Potable Water Master Plan Update - Final

Englewood Water District

District Agreement No. 2022-129

Englewood, FL

January 31, 2024

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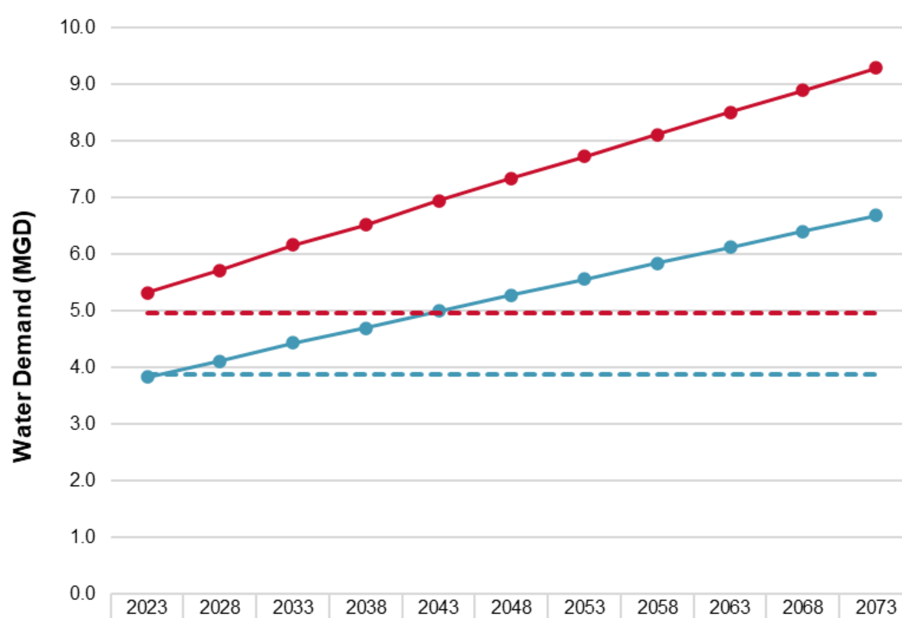
Executive Summary

The District retained HDR Engineering, Inc. (HDR) to provide professional services to develop a Potable Water Master Plan Update. This Master Plan Update assesses the District's water service and facility needs for a 20-year planning period from 2023 through 2043 and a longer 50-year period from 2023 to 2073. For this effort, HDR performed a condition assessment of the existing water treatment plant, developed updated demand projections, and evaluated several alternatives for water supply, treatment, and distribution capacity expansion. This report summarizes findings and recommendations from each of these tasks to inform future decisions regarding needed expansion and improvements to the potable water system.

Condition Assessment Findings: The HDR team performed a walkthrough of the lime softening and reverse osmosis plants in March 2023. This resulted in a high-level assessment of the structural, mechanical, electrical, and instrumentation aspects of major plant processes, based on physical observations and input on performance and age from the District. The condition assessment indicated mechanical and structural concerns with the lime softening treaters, overall concerns regarding the condition of the media filters at the lime softening plant, and structural and electrical deficiencies within the RO system.

Demand Projections Findings: HDR developed per capita demand estimates and multiplied these by four alternative population projections to estimate a 2043 service area Average Annual Day Flow (AADF) demand of 4.996 million gallons per day (MGD) and Maximum Monthly Day Flow (MMDF) of 6.944 MGD. Based on this analysis, it is recommended to expand the water treatment plant to provide a finished water capacity of 7 MGD (see Figure ES- 1).



	2023	2028	2033	2038	2043	2048	2053	2058	2063	2068	2073
Projected AADF	3.827	4.114	4.437	4.693	4.996	5.280	5.561	5.841	6.121	6.401	6.681
Projected MMDF	5.320	5.719	6.168	6.524	6.944	7.340	7.729	8.119	8.508	8.897	9.287
Average Treatment Capacity	3.87	3.87	3.87	3.87	3.87	3.87	3.87	3.87	3.87	3.87	3.87
Peak Treatment Capacity	4.96	4.96	4.96	4.96	4.96	4.96	4.96	4.96	4.96	4.96	4.96

Figure ES- 1: Englewood Water District Future Finished Water Needs to 2073

Water Supply and Treatment Findings: HDR evaluated five alternatives to meet future demand projections and water treatment plant performance needs:

- Alternative 1a – Rehabilitate the Existing LS Plant and Rehabilitate and Expand the RO Plant
- Alternative 1b – Convert the LS Plant to Pellet Softening and Rehabilitate and Expand the RO Plant
- Alternative 2 – Replace the LS Plant with a Nanofiltration (NF) Plant and Rehabilitate and Expand the RO Plant
- Alternative 3a – Decommission LS Plant and Rehabilitate and Expand the RO Plant in Place
- Alternative 3b – Decommission LS Plant and Completely Replace Existing RO Plant at Expanded Capacity with a New RO Plant

Though each alternative reasonably increases the water treatment capacity expansion to 7 MGD, Alternative 3b is recommended. The alternative provides the District with a new single treatment process allowing for modernizations in process energy and operational efficiencies for a more reliable facility for the community. A new RO facility and hardened building with new laboratory, modern operations control room, staff breakroom and restrooms, and emergency operations center could also attract new workers. Furthermore, RO treatment is the only process considered for reasonable plant upgrades that inherently removes contaminants of emerging concern, creating a safer drinking water for District customers. Figure ES- 2 shows a proposed layout of Alternative 3b.

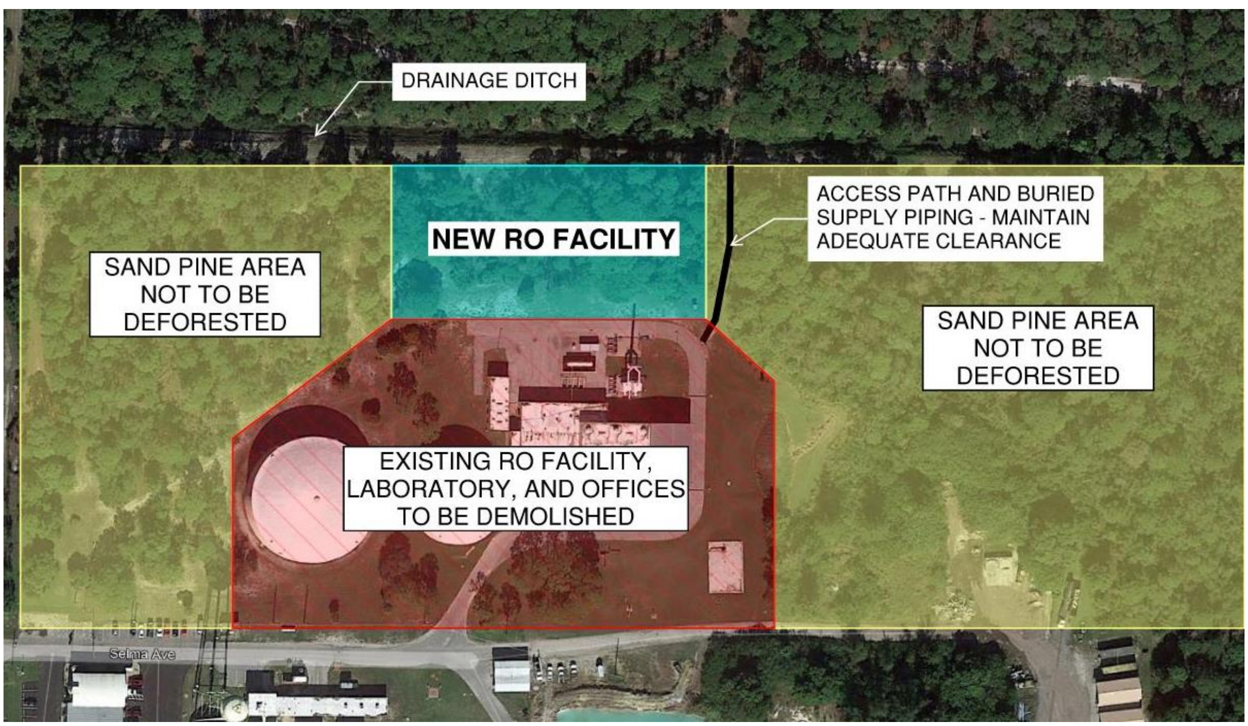


Figure ES- 2: Alternative 3b Future RO Plant Location

Distribution Findings: To assess the distribution system, HDR updated the existing District WaterGEMS Hydraulic Model. Building off District-provided GIS and geocoded water meter data, HDR identified 165 pipes as new or necessary and included them in the modeling update. HDR validated this uncalibrated model to May 2023 customer use data.

Five modeled scenarios were developed to analyze high water demand in the District's distribution system. These entailed existing conditions, 2043 conditions with the distribution system expanded to planned developments, and 2073 conditions to validate potential pipe velocities for the expanded distribution system.

For the distribution system, HDR recommends addressing the primary areas of concern seen in the model: Manasota Key, Japanese Gardens, Englewood Isles, Englewood Rd, and the Southeast Region of Grove City and Mobile Gardens. The areas show a sensitivity to increased demand resulting in an increase in head loss. Additionally, increasing high service pump station's VFD set pressure to 70 psi will improve pressures for the extents of the distribution system. Accordingly, provisions to the elevated storage tank would need to be made, such as adding an altimeter valve to limit the tank being overfilled or replacing it with a hydropneumatic tank at ground level. Recommended projects are shown in Figure ES- 3.

