	665	12	PVC	25	1.7	3.2	5.4
10940	5	6	DI	Null	4.3	3	12.9
10253	4	16	PVC	33	2	3.4	6.8
10307	1,322	6	PVC	23	1.5	1.8	2.7
10942	390	4	PVC	Null	3	2.2	6.6
10605	11	6	PVC	26	1.5	1.8	2.7
10714	20	4	PVC	Null	3.2	1.8	5.8
10447	32	4	PVC	Null	3.2	1.8	5.8
10625	16	6	DI	Null	4.5	3	13.5
10792	25	8	PVC	19	1.2	2.2	2.6
10034	71	8	PVC	23	1.5	3.4	5.1
10043	3,928	14	PVC	39	2	3	6
10349	118	6	PVC	23	1.5	1.8	2.7
10624	54	6	DI	Null	4.5	3	13.5
10095	505	16	PVC	33	2.2	3.2	7
10716	37	20	PVC	33	2	2.8	5.6
10499	53	16	DI	Null	4.5	2.8	12.6
10118	4	24	DI	Null	4.3	2.6	11.2
10164	1,709	8	PVC	25	1.5	3.4	5.1
10519	603	8	DI	32	3.3	2.2	7.3
10212	4	24	DI	Null	4.3	2.6	11.2
10578	1,281	8	PVC	19	1	2.4	2.4
10924	7	8	PVC	Null	3	3.4	10.2
10627	12	6	DI	Null	4.5	2.8	12.6
10103	52	36	DI	28	2.2	3.4	7.5
10369	121	8	PVC	Null	3	2.2	6.6
10821	6	30	DI	18	1.7	4.2	7.1
10069	1,712	6	CIP	30	2.6	3.4	8.8
10823	696	30	DI	18	1.7	3.4	5.8
10889	614	8	PVC	33	2.2	2.8	6.2

Table E-1: Condition Assessment Results for All Pipe Segments

FM Identifier	Pipe Length (ft)	Pipe Diameter (inches)	Material	Pipe Age (years)	POF Score	COF Score	Risk Score
10845	4	16	PVC	33	2	3.6	7.2
10046	2,266	6	CIP	57	3.6	1.8	6.5
10698	392	6	PVC	Null	3.2	1.8	5.8
10022	1,726	10	CIP	57	3.6	2.4	8.6
10170	1,551	24	DI	18	1.7	3.2	5.4
<Null>	2,060	6	DI	Null	4.5	2.2	9.9
10544	736	12	PVC	23	1.5	2.8	4.2
10410	5	8	PVC	Null	3	2.4	7.2
10184	430	8	CIP	33	2.8	2.2	6.2
10575	1,326	8	PVC	Null	3	3.2	9.6
10394	683	12	PVC	23	1.5	2.2	3.3
10260	5	16	PVC	Null	3	2.6	7.8
10537	1,736	30	DI	18	1.7	4	6.8
10856	4	20	DI	57	4.1	3.6	14.8
10021	6,287	18	DI	57	4.1	4	16.4
10137	139	16	DI	35	3.5	2.8	9.8
10528	113	24	DI	28	2.2	3	6.6
10173	706	24	DI	28	2.2	3.4	7.5
10372	45	24	PVC	33	2	4.2	8.4
10866	67	18	DI	Null	4.1	3.4	13.9
10851	233	24	DI	33	3.3	3.6	11.9
10511	4	24	DI	Null	4.3	2.6	11.2
10876	4	8	DI	Null	4.5	3.2	14.4
10600	1,074	24	PVC	23	1.5	3.6	5.4
10857	11	16	DI	57	3.9	3.8	14.8
10396	14	8	PVC	21	1.5	2.2	3.3
10932	5	2	PVC	Null	3	2.8	8.4
10594	523	8	PVC	23	1.5	3	4.5
10549	1,892	8	PVC	21	1.5	2.2	3.3
10521	7	6	DI	Null	4.3	1.8	7.7
10065	938	12	PVC	25	1.5	2.2	3.3
10567	20	12	PVC	24	1.7	2.2	3.7
10925	5	8	PVC	Null	3	3.4	10.2
10493	4	8	PVC	21	1.7	2.2	3.7
10117	4	24	DI	Null	4.3	2.6	11.2
10419	129	8	PVC	23	1.7	2.2	3.7
10245	5	16	PVC	Null	3	2.8	8.4

