MARINA COAST WATER DISTRICT

2019

WATER MASTER PLAN

Final Draft
(Excluding Capacity Fees)

April 2019

AKEL
ENGINEERING GROUP, INC.

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Smart Planning Our Water Resources

April 12, 2019

Marina Coast Water District
2840 4th Avenue
Marina, CA 93933

Attention: Mike Wegley, P.E.
District Engineer

Subject: 2019 Water Master Plan – Draft Report

Dear Mike:

We are pleased to submit the draft report for the Marina Coast Water District Water Master Plan. This master plan is a standalone document, though it was prepared as part of the integrated infrastructure master plans for the water, sewer, and recycled water master plans. The master plan documents the following:

- Existing distribution system facilities, acceptable hydraulic performance criteria, and projected water demands consistent within the District service area.
- Development and calibration of the District's GIS-based water system hydraulic model.
- Capacity evaluation of the existing water system with improvements to mitigate existing deficiencies and to accommodate future growth.
- Capital Improvement Program (CIP) with an opinion of probable construction costs and suggestions for cost allocations to meet AB 1600.

We extend our thanks to you; Keith Van Der Maaten, General Manager; Brian True, Senior Civil Engineer; and other District staff whose courtesy and cooperation were valuable components in completing this study.

Sincerely,

AKEL ENGINEERING GROUP, INC.

Tony Akel, P.E.
Principal

Enclosure: Report

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CHAPTER 1 - INTRODUCTION

This chapter provides a brief background of the Marina Coast Water District's (District) domestic water system, the need for this master plan, and the objectives of the study. Abbreviations and definitions are also provided in this chapter.

1.1 BACKGROUND

The Marina Coast Water District (District) is located approximately 10 miles north of the City of Monterey, 8 miles east of the City of Salinas, and 3 miles south of the City of Castroville (**Figure 1.1**). The District provides potable water service to approximately 36,000 residents, as well as a myriad of commercial, industrial, and institutional establishments. The District operates a domestic water distribution system that consists of 7 active groundwater wells, more than 162 miles of pipelines, and 7 active storage tanks equating to 9.2 million gallons (MG). The District's water system serves two distinct service areas, Central Marina and the Ord Community.

For the District's Central Marina service area, a Water System Master Plan (WSMP) was developed in 2007 that identified capacity deficiencies in the existing water system and recommended improvements to alleviate existing deficiencies and serve future developments. A similar plan was developed for the District's Ord Community service area in 2004.

Recognizing the importance of planning, developing, and financing system facilities to provide reliable water service to existing customers and for servicing anticipated growth within the service area, the District initiated updating elements of the previous master plans to reflect current land use conditions, and to consolidate the plans into one comprehensive planning document.

1.2 SCOPE OF WORK

Marina Coast Water District approved Akel Engineering Group Inc. to prepare this master plan in November of 2016. This 2019 Water Master Plan is intended to serve as a tool for planning and phasing the construction of future domestic water system infrastructure for the projected buildout of the Marina Coast Water District. The 2019 WMP evaluates the District's water system and recommends capacity improvements necessary to service the needs of existing users and for servicing the future growth of the District.

Should planning conditions change, and depending on their magnitude, adjustments to the master plan recommendations might be necessary.

This master plan includes the following tasks:

- Summarizing the District's existing domestic water system facilities
- Documenting growth planning assumptions and known future developments

Monterey Bay

Pacific Ocean

Salinas River State Beach

Salinas River National Wildlife Refuge

Marina

Salinas

Fort Ord Dunes State Park

Pacific Grove

Sand City

Seaside

Fort Ord National Monument

Monterey

Del Rey Oaks

Toro County Park

Jacks Peak Park

Carmel By-The-Sea

1 68 101 183

0 0.5 1 2 Miles

N W GIS E S

Updated: January 4, 2017

Sources: Esri, USGS, NOAA

File Path: P:\xGIS\GIS_Projects\Marina_Coast_WD\Water\MCWD_Fig1-1_RLM_010417.mxd

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Legend

- Major Highways
- City Limits
- Urbanized Area
- Protected Open Space
- Rivers/Streams
- Waterbodies