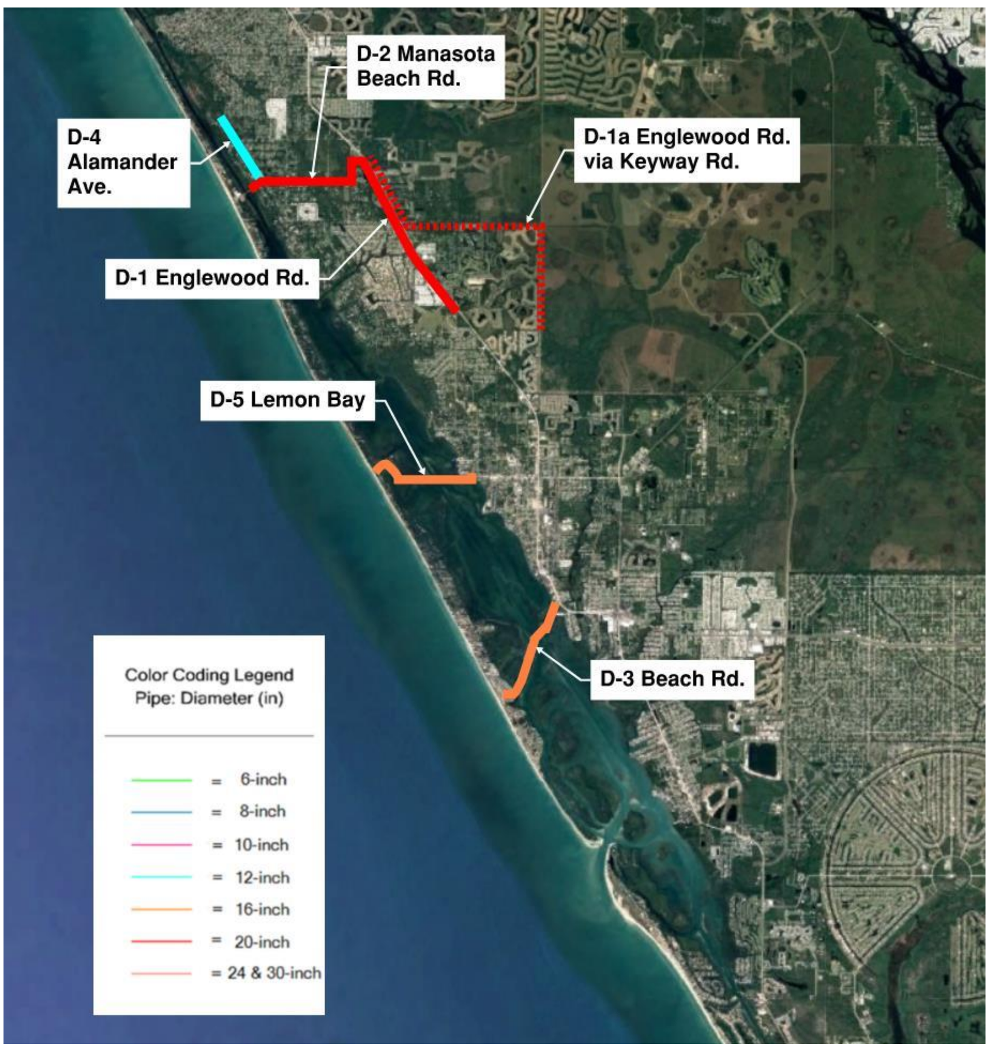


Figure ES- 3: Distribution System Improvement Consideration

Resulting CIP Recommendations: HDR developed AACEI Class IV cost estimates in 2023 dollars for all proposed capital projects, which has an accuracy range of -30% to +50%. A timeline with recommended years for project initiation was developed based on assessed urgencies and project interdependencies as shown in Table ES- 1.

Table ES- 1: CIP Project Descriptions and Capital Costs in 2023 Dollars

ID	Name	Description	Total Cost	Timeline
D-1	Englewood Road Pipeline Upgrade	Consists of 11,000 ft of 20-in diameter pipe improvements along Englewood Rd.	$8,100,000	2028
D-1a	Englewood Road Pipeline Upgrade – Alternative Route via Keyway Road	Consists of 20,500 ft of 20-in diameter pipe improvements connecting to the existing 24-in diameter pipe east of Boca Royale Development, and traveling north to Keyway Rd, west along Keyway Rd, and then north along Englewood Rd. This alternative will be more costly than D-1 but will cause less disturbance to customers.	$15,100,000	2028
D-2	Manasota Beach Road Pipeline Upgrade	Consists of 8,800 ft of 20-in diameter pipe improvements along Manasota Beach Rd.	$7,820,000	2031
D-3	Beach Road Pipeline Upgrade	Consists of 6,000 ft of 16-in diameter pipe improvements along Beach Rd.	$2,890,000	2034
D-4	Alamander Avenue Pipeline Upgrade	Consists of 5,000 ft of 12-in diameter additional pipe along Alamander Ave.	$3,170,000	2036
D-5	Lemon Bay Pipeline Upgrade	An alternative to projects D-2 and D-3, pipe improvements consisting of 5,100 ft of trenchless 16-in diameter pipe and 2,500 ft of open cut 16-in diameter pipe along Lemon Bay.	$9,490,000	2031
D-6	Pump Station Rehabilitation and Upgrade	This project provides funding for pump station to be able to serve 70 psi to the distribution system. Includes a new centrifugal pump (12.9 MGD) and a new 10,000-gallon hydropneumatic tank to maintain system pressure of 70 psi.	$2,220,000	2026
D-7	Hydraulic Model Upgrades	This project includes a further analysis of the distribution system. These upgrades will include adding smaller pipes to the model as well as water quality test points to fine tune areas of impact and identify and address “dead zones” in the system.	$400,000	2032
T-1	RO Plant Studies and Evaluations	Consists of further evaluations of an all-RO system regarding water quality, energy, and operation.	$50,000	2024
T-2	New RO Facility	Includes the design and construction of a new RO facility with membrane components, non-membrane systems, and chemical systems, general plant site work, connecting to the existing system, and taking the existing RO and LS plants offline. To be online by 2028.	$81,580,000	2025
T-3	New Supply Wells	Project includes design and construction additional brackish supply wells for increased demand.	$33,610,000	2025
T-4	Disinfection Upgrades	Convert to liquid sodium hypochlorite and upsize to accommodate increased capacity.	$800,000	2025
T-5	New Deep Injection Well	Consists of designing and constructing a new deep injection well for the increased brine reject from the new RO facility.	$8,660,000	2025
T-6	Upsize Ammonia System	Upsize ammonia storage and dosing system to treat 7 MGD.	$450,000	2025
T-7	New Degasifier	Construct a new 5-MGD degasifier on Clearwell #2 and replace 3-MGD unit with a new 5-MGD unit to provide adequate redundancy in case one unit needs to be taken offline. Assumes that two clearwells will be adequate to treat 7 MGD. Further evaluation needed to consider expansion of clearwell capacity to meet required contact time.	$1,360,000	2025
T-8	Clearwell Repairs	Repair areas with corrosion damage.	$260,000	2026
T-9	New Supply Well Pipeline	Project includes a supply well pipeline from the wellfield to the treatment facilities site.	$13,450,000	2026
T-10	Abandonment of Freshwater Wellfields	Plug and cap existing wells and demolish existing wellheads. To be started after lime softening process has been decommissioned.	$810,000	2030

1 Introduction

1.1 District Background

Englewood Water District (District) was created in 1959 and is classified as a political sub-division of the State of Florida under Chapter 2004-439. The District owns and operates a public utility that provides water services within the unincorporated areas of Sarasota and Charlotte Counties, generally known as Englewood, Grove City, and Manasota Key. The District's current service area boundary encompasses approximately 44.5 square miles. In addition, the District has interlocal agreements for the delivery of potable water to Bocilla Utilities for the residents of Don Pedro and Knight/Palm Island in Charlotte County.

1.2 Master Plan Update Purpose

The District retained HDR Engineering, Inc. (HDR) to provide professional services to develop a Potable Water Master Plan Update. This Master Plan Update assesses the District's water service and facility needs for a 20-year planning period from 2023 through 2043 and a longer 50-year period from 2023 to 2073. For this effort, HDR developed updated demand projections, performed a condition assessment of the existing water treatment plant, and evaluated several alternatives for water supply, treatment, and distribution capacity expansion. This report summarizes findings and recommendations from each of these tasks to inform future decisions regarding needed expansion and improvements to the potable water system.

HDR reviewed historical documents, GIS data, SCADA information, operations data, and site visit findings, and held multiple meetings with District staff to develop the findings, conclusions, and recommendations provided herein.

1.3 Existing Facilities and Distribution System

The District's current Water Use Permit (WUP) issued by the Southwest Florida Water Management District (SWFWMD) (WUP No. 20 004866.012) authorizes total groundwater withdrawals of up to 5,360,000 gallons per day (annual average) and 6,590,000 gallons per day (peak month) while establishing maximum flows within each water type and individual wellfield. These quantities were last allocated to meet the District's potable water demand through 2050; however, as shown in Section 3 of this report, additional drinking water supply is needed to meet increased demand. The District's WUP expires on December 9, 2050.

The District's water supply, treatment and distribution facilities include:

- Five (5) groundwater wellfields
    - Four (4) freshwater well systems with aggregated permitted withdrawal capacities of up to 3.54 MGD (annual average) and up to 4.35 MGD (peak month) within Wellfields 1, 2, 3, and 5 provided the current total WUP allocation is not exceeded.
    - Two (2) brackish water well systems with aggregated permitted withdrawal capacities of up to 4.25 MGD (annual average) and up to 5.44 MGD (peak month) within Wellfields 2 and 4 provided the current total WUP allocation is not exceeded.
- Two (2) water treatment plants
    - One (1) lime softening plant built in 1961 at 3.0 MGD design capacity for treatment of the freshwater wellfield supply; however, the District can only reliably treat 2 MGD of this capacity.

  - One (1) reverse osmosis (RO) Plant built in 1981 at 3.0 MGD design capacity for treatment of the brackish water wellfield supply
- Four (4) finished water storage tanks with a combined capacity of 7.5 million gallons, and one (1) elevated storage tank with 100,000-gallon capacity used to dampen the amplitude of distribution system pressures
- Two (2) deep injection wells
  - One (1) 1.58-MGD deep injection well (DIW-1) onsite for RO concentrate disposal
  - One (1) 2.94-MGD deep injection well (DIW-2) offsite at the Holiday Ventures Lift Station for reclaimed water disposal and backup RO concentrate disposal. Backup capacity is limited due to existing use by the South Water Reclamation Facility (WRF) and future use by the North WRF that is being currently planned.
- Over 3,571 miles of water transmission and distribution pipelines and appurtenances, with emergency interconnections with Sarasota and Charlotte Counties.

The two water treatment plants exist on the same site at Englewood's water treatment plant (WTP) site. A plant aerial is show in Figure 1-1 and a process flow diagram of the two treatment trains in Figure 1-2. The extent of the District's potable distribution network is shown in Figure 1-3.