Table E-1: Condition Assessment Results for All Pipe Segments

FM Identifier	Pipe Length (ft)	Pipe Diameter (inches)	Material	Pipe Age (years)	POF Score	COF Score	Risk Score
10205	48	16	PVC	33	2	3.4	6.8
10533	910	30	DI	18	1.7	3.6	6.1
10500	5	16	DI	Null	4.5	2.8	12.6
10353	5	12	PVC	Null	3	3	9
10632	221	8	DI	Null	4.3	2.2	9.5
<Null>	7	20	DI	Null	4.3	3.4	14.6
10448	43	4	PVC	Null	3.2	1.8	5.8
10712	10	4	PVC	Null	3.2	1.8	5.8
<Null>	8	24	DI	Null	4.3	3.4	14.6
10836	46	16	PVC	33	2.2	3.6	7.9
10473	42	20	PVC	33	2	2.8	5.6
10051	560	8	CIP	57	3.6	3.2	11.5
10536	188	12	PVC	25	1.7	3	5.1
10312	1,757	8	PVC	23	1.5	3.2	4.8
10441	1,297	16	PVC	33	2.2	3.6	7.9
10138	458	6	DI	29	2.2	1.8	4
10268	4	4	PVC	Null	3.2	2	6.4
10288	59	16	PVC	33	2.2	3.4	7.5
10075	9	4	PVC	Null	3	2.2	6.6
10145	6	8	PVC	Null	3	3.2	9.6
10124	5	10	PVC	39	2	2.2	4.4
10422	3	8	PVC	Null	3.2	2.2	7
10633	62	12	DI	Null	4.3	2.4	10.3
10052	2,822	8	CIP	57	4	3.6	14.4
10279	95	12	PVC	25	1.7	2.6	4.4
10172	199	16	PVC	28	1.5	3.4	5.1
10706	75	4	PVC	Null	3.2	1.8	5.8
10458	91	4	PVC	Null	3.2	1.8	5.8
10763	25	16	PVC	24	1.5	2.8	4.2
10291	40	8	DI	26	2.2	2.8	6.2
10258	2	16	PVC	Null	3	2.6	7.8
10449	2,179	4	PVC	Null	3.2	1.8	5.8
10859	14	12	DI	Null	3.9	3.2	12.5
10687	72	6	PVC	Null	3.2	1.8	5.8
10285	1,017	8	PVC	19	1.2	3	3.6
10072	936	4	CIP	53	4	2.2	8.8
10852	491	24	DI	33	3.3	3.2	10.6

Table E-1: Condition Assessment Results for All Pipe Segments

FM Identifier	Pipe Length (ft)	Pipe Diameter (inches)	Material	Pipe Age (years)	POF Score	COF Score	Risk Score
10315	81	24	PVC	23	1.5	3.8	5.7
10089	1,588	8	PVC	25	1.7	2.8	4.8
10610	664	8	PVC	Null	3	2.2	6.6
10294	8	6	PVC	26	1.5	2.2	3.3
10602	77	24	PVC	23	1.5	3.8	5.7
10121	5	24	DI	Null	4.3	2.6	11.2
10319	54	6	PVC	23	1.5	1.8	2.7
<Null>	29	8	DI	26	2.4	2.2	5.3
10047	422	8	CIP	57	3.6	3.4	12.2
10935	2	4	DI	Null	4.3	2.4	10.3
10824	14	24	PVC	33	2	3.4	6.8
10037	1,732	8	PVC	19	1	2.2	2.2
10693	49	6	CIP	Null	4.2	1.8	7.6
10254	21	16	PVC	33	2	3.4	6.8
10155	1,288	30	DI	18	1.7	3.8	6.5
10604	3	6	PVC	26	1.5	1.8	2.7
10058	252	4	PVC	54	3	3.2	9.6
10401	6	8	PVC	21	1.5	2.2	3.3
10363	1,127	24	DI	33	3.3	3.6	11.9
10146	5	12	PVC	Null	3	3.2	9.6
10685	5	6	PVC	Null	3.2	1.8	5.8
10366	4	12	PVC	Null	3	3	9
10206	21	16	PVC	33	2	3.4	6.8
10900	1,245	8	3	57	4.1	2.2	9
10901	64	8	DI	28	1.8	2.2	4
10902	61	8	DI	28	1.8	2.2	4
10903	452	8	DI	Null	3.9	2.2	8.6
10905	166	8	CIP	57	3.6	2.2	7.9
<Null>	14	8	3	57	4.1	2.2	9
<Null>	1,109	8	3	57	4.1	2.2	9
<Null>	13	8	3	57	4.1	2.2	9
10900	96	8	3	57	4.1	2.2	9
<Null>	8	8	3	57	4.1	2.2	9
<Null>	8	2	<Null>	Null	4.1	2.4	9.8
10735	35	8	<Null>	Null	4.1	2.8	11.5
<Null>	1,294	10	<Null>	1	2.1	2.8	5.9
<Null>	4	8	DI	1	1.3	2.8	3.6

Table E-1: Condition Assessment Results for All Pipe Segments

FM Identifier	Pipe Length (ft)	Pipe Diameter (inches)	Material	Pipe Age (years)	POF Score	COF Score	Risk Score
10736	737	10	<Null>	Null	4.1	3.2	13.1
<Null>	18	8	DI	1	1.3	2.8	3.6
<Null>	510	10	<Null>	1	2.1	2.8	5.9
10733	36	10	<Null>	Null	4.1	2.8	11.5
<Null>	23	8	DI	1	1.3	2.8	3.6
<Null>	3	8	<Null>	1	2.1	2.8	5.9
<Null>	3	8	DI	1	1.3	2.8	3.6
<Null>	1	8	<Null>	1	2.1	2.8	5.9



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