PRELIMINARY

Figure 1.1
Regional Location Map

Water Master Plan
Marina Coast Water District

MARINA COAST WATER DISTRICT

- Updating the domestic water system performance criteria
- Projecting future domestic water demands
- Updating and calibrating a new hydraulic model using Geographic Information Systems (GIS) data
- Evaluating the domestic water facilities to meet existing and projected demand requirements and fire flows
- Performing a capacity analysis for major distribution mains
- Performing a fire flow analysis
- Recommending a capital improvement program (CIP) with an opinion of probable costs
- Performing a capacity allocation analysis for cost sharing purposes
- Developing a 2019 Water Master Plan report

1.3 INTEGRATED APPROACH TO MASTER PLANNING

The District implemented an integrated master planning approach and contracted the services of Akel Engineering Group to prepare the following documents:

- Water Master Plan
- Sewer Master Plan
- Recycled Water Master Plan

While each of these reports is published as a standalone document, they have been coordinated for consistency with the various planning documents within the District's service area. Additionally, each document has been cross referenced to reflect relevant analysis results with the other documents.

1.4 PREVIOUS MASTER PLANS

The District's most recent water master plans were completed in 2007 for the combined City of Marina and Fort Ord Community service areas, with a standalone water master plan completed for the Fort Ord Community service area in 2004. These master plans included an evaluation of servicing growth to the planning boundaries, evaluated existing demands and projected future demands, and recommended phased improvements to the water system for a horizon year of 2025.

1.5 RELEVANT REPORTS

Various reports and special studies intended to evaluate localized growth have been completed for the various jurisdictions within the District's service area. These reports were referenced and used during this capacity analysis. The following lists relevant reports that were used in the completion of this master plan, as well as a brief description of each document:

- **Marina Coast Water System Master Plan, November 2006 (2007 WSMP).** This report documents the planning and performance criteria, evaluates the water system, recommends improvements, and provides an estimate of costs.

- **Ord Water System Master Plan, June 2004 (2004 WSMP).** This report documents the planning and performance criteria, evaluates the water system, recommends improvements, and provides an estimate of costs.

- **City of Marina General Plan, December 2006, (2006 General Plan).** The City's 2006 General Plan provides future land use planning, and growth assumptions for the planning areas. Additionally, this report establishes the planning horizon for improvements in this master plan.

- **County of Monterey General Plan, October 2010.** The County's 2010 General Plan addresses unincorporated areas of the County and considers the general plans of cities within the County to allow for cooperative planning. The Fort Ord Land Use Plan provided within the County's 2010 General Plan was used to assist in the development of the potential future land use within the District's service area.

- **City of Monterey General Plan, January 2005.** The City's 2005 General Plan provides future land use planning and growth assumptions. These growth assumptions were used to assist in the development of the potential future land use within the District's service area, generally along South Boundary Road.

- **City of Seaside General Plan, August 2004.** The City of Seaside's 2004 General Plan provides future land use planning and growth assumptions. These growth assumptions were used to assist in the development of the potential future land use within the District's service area, generally along General Jim Moore Boulevard south of Inter-Garrison Road.

- **City of Del Rey Oaks General Plan, January 1997.** The City of Del Rey Oaks' 1997 General Plan provides future land use planning and growth assumptions. These growth assumptions were used to assist in the development of the potential future land use within the District's service area, generally along South Boundary Road east of General Jim Moore Boulevard.

- **California State University, Monterey Bay Draft Campus Master Plan, June 2017.** The California State University, Monterey Bay's (CSUMB) Draft Campus Master Plan provides future land use planning and growth assumptions for the exiting campus. These growth assumptions were used to assist in the development of the planned future land use of the CSUMB campus within the District's service area.

- **Fort Ord Reuse Plan, June 1997 (1997 FORP).** The Fort Ord Reuse Plan, prepared by the Fort Ord Reuse Authority, provides future land use planning and development assumptions for lands that are part of the former Fort Ord.