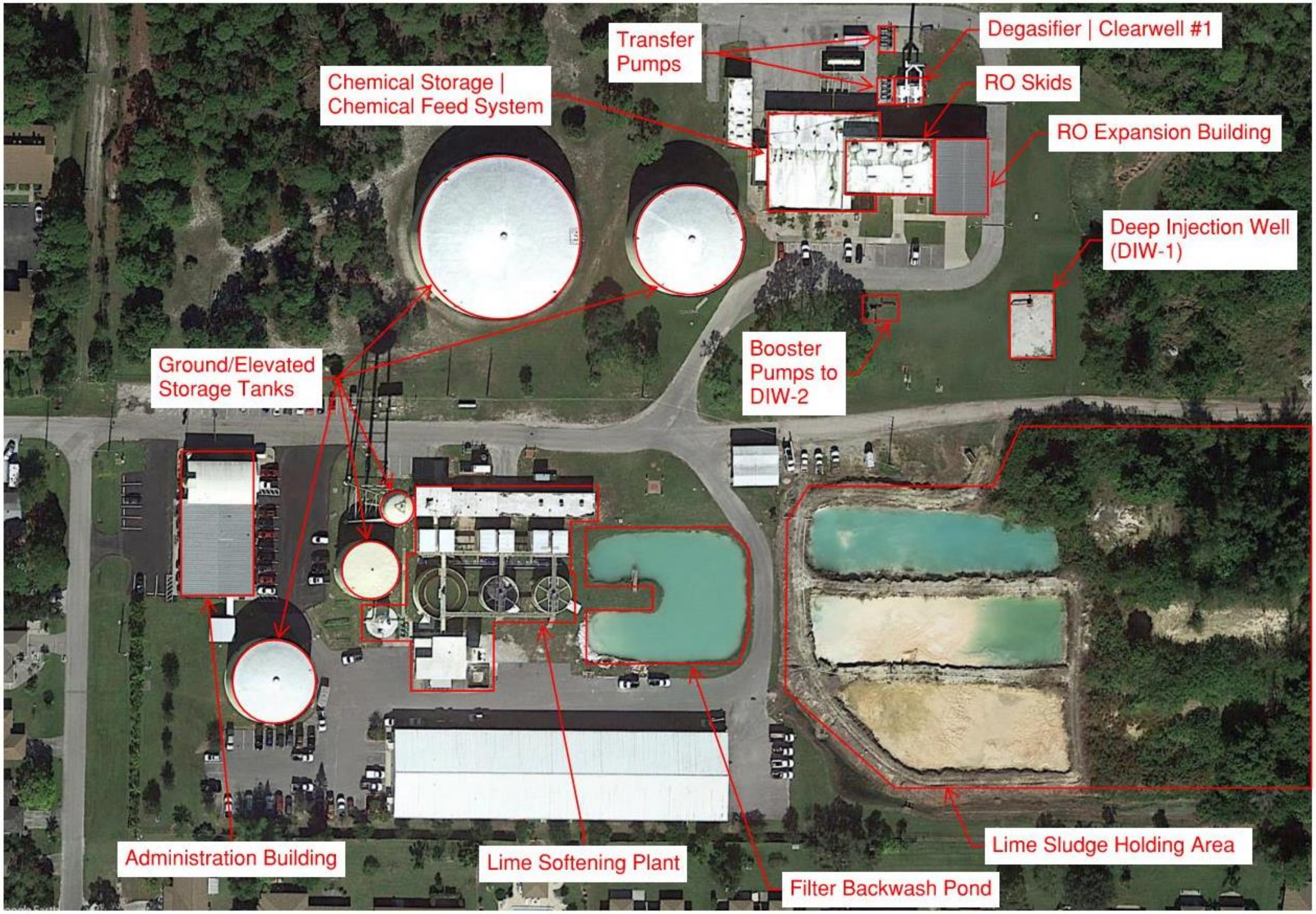


Figure 1-1: Englewood Water Treatment Plant Site

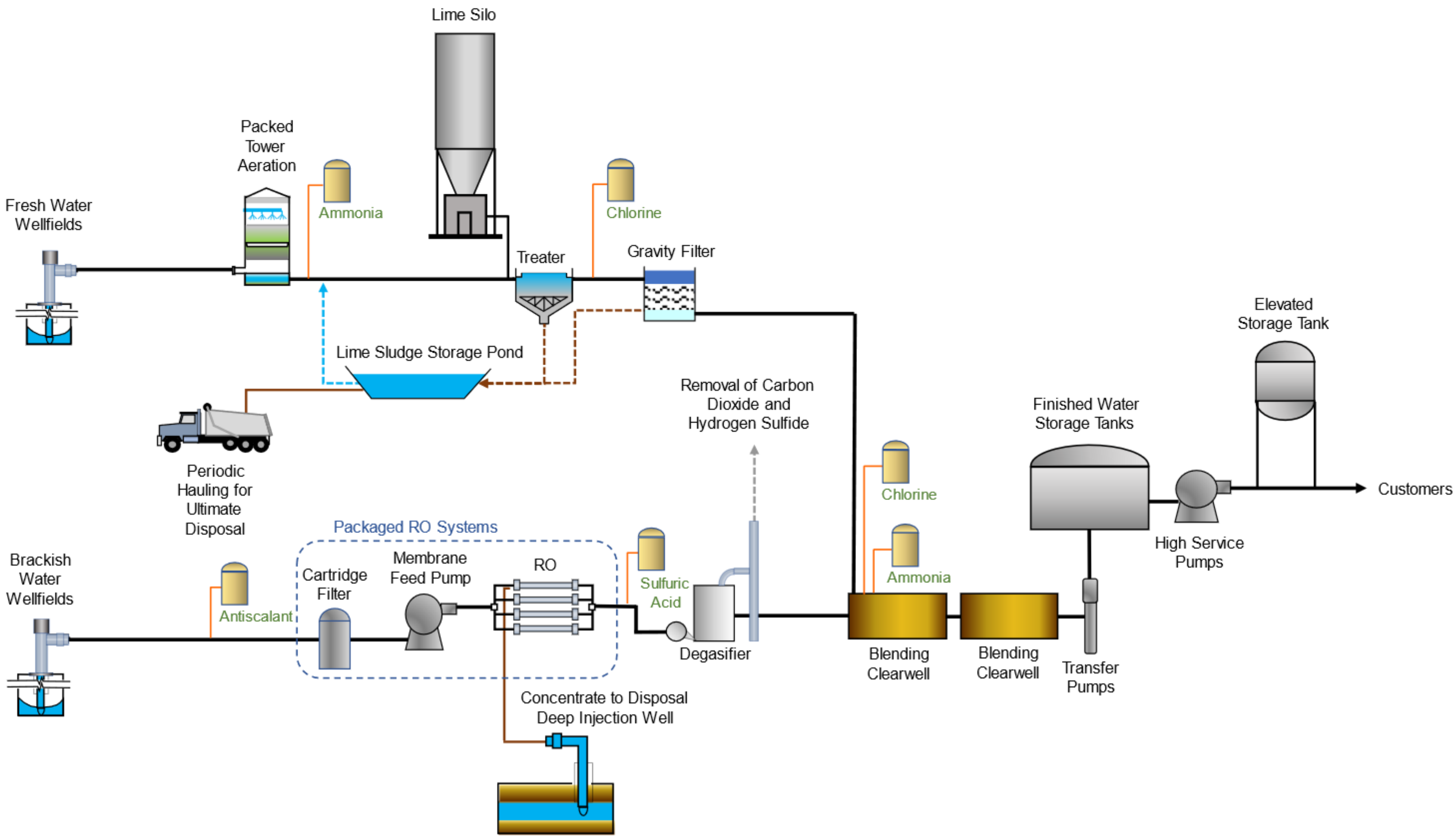


Figure 1-2: Englewood WTP Process Flow Diagram

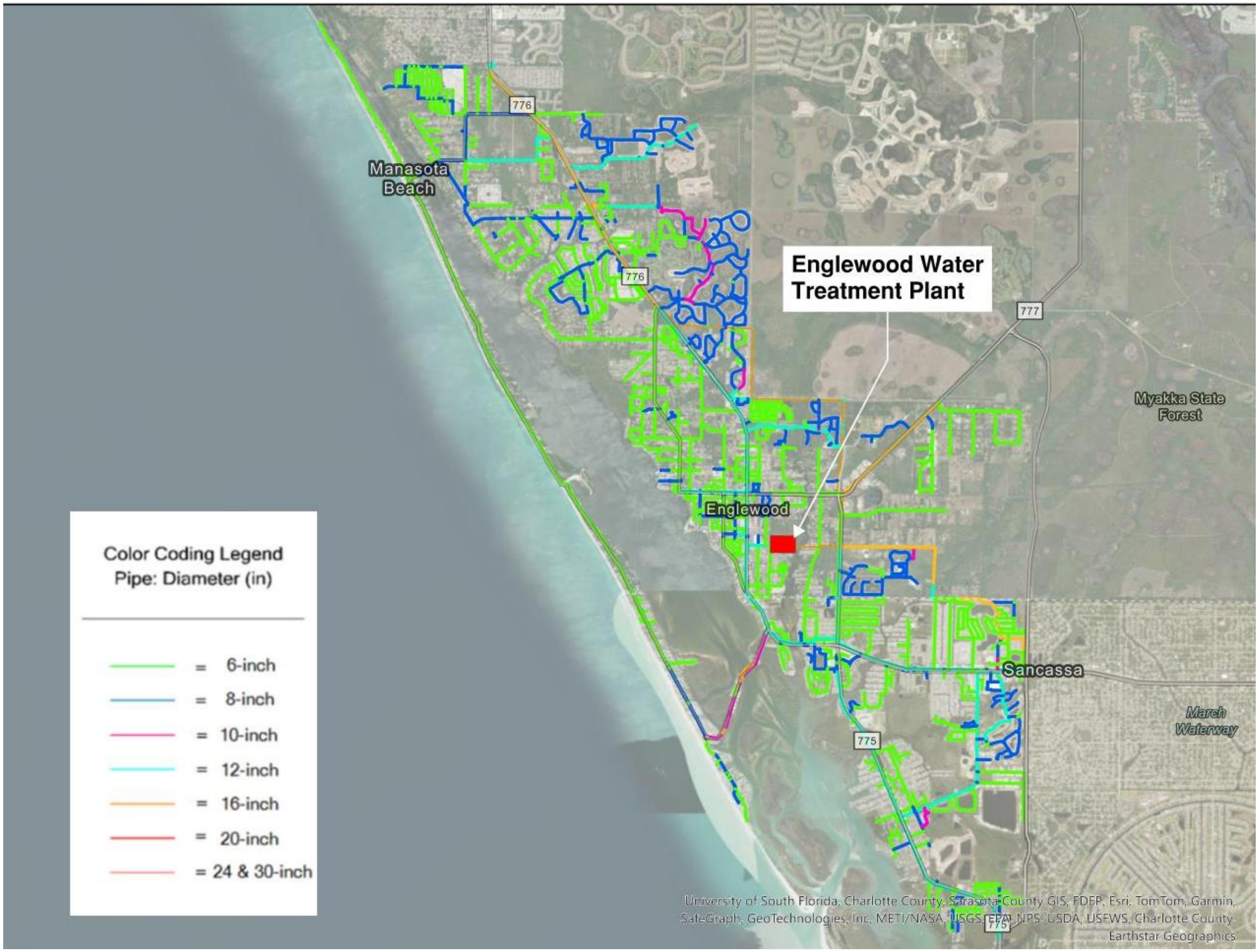


Figure 1-3: Englewood Water Distribution Network (<6-inch not shown)

2 Condition Assessment

2.1 Condition Assessment Background

The HDR team performed a walkthrough of the lime softening and reverse osmosis plants with Keith Ledford, Technical Support Manager, and Dewey Futch, Water Operations Manager, from the District on Friday, March 31, 2023. The District provided a short overview presentation explaining the layout and flow routing through the plants. The HDR team provided a high-level assessment of the structural, mechanical, electrical, and instrumentation aspects of major plant processes, based on physical observations and input on performance and age from the District. HDR rated the assessed facilities on criteria detailed below.

2.2 Framework & Criteria

The condition assessment framework was based on a three-tier asset hierarchy consisting of the following:

- Level 1: Facility (General Site, Lime Softening, Reverse Osmosis)
- Level 2: System (Site Security, General Plant Facilities, Packed Tower Aerator, Lime Feed System, Lime Treaters, Dual-Media Filters, RO Trains, Disinfection, Clearwells, New/Old High Service Pump Stations, Finished Water Storage Tanks)
- Level 3: Discipline (Structural, Mechanical, Electrical, Instrumentation)

Scores for each Level 3 asset were provided from 1 – 5, with 1 being the best condition and 5 being the worst. Scores were based on a combination of observed conditions and comments on functionality and performance from accompanying Englewood Water District staff.