- **Marina Coast Water District 2015 Urban Water Management Plan, (2015 UWMP).** The 2015 Urban Water Management Plan (UWMP) establishes a benchmark per capita water usage and targets in order to achieve higher levels of water conservation for the sustainability of water supply sources. This includes adopting an updated water shortage contingency plan, defining supply sources, addressing supply reliability, and projecting sustainable supply yields and future demands.

1.6 REPORT ORGANIZATION

The water system master plan report contains the following chapters:

Chapter 1 - Introduction. This chapter provides a brief background of the Marina Coast Water District's (District) domestic water system, the need for this master plan, and the objectives of the study. Abbreviations and definitions are also provided in this chapter.

Chapter 2 - Planning Areas Characteristics. This chapter presents a discussion of the planning area characteristics for this master plan and defines the land use classifications. This chapter also provides a description of the water service area and historical and projected population.

Chapter 3 - Existing Domestic Water Facilities. This chapter presents the District's performance and design criteria, which was used in this analysis for identifying current system capacity deficiencies and for sizing proposed distribution mains, storage reservoirs, and wells.

Chapter 4 - System Performance and Design Criteria. This chapter provides a description of the District's existing domestic water system facilities including the existing wells, pressure zones, distribution mains, storage reservoirs, and booster pump stations.

Chapter 5 - Water Demands and Supply Characteristics. This chapter summarizes existing domestic water demands and projects the future domestic water demands.

Chapter 6 - Hydraulic Model Development. This chapter describes the development and calibration of the District's domestic water distribution system hydraulic model. The hydraulic model was used to evaluate the capacity adequacy of the existing system and to plan its expansion to service anticipated future growth.

Chapter 7 - Evaluation and Proposed Improvements. This section presents a summary of the domestic water system evaluation and identifies improvements needed to mitigate existing deficiencies, as well as improvements needed to expand the system and service growth.

Chapter 8 - Capital Improvement Program. This chapter provides a summary of the recommended domestic water system improvements to mitigate existing capacity deficiencies and to accommodate anticipated future growth. The chapter also presents the cost criteria and methodologies for developing the capital improvement program. Finally, a capacity allocation analysis, usually used for cost sharing purposes, is also included.

Chapter 9 – Water System Capacity Fees. This chapter provides a summary of the review and update of the District's water system capacity fees. The Capacity Fee analysis was completed by Bartle Wells. This section was extracted directly from the Bartle Wells report.

1.7 ACKNOWLEDGEMENTS

Obtaining the necessary information to successfully complete the analysis presented in this report, and developing the long term strategy for mitigating the existing system deficiencies and for accommodating future growth, was accomplished with the strong commitment and very active input from dedicated team members including:

- Keith Van Der Maaten, General Manager
- Michael Wegley, District Engineer
- Derek Cray, Maintenance and Operations Manager
- Brian True, Senior Civil Engineer
- Jaron Hollida, Assistant Engineer
- Andrew Racz, Associate Engineer
- Andy Sterbenz, Consultant

1.8 UNIT CONVERSIONS AND ABBREVIATIONS

Engineering units were used in reporting flow rates and volumes pertaining to the design and operation of various components of the domestic water distribution system. Where it was necessary to report values in smaller or larger quantities, different sets of units were used to describe the same parameter. Values reported in one set of units can be converted to another set of units by applying a multiplication factor. A list of multiplication factors for units used in this report is shown on **Table 1.1**. Various abbreviations and acronyms were also used in this report to represent relevant water system terminologies and engineering units. A list of abbreviations and acronyms is included in **Table 1.2**.

1.9 GEOGRAPHIC INFORMATION SYSTEMS

This master planning effort made extensive use of Geographic Information Systems (GIS) technology, for completing the following tasks:

- Develop the physical characteristics of the hydraulic model (pipes and junctions, wells, and storage reservoirs)
- Allocate existing water demands, as extracted from the water billing records, and based on each user's physical address
- Calculate and allocating future water demands, based on future developments water use
- Extract ground elevations along the distribution mains from available contour maps
- Generate maps and exhibits used in this master plan

Table 1.1 Unit Conversions

Water Master Plan

Marina Coast Water District

PRELIMINARY

Volume Unit Calculations		
To Convert From:	**To:**	**Multiply by:**
acre feet	gallons	325,851
acre feet	cubic feet	43,560
acre feet	million gallons	0.3259
cubic feet	gallons	7.481
cubic feet	acre feet	2.296×10^{-5}
cubic feet	million gallons	7.481×10^{-6}
gallons	cubic feet	0.1337
gallons	acre feet	3.069×10^{-6}
gallons	million gallons	1,000,000
million gallons	gallons	1×10^{-6}
million gallons	cubic feet	133,672
million gallons	acre feet	3.069

Flow Rate Calculations		
To Convert From:	**To:**	**Multiply By:**
ac-ft/yr	mgd	8.93×10^{-4}
ac-ft/yr	cfs	1.381×10^{-3}
ac-ft/yr	gpm	0.621
ac-ft/yr	gpd	892.7
cfs	mgd	0.646
cfs	gpm	448.8
cfs	ac-ft/yr	724
cfs	gpd	646300
gpd	mgd	1×10^{-6}
gpd	cfs	1.547×10^{-6}
gpd	gpm	6.944×10^{-4}
gpd	ac-ft/yr	1.12×10^{-3}
gpm	mgd	1.44×10^{-3}
gpm	cfs	2.228×10^{-3}
gpm	ac-ft/yr	1.61
gpm	gpd	1,440
mgd	cfs	1.547
mgd	gpm	694.4
mgd	ac-ft/yr	1,120
mgd	gpd	1,000,000

Table 1.2 Abbreviations and Acronyms

Water Master Plan

Marina Coast Water District

PRELIMINARY

Abbreviation	Expansion	Abbreviation	Expansion
2007 WSMP	2007 Water System Master Plan	gpm	Gallons per minute
2019 WMP	2019 Water Master Plan	GSA	Groundwater Sustainability Agency
AACE International	Association for the Advancement of Cost Engineering	hp	Horsepower
AC	Acre	HGL	Hydraulic grade line
ACP	Asbestos Cement Pipe	HWL	High water level
ADD	Average Day Demand	in	Inch
Akel	Akel Engineering Group, Inc.	LAFCO	Local Agency Formation Commission
CCI	Construction Cost Index	LF	Linear feet
CDPH	California Department of Public Health	MCWRA	Monterey County Water Resources Agency
cfs	Cubic feet per second	MDD	Maximum day demand
CI	Cast Iron Pipe	MG	Million gallons
CIB	Capital Improvement Budget	MGD	Million gallons per day
CIP	Capital Improvement Program	MMD	Maximum month demand
CSIP	Castroville Seawater Intrusion Project	MPWMD	Monterey Peninsula Water Management District
DIP	Ductile Iron Pipe	M1W	Monterey One Water
District / MCWD	Marina Coast Water District	NFPA	National Fire Protection Association
DDW	Division of Drinking Water	PHD	Peak hour demand
DU	Dwelling Unit	PRV	Pressure reducing valve
EDU	Equivalent Dwelling Unit	psi	Pounds per square inch
ENR	Engineering News Record	ROW	Right of Way
EPA	Environmental Protection Agency	SCADA	Supervisory Control and Data Acquisition
EPS	Extended Period Simulation	SOI	Sphere of Influence
FORA	Fort Ord Reuse Authority	SVGB	Salinas Valley Groundwater Basin
FRC	Facility Reserve Charge	SVWP	Salinas Valley Water Project
ft	Feet	SWRCB	State Water Resources Control Board
fps	Feet per second	TBD	To be determined
FY	Fiscal Year	ULL	Urban Limit Line
GIS	Geographic Information Systems	UWMP	Urban Water Management Plan
gpd	Gallons per day	WMP	Water Master Plan
gpdc	Gallons per day per capita	WTP	Water Treatment Plant

CHAPTER 2 - PLANNING AREA CHARACTERISTICS

This chapter presents a discussion of the planning area characteristics for this master plan and defines the land use classifications. This chapter also provides a description of the water service area and historical and projected population.