2.3 Summary of Results

The HDR team used the findings from the condition assessment to assign scores to each major process. Table 2-1 shows the scoring for each process area sorted by discipline. The condition assessment scores are further detailed in the Englewood Condition Assessment Technical Memorandum in Appendix A. A color-coding legend is explained below:

Table 2-1: Condition Assessment Results Summary

Facility	System	Condition Score				
		Structural	Mechanical	Electrical	Instrumentation	Average
General Site	Site Security	1	1	1	2	1
Lime Softening	General Facility	2	4	1	1	3
Lime Softening	Packed Tower Aerator	1	2	1	2	2
Lime Softening	Lime Feed System	3	2	2	2	2
Lime Softening	Treater 1	3	3	2	1	2
Lime Softening	Treater 2	4	3	2	1	2
Lime Softening	Treater 3	4	3	2	1	2

Color Coding Reference:

Green – Very Good
Yellow – Good
Gray – Average
Orange – Poor
Red – Very Poor

Facility	System	Condition Score				
		Structural	Mechanical	Electrical	Instrumentation	Average
Lime Softening	Filters	4	4	2	4	4
Lime Softening	Old High Service Pump Station	1	2	1	1	1
Lime Softening	New High Service Pump Station	1	2	1	1	1
Lime Softening	Chemical Storage and Dosing	2	2	1	1	2
Reverse Osmosis	General Facility	3	3	1	1	2
Reverse Osmosis	Electrical & Control Rooms	4	1	4	4	3
Reverse Osmosis	RO Train A	5	4	2	3	4
Reverse Osmosis	RO Train B	5	2	2	2	3
Reverse Osmosis	RO Train C	5	1	2	3	3
Reverse Osmosis	RO Train D	5	4	2	2	3
Reverse Osmosis	RO Train E	2	2	2	3	2
Reverse Osmosis	RO Train F	1	3	2	2	2
Reverse Osmosis	Clearwell 1	4	3	2	3	3
Reverse Osmosis	Clearwell 2	1	1	2	2	2
Reverse Osmosis	Chemical Storage and Dosing	2	1	1	1	1

Color Coding Reference:
- **Green** – Very Good
- **Yellow** – Good
- **Gray** – Average
- **Orange** – Poor
- **Red** – Very Poor

2.4 Condition Assessment Recommendations

Table 2-2 lists the recommendations compiled by HDR to address deficiencies observed on site during the condition assessment.

Table 2-2 Condition Assessment Recommendations

Plant	System	Recommendation
General	Site Security	Increase security cameras and footage storage.
General	Disinfection (Sitewide)	Consider switching to liquid chlorine and consolidate storage to one location on site.
General	Disinfection (Sitewide)	Consider using free chlorine instead of chloramines.
Lime Softening	Lime Softening (General)	Conduct lime dosing optimization study to reduce lime use and assess caustic to filter effluent or clearwell for finished water pH balance.
Lime Softening	Treater 1	Replace drive unit.
Lime Softening	Treater 2	Observe for worsening external moisture and consider performing structural testing for tank integrity.
Lime Softening	Treater 3	Observe for worsening external moisture and consider performing structural testing for tank integrity.
Lime Softening	Filters	Consider raising troughs to reduce media carryover.
Lime Softening	Filters	Add air scour and media sweeps to improve backwashing and prevent media hardening.

Plant	System	Recommendation
Lime Softening	Filters	Replace existing local control panels containing backwash controls.
Lime Softening	Filters	Replace missing and deteriorating guardrails.
Lime Softening	New HSP Station	Replace check valves at Pumps 7 and 9 with Slaminator check valves.
Lime Softening	Chemical Storage and Dosing	Store anhydrous ammonia in a cooler location without exposure to direct sunlight.
Reverse Osmosis	RO General Facility	Evaluate alternatives for electrical supply to future RO expansion.
Reverse Osmosis	RO General Facility	Increase raw water pipe sizes to remove bottlenecks.
Reverse Osmosis	RO General Facility	Reroute raw water piping to RO plant from below the building.
Reverse Osmosis	Electrical & Control Rooms	Move some equipment to new electrical supply room to meet code.
Reverse Osmosis	Electrical & Control Rooms	Reroute roof drain along outside of building.
Reverse Osmosis	Electrical & Control Rooms	Repair damage from fire and replace failed control system enclosure components
Reverse Osmosis	RO (General)	Perform CIPs as needed to extend membrane service life.
Reverse Osmosis	RO (General)	Review and trend operating data and water quality to optimize operation, including alternative pH adjustment or antiscalant chemicals/doses.
Reverse Osmosis	RO (General)	If reusing membranes from Train B-F is needed, make relocation to Train A as soon as possible to avoid membrane drying.
Reverse Osmosis	RO (General)	Repair/replace concrete pedestals.
Reverse Osmosis	RO (General)	Perform electrical study and check pump performance metrics to troubleshoot Train C supply pump motor issues.
Reverse Osmosis	RO (General)	Repair/replace leaking joints.
Reverse Osmosis	Clearwell 1	Repair eroded concrete from degasification unit and make modifications to clearwell to prevent future damage.
Reverse Osmosis	Chemical Storage and Dosing	Repair damage to sump beneath sulfuric acid storage tank.

3 Basis of Planning

Basis of planning informs capacity upgrades and facility improvements through pertinent information review, baseline calculations, and baseline modeling including:

- Review of current and emerging regulations
- Calculating system demand projections using historic flows
- Performing an analysis of water quality
- Assessing and updating hydraulic modeling to develop improved alternative analyses

3.1 Regulatory

Any water treatment facility upgrades must meet the rules and regulations set by national and local governing bodies. The US Environmental Protection Agency (EPA) set drinking water Maximum Contaminant Levels (MCLs) in the Primary and Secondary Drinking Water Standards. The Florida Department of Environmental Protection (FDEP) regulates Florida public water systems and adopts EPA criteria. The Department of Health (DOH) can regulate distribution system maintenance and was also taken in consideration. HDR utilized the above governing bodies to compare existing water quality data detailed in the next section. There is also ongoing newer legislation as shown in Table 3-1 related to cybersecurity and emerging contaminants (i.e., PFAS) which will contain broader implications to water treatment facility upgrades.

Table 3-1: Relevant Rules and Regulations

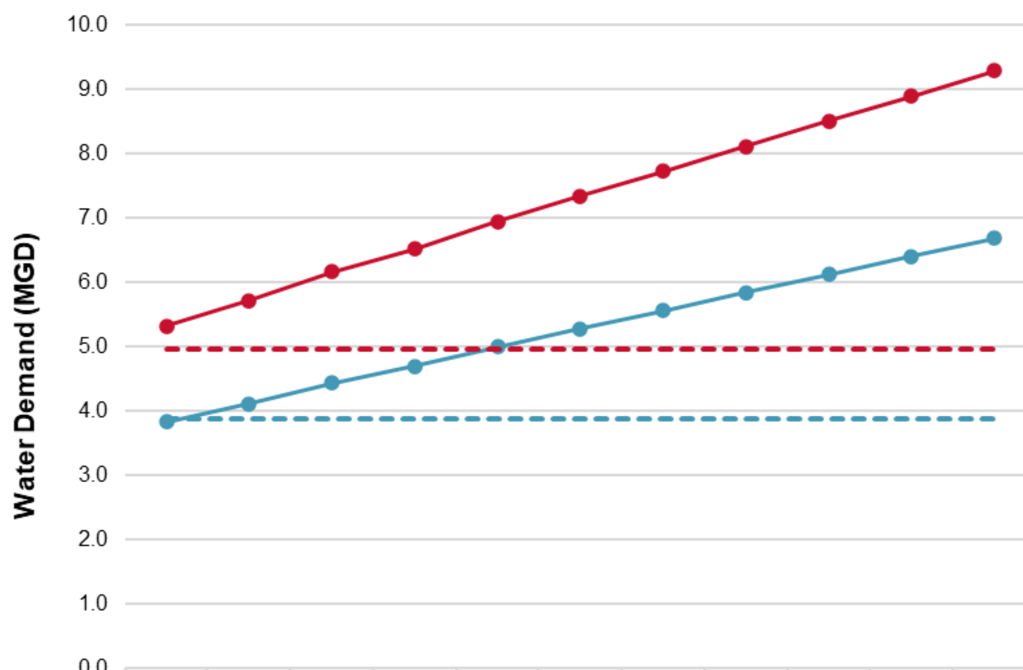
Legislation Category	Rules and Regulations	Description
Groundwater Supply	F.S. 120 & 373 F.A.C. 40D-1 & 40D-2	• Establishes application requirements for Water Use Permits (WUPs) prior to groundwater withdrawal • Delegates WUP issuance to Water Management Districts
Groundwater Supply	F.A.C. 40D-3	• Requires well construction permit prior to the construction, repair or abandonment of a well
Water Distribution System	F.A.C. 62-555	• Establishes requirements for design, construction, operation, and maintenance of a public water system
Drinking Water Standards	F.A.C. 62-550	• Establishes Maximum Contaminant Levels (MCLs) for primary and secondary drinking water standards • Defines monitoring, reporting, and recordkeeping requirements for various drinking water quality constituents
Recent Legislation	40 CFR 141(I) Lead and Copper Rule	• Sets lead trigger level (TL) at 10 µg/L
Cybersecurity	CS/HB 7055/ 282.318, F.S.	• Strengthens the existing Florida State Cybersecurity Act • Outlaws compliance with any ransomware attacks • Redefines security threat levels
Cybersecurity	S.3600 Strengthening American Cybersecurity Act of 2022	• Requires WTPs to: ○ Report cyber incidents and ransom payments within a specified time frame ○ Limit the use and disclosure of reported information ○ Update reporting protocol to match the standardized protocol
PFAS	H.R.2467 – PFAS Action Act of 2021	• Limits the use of perfluoroalkyl and polyfluoroalkyl substances (PFAS) and remediate PFAS in the environment • Directs EPA to designate PFAS, perfluorooctanoic acid (PFOA) and perfluorooctane sulfonic acid (PFOS) as hazardous substances
PFAS	S.B. 7012 – A bill to be titled.	• Provides the membership, organization, and duties of a PFAS task force within FDEP
PFAS	C.S./H.B. 1475 – Cleanup of Perfluoroalkyl and Polyfluoroalkyl Substances.	• Requires DEP to adopt statewide rules for PFAS cleanup target levels in drinking water, groundwater, & soil

3.2 Population and Flow Projections

HDR used a Per Capita Model for forecasting water supply demands. The Per Capita Model calculates the total production or consumption per capita for a historical period and applies the current year per capita consumption to the population projections for future periods. A simple forecasting method, it requires only historical production or consumption data, historical population, and forecast of population through the demand forecasting horizon.

Utilizing the District's historical (2018-2022) records of production data as well as the Historical Population Served reported on the District's Public Supply Annual Reports (PSAR's) to the Southwest Florida Water Management District, a per capita usage of 80 gallons per capita per day (gpcd) was calculated. With a conservative population projection, this usage was projected from 2023 to 2073, shown in Figure 3-1. As an approximate 20-year equipment service life is standard, the water treatment capacity should be focused from 2023 to 2043. Thus, the projected annual average water supply demands for the Englewood Water District within its current service boundary ranges from 3.827 MGD in 2023 to 4.996 MGD in 2043. The projected peak month water supply demands ranges from 5.320 MGD in 2023 to 6.944 MGD in 2043. Therefore, it is recommended to expand the water treatment plant to provide a finished water capacity of 7 MGD.

A more detailed evaluation of the water demand projections can be found in the Population and Demand Projections Technical Memorandum in Appendix B.