2.1 STUDY AREA DESCRIPTION

The Marina Coast Water District is located in Monterey County on the west coast of California, south of the City of San Francisco. The District is located approximately 10 miles north of the City of Monterey, 8 miles east of the City of Salinas, and 3 miles south of the City of Castroville. Pacific Coast Highway 101 runs from south to north near the District's western boundary. The District currently serves more than 36,000 customers and encompasses an area greater than 29,000 acres.

The District service area is generally bound to the north by Marina Green Drive, to the east by Reservation Road, to the west by Pacific Coast Highway 1, and to the south by Road 218. The topography generally slopes downward toward the ocean from west to east, with elevations ranging between 50 feet to more than 400 feet. **Figure 2.1** displays the District's existing service area and the local municipal boundaries.

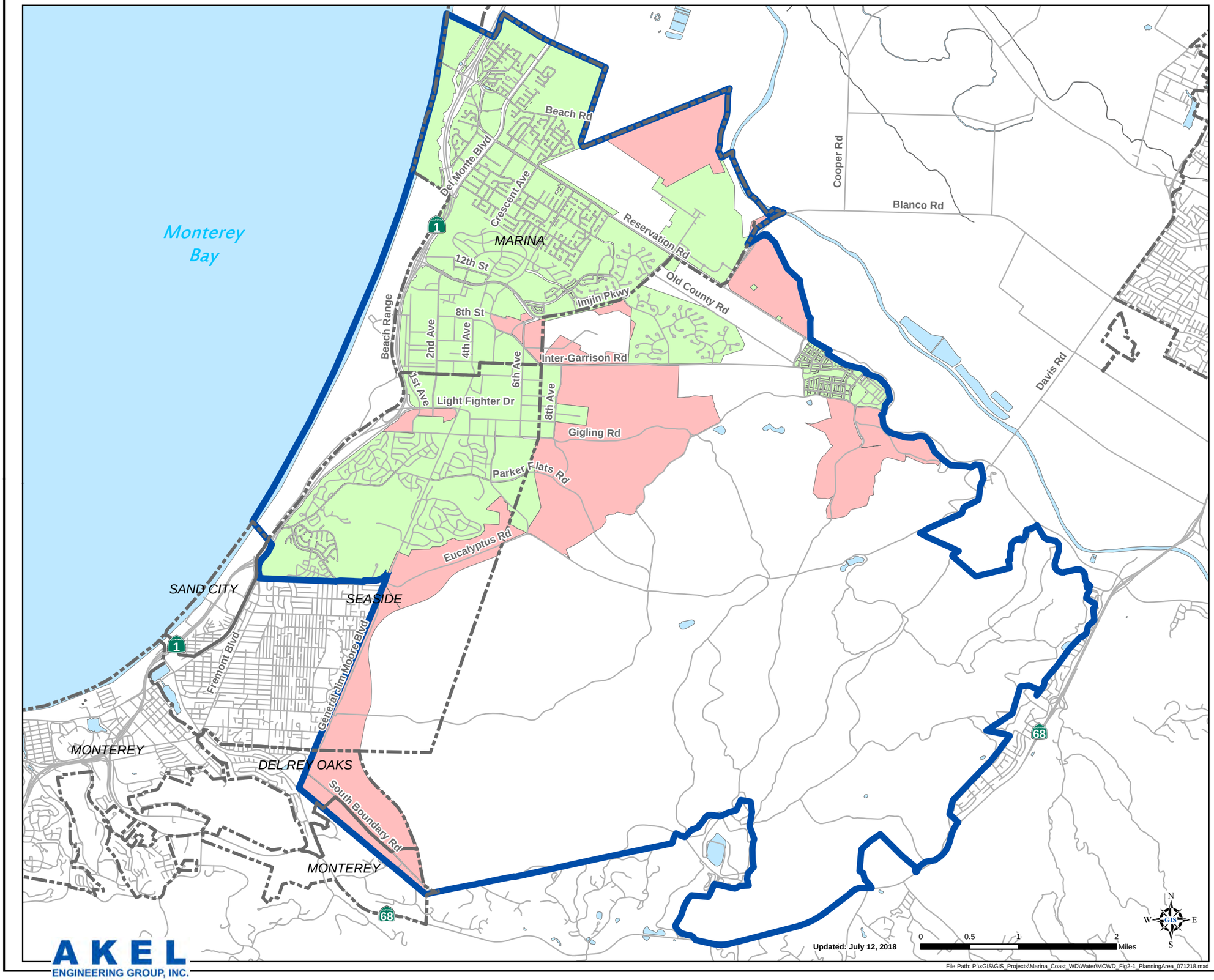
The District operates and maintains a domestic water system that extends from the City of Marina throughout the former Fort Ord area; currently, the domestic water system is supplied from groundwater wells generally located along Reservation Road.