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Peak Treatment Capacity	4.96	4.96	4.96	4.96	4.96	4.96	4.96	4.96	4.96	4.96	4.96

Figure 3-1 Englewood Water District Future Finished Water Needs to 2073

3.3 Water Quality Analysis

HDR assessed water quality data from raw water flowing into the lime-softening (LS) and reverse osmosis (RO) plants. The data includes recent wellfield sampling from March to May 2023 and several sampling events conducted in December of 2022. The minimum, average, 90th percentile, and maximum values from each data parameter were calculated, and a flow weighting applied for the varied data time periods. HDR compared the cleaned water quality data to the Maximum Contaminant Levels (MCLs) from the Primary Drinking Water Standards set by the U.S. Environmental Protection Agency (EPA).

The LS and RO wellfields differ mostly in salinity which is to be expected since the LS wellfield is a freshwater source while the RO wellfield is a brackish water source. There is also a difference between the water sources' nitrate levels with freshwater wellfields being below and brackish wellfields being above nitrate MCL levels of 10 mg/L. Total organic carbon is high for the freshwater source; this raises concerns for water color issues which have been observed by District staff and should continue to be monitored as it could be indicative of dissolved organic material. It is also worth noting that chloride trigger levels are imposed on the LS wellfields, which cause the District to restrict use of wells that have chloride trigger level exceedances.

Both freshwater and brackish water wellfields observed total dissolved solids (TDS) concentrations above the secondary MCL of 500 mg/L. In the WY 2021 EWD Annual Wellfield Report, trend analysis of the monthly TDS concentrations collected from the RO WF 2 and RO WF 4 production wells were conducted using the Seasonal Kendall Tau test. The results of the Seasonal Kendall Tau tests project RO WF2 to have 2051 TDS concentrations of 7,579 mg/L, up from the current 4,957 mg/L. RO WF4 to have 2051 TDS concentrations of 14,491 mg/L, up from the current 4,827 mg/L. The RO plant will need further assessments to determine if the existing membranes could handle these projected TDS concentrations with reasonable performance efficiency long term.

The full water quality data results and comparison to standards can be found in Appendix C in the Englewood Water District Master Plan Alternatives Analysis Technical Memorandum.

3.4 Hydraulic Modeling Analysis

3.4.1 Model Background and Validation

HDR updated the existing District Model of the distribution system as part of this Master Plan Update effort. Building off District-provided GIS and geocoded water meter data, HDR identified 165 pipes as new or necessary and included them in the modeling update. It should be noted the model does not include all pipes; because of this, there is limited accuracy in the analysis of pressures and available fire flow (FF) at many locations within the District. The minimum pipe diameter included in the pipe network was 8 inches (with a few exceptions to complete some large pipe looping) and the analysis is based on the locations where service mains tie into the transmission mains.

To allocate system demands, water billing data was geolocated. Meter address data was collected, cleaned, and imported into the GIS model. The current demand was compared to the total produced finished water for the month of March 2023. The lost and unaccounted water consist of 17% of the finished water, as determined in this project's Population and Flow Projections Technical Memorandum, Appendix B.

HDR developed a future system expansion scenario based on District-provided planned developments and projected maximum month daily (MMD) water demands within the District from the Population and Flow Projections Technical Memorandum, Appendix B.

3.4.2 Model Simulations and Results

The existing system model simulated steady state conditions at the MMD with diurnal peaking factor as noted in Appendix D. The high service pump station operates on a VFD set at 57 pounds per square inch (psi). The model accounts for this with a valve that reduces the pressure at the pump station to simulate standard operating conditions of the District's typical water distribution.

The existing model simulated a 10.6 MGD flow from the WTP showing system wide moderate pressure reductions, Figure 3-2. The largest areas of pressure drop occurred in the north (29 psi pressure reduction from WTP) and south extremes (11psi pressure reduction from WTP). The existing model results confirmed the District's capacity issues on Manasota Key.

An immediate consideration to the system is to increase the target discharge pressure at the high service pump station. Typical preferred distribution pressures range from 40psi to 80 psi. Increasing high service pump station's VFD set pressure to 70 psi will improve pressures for the extents of the distribution system. Accordingly, provisions to the elevated storage tank would need to be made, such as adding an altimeter valve, to limit the tank being overfilled or replacing it with a hydropneumatics tank at ground level.

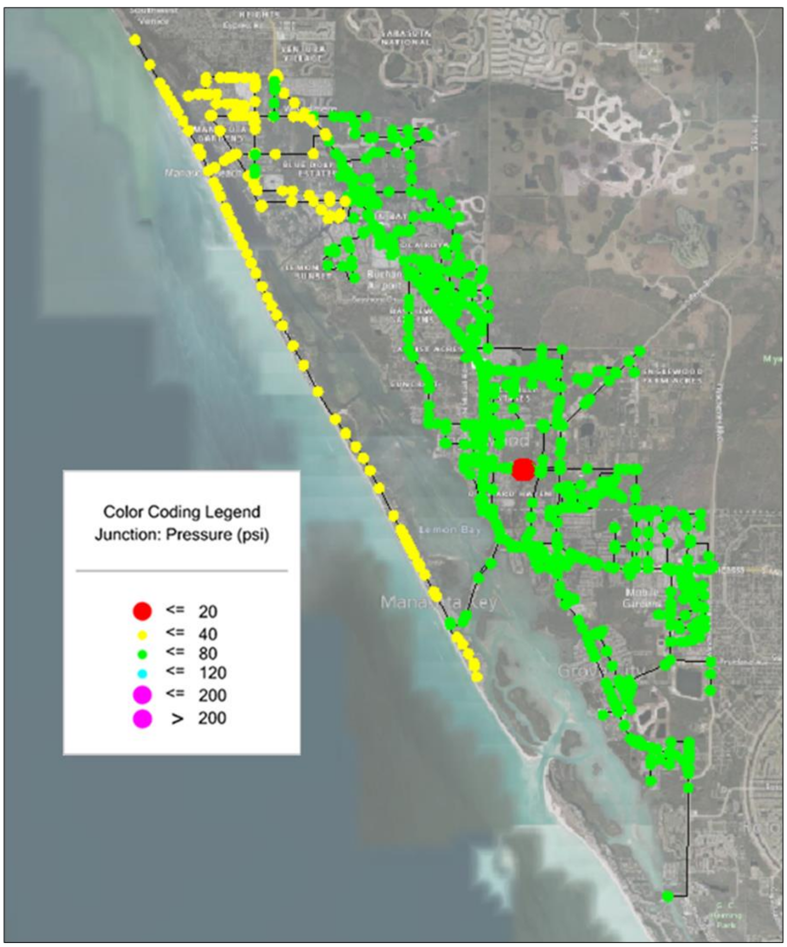

Figure 3-2 Pressure Results from Existing Model MMD

HDR simulated the projected 2043 and 2073 systems at steady state conditions at the MMD with a diurnal peaking factor of 2.0, see Appendix D for further details. The 2043 model simulated a total flow of 13.8 MGD and the 2073 model a flow of 18.6 MGD. Both model simulations showed pressure drops across the network, Figure 3-3 for 2043 and Figure 3-4 for 2073. A key concern is in Manasota Key where pressures drop below 20 psi. In 2073, half the system is below acceptable pressures with any further demand increases compromising the system pressures more especially at Manasota Key.

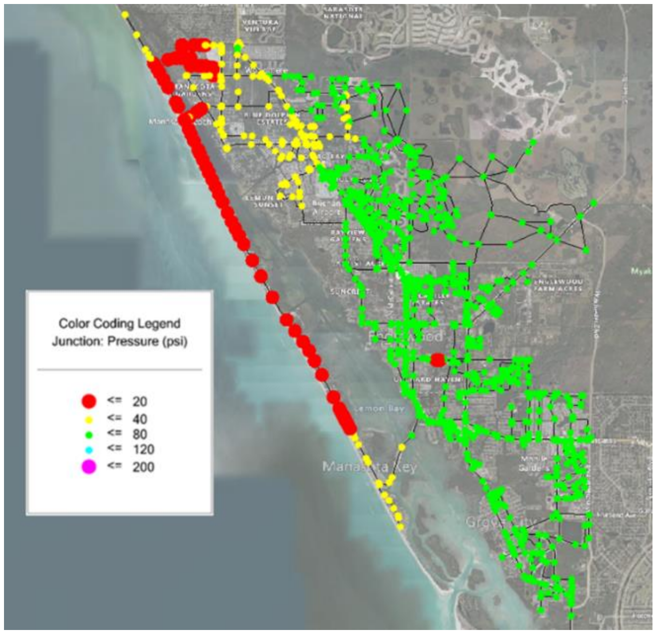

Figure 3-3 Pressure Results from Future Systems Model MMD 2043

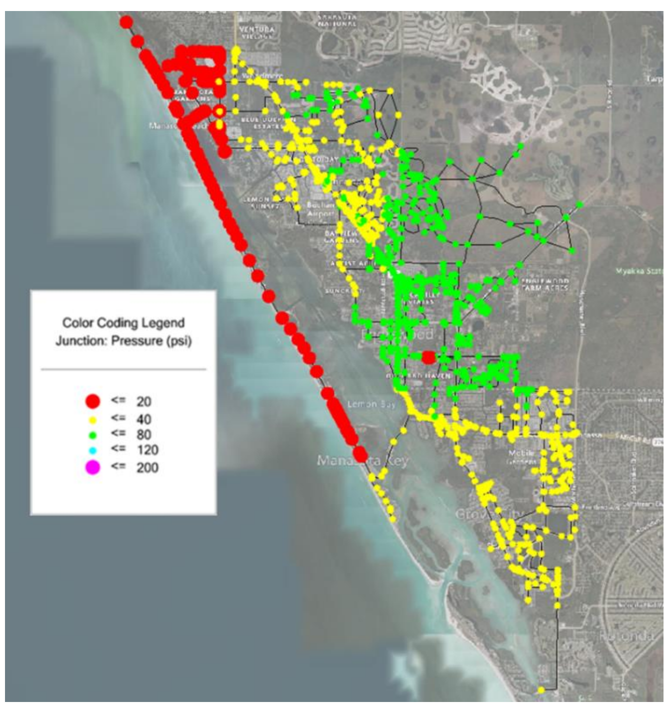

Figure 3-4 Pressure Results from Future System Model MMD 2073

4 Water Supply and Treatment Alternatives

HDR evaluated five alternatives to meet future demand projections and water treatment plant performance needs. A projected peak finished water capacity of 7.0 MGD was used for planning.

- Alternative 1a – Rehabilitate the Existing LS Plant and Rehabilitate and Expand the RO Plant
- Alternative 1b – Convert the LS Plant to Pellet Softening and Rehabilitate and Expand the RO Plant
- Alternative 2 – Replace the LS Plant with a Nanofiltration (NF) Plant and Rehabilitate and Expand the RO Plant
- Alternative 3a – Decommission LS Plant and Rehabilitate and Expand the RO Plant in Place
- Alternative 3b – Decommission LS Plant and Completely Replace Existing RO Plant at Expanded Capacity with a New RO Plant

The alternatives were the results of a site visit and engineering best practices to evaluate design hydraulic and treatment capacity relative to current unit process performance. Alternatives were considered on non-cost factors such as water quality, energy efficiency, operational complexity, and concentrate/residuals disposal. Planning-level cost estimates were developed for each alternative. See Appendix C for further information on alternatives.

4.1 Alternative 1 – Rehabilitate LS Plant and Rehabilitate and Expand RO Plant

Alternative 1 involves upgrading the existing WTP infrastructure and maintaining parallel treatment trains of non-membrane softening and RO. This alternative contains two options, alternative 1a and 1b. The optimal alternative is dependent on the results of the softening upgrades study. Alternative 1a includes rehabilitating the LS plant to maintain the lime softening process. Alternative 1b includes converting the LS plant to pellet softening. Both alternatives include simultaneously rehabilitating and expanding the existing RO plant to produce a combined total of up to 7.0 MGD of finished water. This purpose of this alternative is to prolong the life of existing facilities. The LS plant will continue to produce up to 2.0 MGD (current reliable capacity), and the RO plant production will increase from the current design of 3.0 MGD up to 5.0 MGD. Major projects required for this alternative are shown below and in Figure 4-1.

Studies and Evaluations:

- LS Plant Filter Evaluation.
- LS Plant Softening Upgrades Study.
- RO Plant Membrane Management Study.

Capital Projects:

- LS Plant rehabilitation (1a) or pellet softening conversion (1b).
- LS Plant Filter rehabilitation.
- Increasing brackish water well capacity.
- RO system rehabilitation.
- RO plant expansion.
- Degasifier Expansion
- Additional Deep Injection Well
- Post treatment chemical upgrades.
    - Corrosion control and post-treatment.
    - Conversion of chlorine gas to liquid sodium hypochlorite.

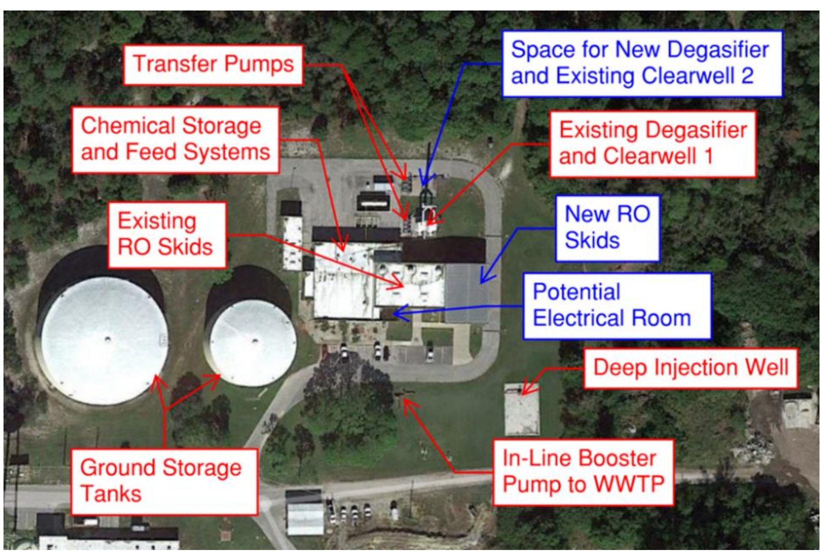

Figure 4-1 Existing and Future RO Plant System Locations

4.2 Alternative 2 – Replace the LS Plant with a Nanofiltration Plant and Rehabilitate and Expand the RO Plant

Alternative 2 considers replacing the existing LS plant with nanofiltration (NF) membranes (2 MGD finished water capacity) and along with rehabilitating and expanding the existing RO plant (5 MGD finished water capacity) to produce a total of 7.0 MGD. The purpose of this alternative would be to move away from LS and granular media filtration and rely on membranes for treatment. NF membranes operate like RO but use less pressure, operate at higher recoveries, and are often used in softening applications to treat fresh groundwater. Shared components include cartridge filters, feed pumps, membrane skids, degasification, and sulfuric acid/antiscalant chemicals. Major projects required of this alternative are shown below and in Figure 4-2.

Studies and Evaluations:

- Membrane (RO) Management Study.
- Softening Upgrades Study

Capital Projects:

- Increasing the brackish water well capacity.
- LS Plant demolition.
- Media filter rehabilitation
- NF Plant construction.
- RO system rehabilitation.
- RO system expansion.
- Degasifier Expansion
- Additional Deep Injection Well
- Post Treatment Chemical Upgrades
    - Corrosion control and post-treatment.
    - Conversion of chlorine gas to liquid sodium hypochlorite.

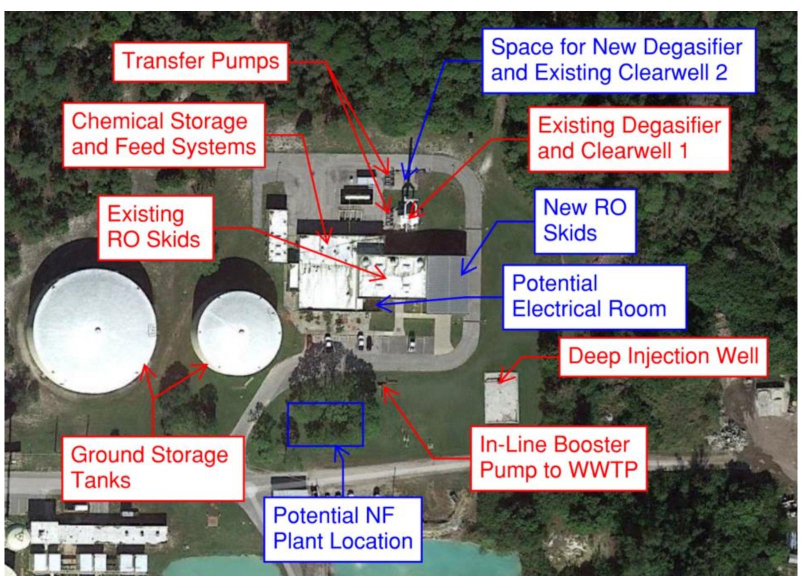

Figure 4-2 Existing and Future RO Plant and Future NF Plant Locations

4.3 Alternative 3 – Complete Replacement

Alternative 3 evaluated decommissioning the LS plant and utilizing an all-RO system. This alternative contains two options, alternative 3a and 3b. These options include (3a) expanding the existing RO plant to 7 MGD in the existing structure as best as possible or (3b) replacing the existing RO Plant with a new hurricane-hardened 7 MGD RO facility, including a new laboratory and housing quarters for staff during severe weather events. Option 3b would entail constructing a new 7.0 MGD RO Plant north of the existing RO facility and then demolishing or repurposing the existing LS Plant and RO Plant infrastructure.

Major scope items involved in Alternative 3a – Decommission LS Plant and Expand Existing RO Plant:

- Increasing the brackish water well capacity.
- LS Plant demolition.
- Existing RO system rehabilitation.
- RO system expansion in existing building.
- Degasifier Expansion
- Additional Deep Injection Well
- Post Treatment Chemical Upgrades
    - Corrosion control evaluation.
    - Conversion of chlorine gas to liquid sodium hypochlorite.

Major scope items involved in Alternative 3b – Decommission LS Plant and Construct New RO Facility:

- Increasing brackish water well capacity.
- LS Plant demolition.
- RO Plant demolition.
- New RO facility construction, including laboratory and staff housing
- RO system replacement and expansion.
- Degasifier Expansion
- Additional Deep Injection Well
- Post Treatment Chemical Upgrades
    - Corrosion control evaluation.
    - Conversion of chlorine gas to liquid sodium hypochlorite.

A phased approach would be required to continue providing water while construction occurs, Figure 4-3. The new RO Plant would be constructed in the wooded area located north of the existing RO Plant, Figure 4-4.

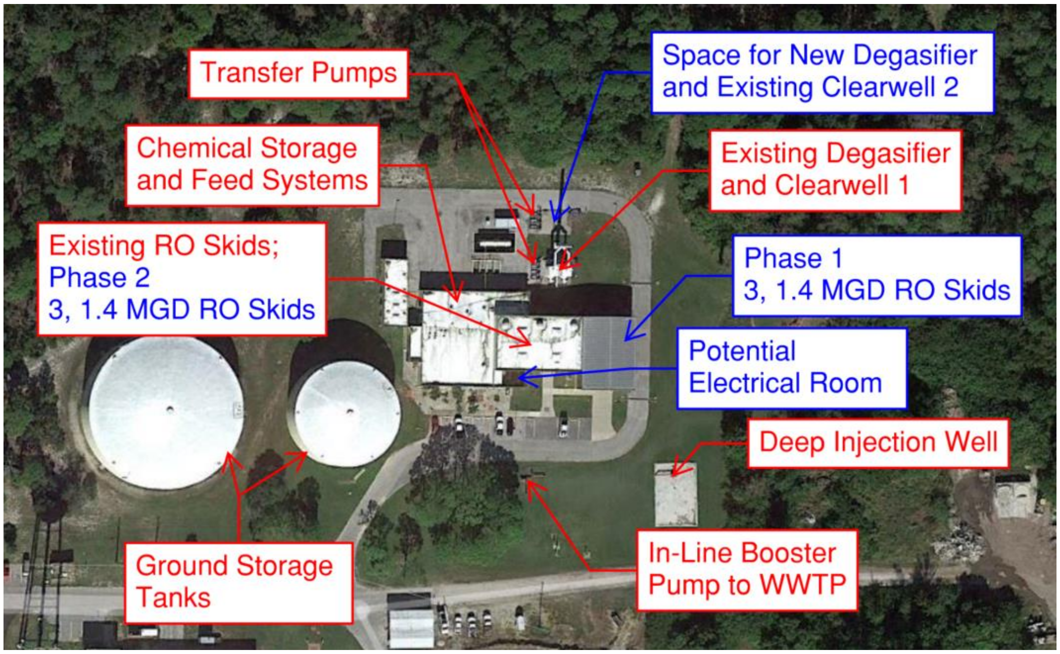

Figure 4-3 Alternative 3a Existing and Future RO Plant Locations (Phase 1 and 2)