2.2 WATER SERVICE AREA

The District's water system services residential and non-residential lands within the District limits, as shown on **Figure 2.1**. The District's water service area can generally be divided into two regions: Central Marina and the Fort Ord Community. The boundaries and planning area characteristics of these two regions are briefly described in the following sections:

2.2.1 Central Marina Service Area

The Central Marina service area region is the portion of the City of Marina outside of the Ord Community, generally north of Patton Parkway and west of Salinas Avenue. The future development within this service area region is generally comprised of the development of vacant parcels located throughout the city as well as one large area of potential development generally north of Beach Road.



Legend

- Planning Boundary
- Existing Service Area
- Future Study Area
- Municipal Boundaries
- Rivers/Streams
- Waterbodies

PRELIMINARY

Figure 2.1
Planning Area

Water Master Plan
Marina Coast Water District

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2.2.2 Ord Community Service Area

The Ord Community service area region includes developed, vacant, and designated open space lands within the former Fort Ord as well as portions of the County of Monterey, City of Seaside, City of Marina, the City of Monterey, and City of Del Rey Oaks. The potential future development within this area is generally comprised of the new development on currently vacant lands. For conservative planning purposes the master plan assumes the buildout development of potential developable lands, however the Fort Ord Reuse Authority (FORA) has established limits for growth within the former Fort Ord area, which are briefly summarized as follows:

2.2.2.1 15-Year Development Areas

In addition to outlining improvements, the FORA capital improvement plan specifies the allowable development within the former Fort Ord area. These allowable developments typically represent a portion of the potential developable lands and are summarized on **Table 2.1**. The potential acreages associated with these development limits, summarized on **Table 2.2**, were estimated for the purposes of establishing future water demands. These acreages were based on the following general assumptions:

- Residential: Future dwelling units were converted to acreages based on an average dwelling unit density of 8 du/acre
- Office, Industrial, Commercial: Future square feet of development were converted to acreages based on an average floor-area-ratio of 0.6.
- Hotel: Acreages for future hotels were estimated based on various planning documents and County of Monterey parcel database

2.2.2.2 Parker Flats Land Use Swap

The 1997 Fort Ord Installation-Wide Multi-Species Habitat Management Plan (1997 HMP) identified up to 6,300 acres throughout the Fort Ord base that could potentially develop from vegetation and habitat to a municipal-type use. As part of the 1997 HMP, East Garrison development was limited to 200 acres, with the majority of development slated for the Parker Flats are of Fort Ord. In 2002, FORA, the County of Monterey, and Monterey Peninsula College submitted a proposal to modify the 1997 HMP land use, specifically allowing for more development in the East Garrison area, while converting developable lands in Parker Flats to habitat reserve areas. This proposal was submitted as an official Land Swap Agreement (LSA) to the United States Army and the United States Fish and Wildlife Service.

The LSA ultimately allowed for an additional 210 acres of land to be developed at East Garrison, while converting approximately 447 acres of land within Parker Flats to habitat reserve. The Memorandum of Understanding (MOU) for the LSA was signed on October 14, 2003.