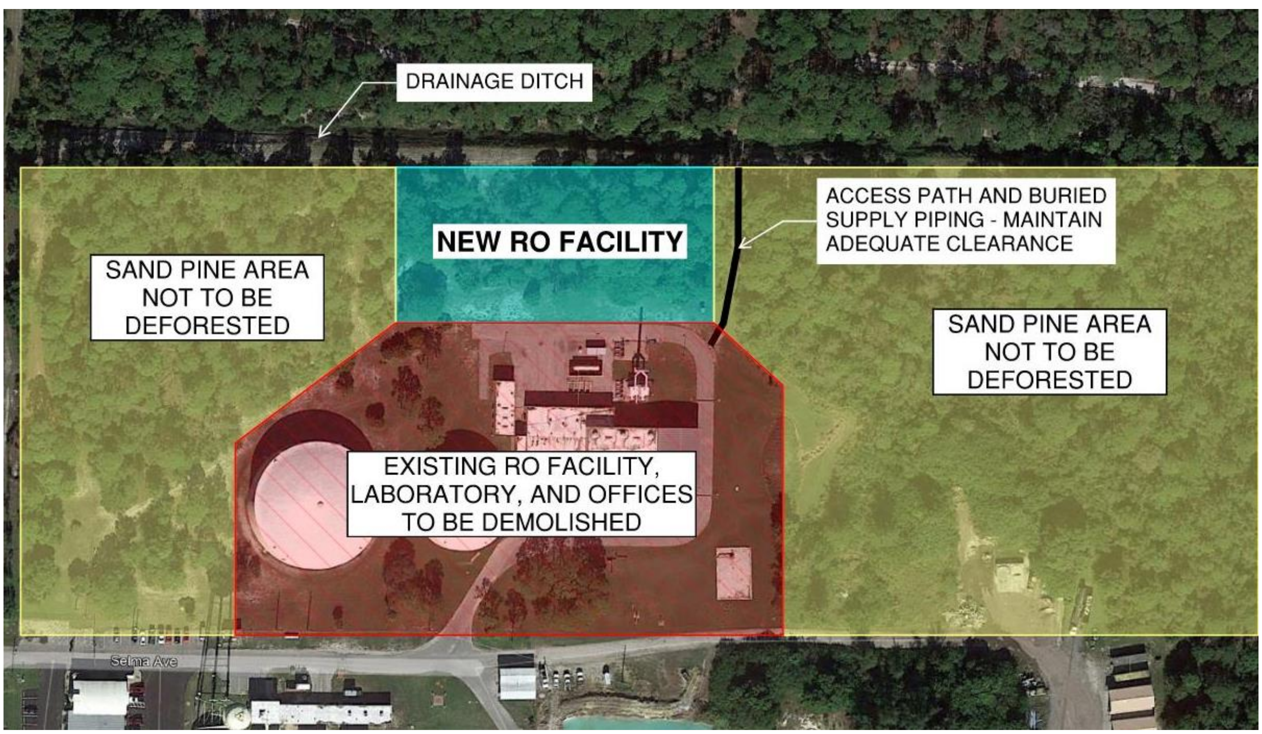

Figure 4-4 Alternative 3b Future RO Plant Location

4.4 Alternative Summary

The alternatives' advantages, disadvantages, and high-level costs of each alternative are summarized in Table 4-1.

Table 4-1 Water Supply and Treatment Alternative Comparison

Alternative	Estimated Capital Cost (2023 Dollars)	Key Advantages	Key Disadvantages
Alternative 1a – Rehabilitate the LS Plant and Rehabilitate and Expand the RO Plant	$40,520,000	• Less disruption to the current process • Shorter construction durations	• Lime sludge waste generation remains • Continued vulnerability of surficial aquifer to water supply stresses and wetland influence
Alternative 1b - Convert the LS Plant to Pellet Softening and Rehabilitation and Expand the RO Plant	$40,950,000	• Less waste generated • Uses caustic instead of lime	• Not in widespread use, emerging technology • Disruptive to the current site, longer construction • Continued vulnerability of surficial aquifer to water supply stresses and wetland influence
Alternative 2 – Replace the LS Plant with a Nanofiltration (NF) Plant and Rehabilitate and Expand the RO Plant	$50,520,000	• Compared to RO option: ○ Lower feed pressure ○ Operate at higher recoveries • Similar components used between the RO plant and NF plant • Enhanced TOC removal	• More costly than other softening options • Disruptive to the current site, longer construction • Increased membrane cleaning and replacement
Alternative 3 – Decommission LS Plant and Rehabilitate and Expand Existing RO Plant	$88,370,000	• Smaller footprint • Single treatment process • Allows upgrades to modern components and materials of construction	• Costly • Increased membrane cleaning and replacement • Significant brackish water supply expansion required • Risk of unforeseen site space and facility retrofit challenges
Alternative 3b – Decommission LS Plant and Rehabilitate and Construct New, Expanded RO Facility	$141,000,000	• Smaller footprint than current plant • Single treatment process • Allows upgrades to modern components and materials of construction • Hurricane hardened facility • New laboratory and emergency housing for employees • Least complicated construction • Can repurpose existing buildings for alternative uses to save cost	• Most costly • Increased membrane cleaning and replacement • Significant brackish water supply expansion required

5 Recommendations

5.1 Water Supply and Treatment Recommendations

While each alternative is reasonable to create the water treatment capacity expansion to 7 MGD, Alternative 3b is recommended. Providing the District with a new single treatment process with modernizations for process energy and operational efficiencies would allow for a more reliable facility for the community. A new RO facility and hardened building with new laboratory, modern operations control room, staff breakroom and restrooms, and emergency operations center could attract new workers. Construction would have the least impact to current operations. During construction, District staff can learn about modern processes installed, and the system can be placed online when all staff are comfortable with doing so. This alternative may require the least amount of piloting with any upgrade and lessen the complexity of blending two water types. Using RO treatment solely has the added benefit of potentially lessening system disinfection costs overall by having the highest probability of allowing the District to convert their disinfection strategy from chloramination to free chlorine, thereby eliminating the need for ammonia dosing systems. Furthermore, RO treatment is the only process considered for reasonable plant upgrades that inherently removes contaminants of emerging concern, creating a safer drinking water for Distrist customers. Table 5-1 below lists all the proposed projects for Alternative 3b.

Table 5-1 New WTP Projects for Alternative 3b

Master Plan ID	Name	Description
T-1	RO Plant Studies and Evaluations	Consists of further evaluations of an all-RO system in regard to water quality, energy, and operation.
T-2	New RO Facility	Includes the design and construction of a new RO facility with membrane components, non-membrane systems, and chemical systems, general plant site work, connecting to the existing system, and taking the existing RO and LS plants offline. To be online by 2028.
T-3	New Supply Wells	Project includes design and construction additional brackish supply wells for increased demand.
T-4	Disinfection Upgrades	Convert to liquid sodium hypochlorite and upsize to accommodate increased capacity.
T-5	New Deep Injection Well	Consists of designing and constructing a new deep injection well for the increased brine reject from the new RO facility.
T-6	Upsize Ammonia System	Upsize ammonia storage and dosing system to treat 7 MGD.
T-7	New Degasifiers	Construct a new 5-MGD degasifier on Clearwell #2 and replace 3-MGD unit with a new 5-MGD unit to provide adequate redundancy in case one unit needs to be taken offline. Assumes that two clearwells will be adequate to treat 7 MGD. Further evaluation needed to consider expansion of clearwell capacity to meet required contact time.
T-8	Clearwell Repairs	Repair areas with corrosion damage.
T-9	New Supply Well Pipeline	Project includes a supply well pipeline from the wellfield to the treatment facilities site.
T-10	Abandonment of Freshwater Wellfields	Plug and cap existing wells and demolish existing wellheads. To be started after lime softening process has been decommissioned.

5.2 Distribution System Recommendations

For the distribution system, HDR recommends addressing the primary areas of concern seen in the model: Manasota Key, Japanese Gardens, Englewood Isles, Englewood Rd, and the Southeast Region of Grove City and Mobile Gardens. The areas show a sensitivity to increased demand resulting in an increase in head loss.

As shown in Figure 5-1 and Table 5-2, there are five pipelines that are recommended for CIPs. The CIPs are numbered according to priority: number D-1 being the most urgent and the most impactful to the system and number D-5 affecting the least number of customers. Each of these CIPs was modeled as an additional parallel pipeline with no tie overs along the assumed path. Before any of these improvements were analyzed the discharge pressure at the Pump Station was increased to 70 psi as recommended for consideration in Project 6. Additionally, Project D-7 is recommended to improve distribution system understanding and effectiveness of the modeling tool.

HDR modeled how the future distribution system will perform after the above CIPs are implemented. Two alternatives provided similar levels of service in the results because project D-5 could replace projects D-2 and D-3. Projects D-1, D-4, D-5, D-6, and D-7 will be considered Alternative 1 and projects D-1, D-2, D-3, D-4, D-6, and D-7 will be considered Alternative 2.

Alternatives 1 and 2 both evenly distribute pressure throughout the system in the 2043 projection. In the 2073 projection, Alternative 1 has lower pressure in the southmost area of the system, while Alternative 2 keeps a low pressure throughout the system. The velocity distributions are similar for both alternatives; however, Alternative 1 distributes a higher velocity at the center of Manasota Key, while Alternative 2 distributes a higher velocity at the ends of Manasota Key. Both Alternatives provide similar fire flow distribution; however, Alternative 1 provides more fire flow availability at Manasota Key.

Alternatives 1 and 2 provide similar improvements of the systems velocity distribution and fire flow availability, but Alternative 2 provides a better long-term distribution of pressure throughout the network. Alternative 1 will be less impactful on the community, while construction on the beach roads in Alternative 2 will require a traffic control plan.

The full detail of these projects and recommendations is in the Distribution System Evaluation TM in Appendix D.

Table 5-2: Proposed Distribution System Improvement Projects

Master Plan ID	Name	Description
D-1	Englewood Road Pipeline Upgrade	Consists of 11,000 ft of 20-in diameter pipe improvements along Englewood Rd.
D-1a (Alternative Route)	Englewood Road Pipeline Upgrade – Alternative Route via Keyway Road	Consists of 20,500 ft of 20-in diameter pipe improvements connecting to the existing 24-in diameter pipe east of Boca Royale Development, and traveling north to Keyway Rd, west along Keyway Rd, and then north along Englewood Rd. This alternative will be more costly than D-1 but will cause less disturbance to customers.
D-2	Manasota Beach Road Pipeline Upgrade	Consists of 8,800 ft of 20-in diameter pipe improvements along Manasota Beach Rd.
D-3	Beach Road Pipeline Upgrade	Consists of 6,000 ft of 16-in diameter pipe improvements along Beach Rd.
D-4	Alamander Avenue Pipeline Upgrade	Consists of 5,000 ft of 12-in diameter additional pipe along Alamander Ave.
D-5	Lemon Bay Pipeline Upgrade	An alternative to projects D-2 and D-3, pipe improvements consisting of 5,100 ft of trenchless 16-in diameter pipe and 2,500 ft of open cut 16-in diameter pipe along Lemon Bay.
D-6	Pump Station Rehabilitation and Upgrade	This project provides funding for pump station to be able to serve 70 psi to the distribution system. Includes a new centrifugal pump (12.9 MGD) and a new 10,000-gallon hydropneumatic tank to maintain system pressure of 70 psi.
D-7	Hydraulic Model Upgrades	This project includes a further analysis of the distribution system. These upgrades will include adding smaller pipes to the model as well as water quality test points to fine tune areas of impact and identify and address “dead zones” in the system.

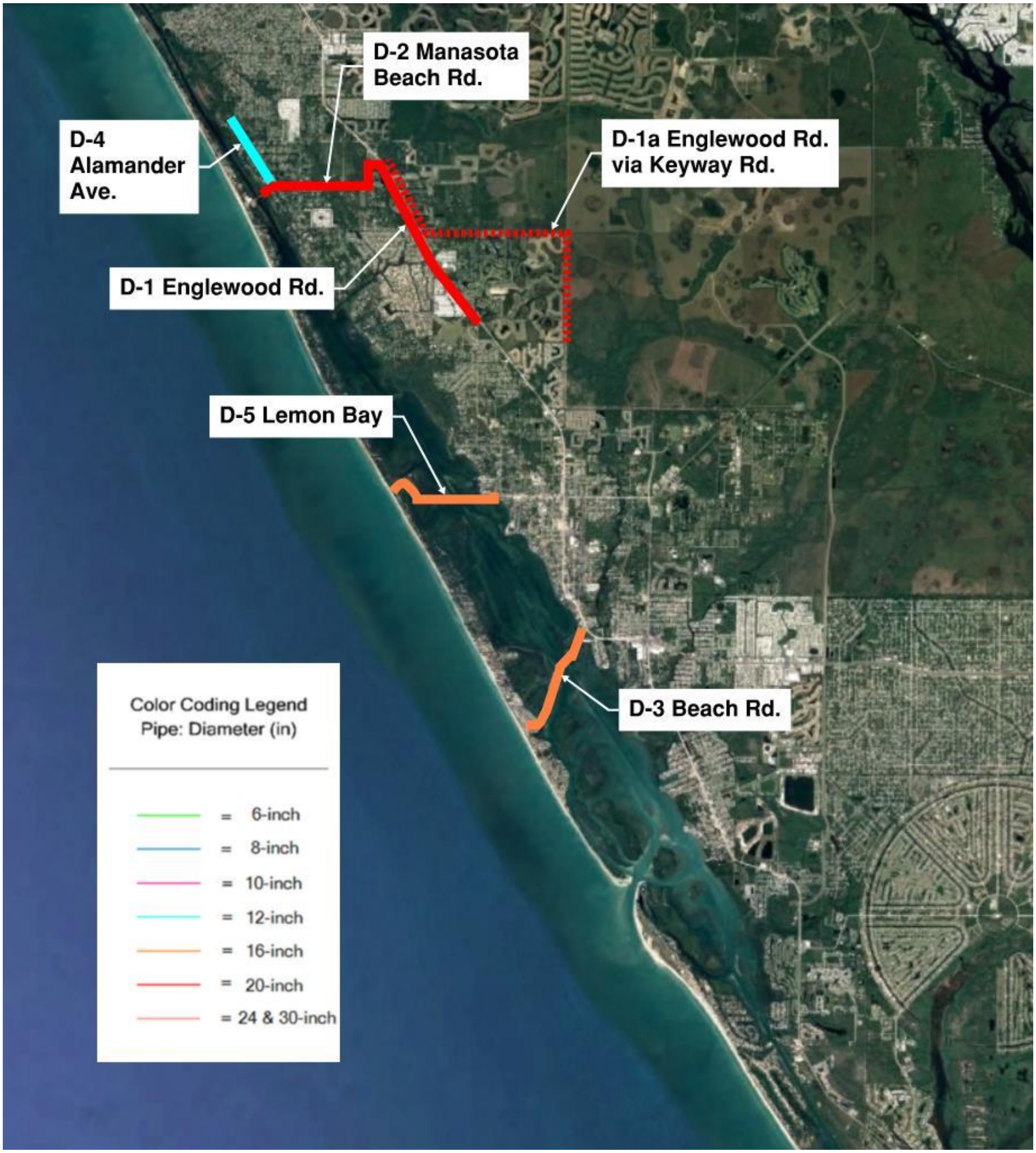

Figure 5-1 Distribution System Improvement Considerations

6 Capital Planning

Facility improvements identified are to be incorporated into the District's capital improvement plan (CIP). CIP planning involved Class V capital cost estimation, benefit scoring, and economic analysis. These efforts are further described in the following subsections.

6.1 Capital Cost Development

HDR proposes 17 projects to address the recommendations in this Master Plan update. Capital costs for each of these projects were developed through a combination of three methods:

1. CostSPACE – HDR's proprietary parametric tool which uses actual costs from HDR projects to develop cost curves for major WTP and pump station processes. Users input capacity demand for the process and the tool provides an estimate of capital cost, annual O&M costs, and 20-year net present value. This method was used to estimate costs of major processes such as the vertical turbine pump stations.
2. Quantity take-offs – Standard method of applying a unit cost to an estimated quantity of material. This method was used to estimate the cost of improvements such as the transmission main replacements.
3. Vendor quotes – Vendor costs were used to estimate costs of major process equipment such as pumps and electrical equipment.

Base costs were developed into capital costs after the application of appropriate multipliers and contingencies. Cost estimates are in 2023 dollars and include applicable demolition, sitework, electrical components, instrumentation, and electrical equipment. HDR does not guarantee that proposals, bids or actual project or construction cost will not vary from opinions of probable cost that HDR prepares. The following assumptions were applied to estimate these factors:

- Costs are AACE Class IV estimates (-30% / +50%)
- Costs based on 2023 dollars
- Distribution system project (D-#) costs are based on the following:
  - Length and diameter of pipe
  - HDPE pipe
  - Type of construction (trenchless or open cut)
- Treatment project (T-#) costs include the following:
  - Equipment
  - Demolition
  - Sitework
  - Electrical
  - Instrumentation

initiation.

Table 6-1 lists the recommended CIP projects along with their respective costs and a recommended year to begin design and construction. Project scheduling is based on assessed urgencies and dependencies, but the District may choose to alter the project timelines as needed. Figure 6-1 illustrates the total costs laid out on the recommended timeline, assuming that all project costs are encumbered the year of project initiation.

Table 6-1: CIP Project Descriptions and Capital Costs in 2023 Dollars

ID	Name	Description	Total Cost	Timeline
D-1	Englewood Road Pipeline Upgrade	Consists of 11,000 ft of 20-in diameter pipe improvements along Englewood Rd.	$8,100,000	2028
D-1a	Englewood Road Pipeline Upgrade – Alternative Route via Keyway Road	Consists of 20,500 ft of 20-in diameter pipe improvements connecting to the existing 24-in diameter pipe east of Boca Royale Development, and traveling north to Keyway Rd, west along Keyway Rd, and then north along Englewood Rd. This alternative will be more costly than D-1 but will cause less disturbance to customers.	$15,100,000	2028
D-2	Manasota Beach Road Pipeline Upgrade	Consists of 8,800 ft of 20-in diameter pipe improvements along Manasota Beach Rd.	$7,820,000	2031
D-3	Beach Road Pipeline Upgrade	Consists of 6,000 ft of 16-in diameter pipe improvements along Beach Rd.	$2,890,000	2034
D-4	Alamander Avenue Pipeline Upgrade	Consists of 5,000 ft of 12-in diameter additional pipe along Alamander Ave.	$3,170,000	2036
D-5	Lemon Bay Pipeline Upgrade	An alternative to projects D-2 and D-3, pipe improvements consisting of 5,100 ft of trenchless 16-in diameter pipe and 2,500 ft of open cut 16-in diameter pipe along Lemon Bay.	$9,490,000	2031
D-6	Pump Station Rehabilitation and Upgrade	This project provides funding for pump station to be able to serve 70 psi to the distribution system. Includes a new centrifugal pump (12.9 MGD) and a new 10,000-gallon hydropneumatic tank to maintain system pressure of 70 psi.	$2,220,000	2026
D-7	Hydraulic Model Upgrades	This project includes a further analysis of the distribution system. These upgrades will include adding smaller pipes to the model as well as water quality test points to fine tune areas of impact and identify and address “dead zones” in the system.	$400,000	2032
T-1	RO Plant Studies and Evaluations	Consists of further evaluations of an all-RO system regarding water quality, energy, and operation.	$50,000	2024
T-2	New RO Facility	Includes the design and construction of a new RO facility with membrane components, non-membrane systems, and chemical systems, general plant site work, connecting to the existing system, and taking the existing RO and LS plants offline. To be online by 2028.	$81,580,000	2025
T-3	New Supply Wells	Project includes design and construction additional brackish supply wells for increased demand.	$33,610,000	2025
T-4	Disinfection Upgrades	Convert to liquid sodium hypochlorite and upsize to accommodate increased capacity.	$800,000	2025
T-5	New Deep Injection Well	Consists of designing and constructing a new deep injection well for the increased brine reject from the new RO facility.	$8,660,000	2025
T-6	Upsize Ammonia System	Upsize ammonia storage and dosing system to treat 7 MGD.	$450,000	2025
T-7	New Degasifiers	Construct a new 5-MGD degasifier on Clearwell #2 and replace 3-MGD unit with a new 5-MGD unit to provide adequate redundancy in case one unit needs to be taken offline. Assumes that two clearwells will be adequate to treat 7 MGD. Further evaluation needed to consider expansion of clearwell capacity to meet required contact time.	$1,360,000	2025
T-8	Clearwell Repairs	Repair areas with corrosion damage.	$260,000	2026
T-9	New Supply Well Pipeline	Project includes a supply well pipeline from the wellfield to the treatment facilities site.	$13,450,000	2026
T-10	Abandonment of Freshwater Wellfields	Plug and cap existing wells and demolish existing wellheads. To be started after lime softening process has been decommissioned.	$810,000	2030

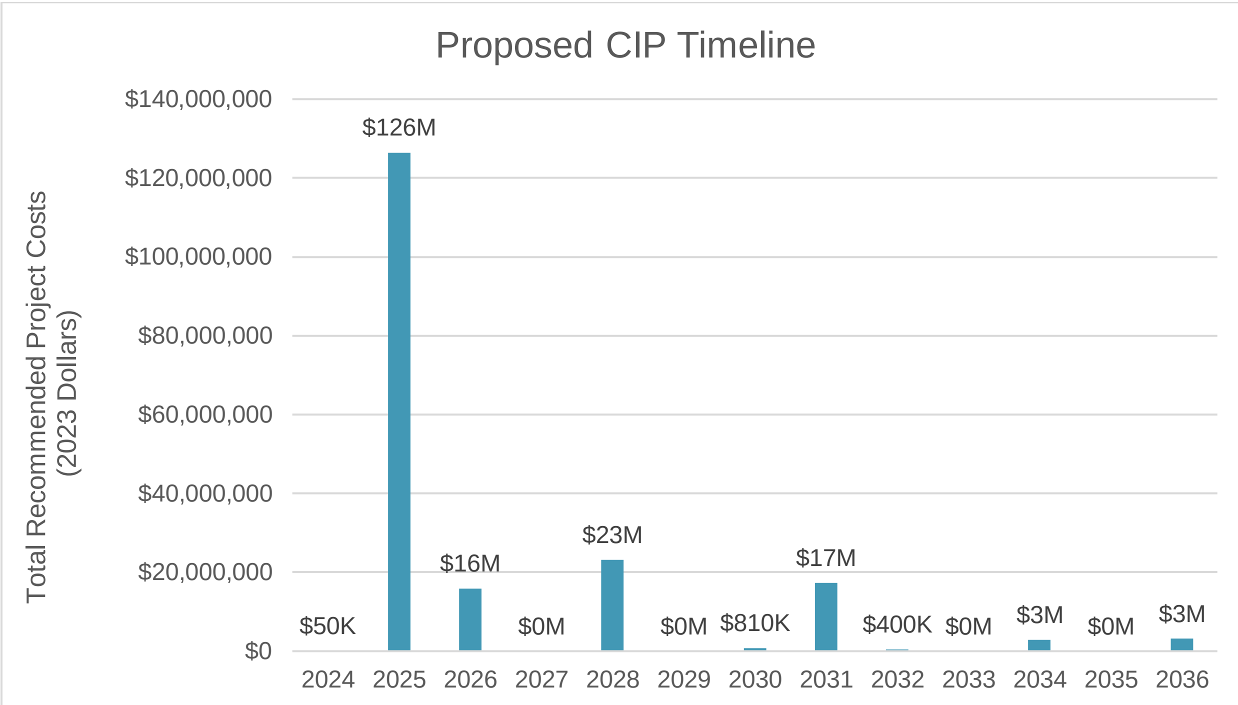

Figure 6-1: Total Recommended CIP Encumbered Costs and Timeline