Table 2.1 Fort Ord Reuse Authority 10-Year Development Limits

Water Master Plan

Marina Coast Water District

PRELIMINARY

Development Areas[1]	Residential (du)	Office (sf)	Industrial (sf)	Commercial (sf)	Hotel Rooms
Campus Town Specific Plan					
26 Acre Parcel (Planned)	150	0	0	0	0
Campus Town / 26 Acre (Planned)	0	10,000	30,000	40,000	300
Campus Town / Surplus II (Planned)	0	10,000	40,000	50,000	0
Surplus II (Planned)	238	0	0	0	0
Subtotal	388	20,000	70,000	90,000	300
Cypress Knolls					
Cypress Knolls (Entitled)	712	0	0	0	0
Del Rey Oaks					
Del Rey Oaks (Planned)	691	0	0	0	0
Del Rey Oaks RV Park (Entitled)	0	400,000	0	0	0
Del Rey Oaks RV Park (Planned)	0	0	0	0	550
Subtotal	691	400,000	0	0	550
Dunes Phase 1, 2, & 3					
Dunes Phase 1 (Entitled)	187	69,000	0	80,000	0
Dunes Phase 2 (Entitled)	225	0	0	0	394
Dunes Phase 3 (Entitled)	435	450,000	450,000	0	0
Subtotal	847	519,000	450,000	80,000	394
East Garrison					
East Garrison I (Entitled)	721	68,000	0	34,000	0
Main Gate					
Main Gate	0	0	0	150,000	350
Main Gates (Planned)	145	0	0	0	0
Subtotal	145	0	0	150,000	350
City of Monterey					
Monterey (Planned)	0	721,524	216,276	0	0
Sea Haven					
Sea Haven A (Entitled)	802	0	0	0	0
Seahaven (Entitled)	127	0	0	0	0
Subtotal	929	0	0	0	0
Seaside East					
Seaside East (Planned)	310	30,000	30,000	30,000	0
Seaside Resort					
Seaside Resort (Entitled)	122	0	0	10,000	330
Seaside Resort TS (Entitled)	0	0	0	0	68
Subtotal	122	0	0	10,000	398
UC MBEST					
UC (Planned)	0	680,000	100,000	310,000	0
UC Blanco Triangle (Planned)	240	0	0	0	0
Subtotal	240	680,000	100,000	310,000	0
Development Total					
	5,105	**2,438,524**	**866,276**	**704,000**	**1,992**

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10/19/2018

Note:

1. Development Areas extracted from Development Forecasts documented in FORA "FY 2018-2019 Capital Improvement Program", Table 6 and Table 7.

Table 2.2 15-Year Development Summary

Water Master Plan

Marina Coast Water District

PRELIMINARY

Development Areas	Development Limits[1]			Estimated Development Area			
	Residential	Office, Industrial, Commercial	Hotel	Residential[2]	Office, Industrial, Commercial[3]	Hotel[4]	Total
	(du)	(sf)	(rooms)	(acres)	(acres)	(acres)	(acres)
1	2	3	4	5	6	7	8
Campus Town Specific Plan	388	180,000	300	48.5	6.9	2.5	57.9
Cypress Knolls	712	0	0	89.0	0.0	0.0	89.0
Del Rey Oaks	691	400,000	550	86.4	15.3	38.6	140.2
Dunes Phase 1, 2, & 3	847	1,049,000	394	105.9	40.1	12.9	158.9
East Garrison	721	102,000	0	90.1	3.9	0.0	94.0
Main Gate	145	150,000	350	18.1	5.7	7.8	31.6
City of Monterey	0	937,800	0	0.0	35.9	0.0	35.9
Sea Haven	929	0	0	116.1	0.0	0.0	116.1
Seaside East	310	90,000	0	38.8	3.4	0.0	42.2
Seaside Resort	122	10,000	398	15.3	0.4	16.8	32.4
UC MBEST	240	1,090,000	0	30.0	41.7	0.0	71.7
Total	**5,105**	**4,008,800**	**1,992**	**638.1**	**153.4**	**78.5**	**870.0**

AKEL ENGINEERING GROUP, INC.

3/15/2019

Notes:

1. Development limits based on development Forecasts documented in FORA "FY 2018-2019 Capital Improvement Program", Table 6 and Table 7 and reflect remaining entitlements.
2. Residential acreage estimated based on average residential density of 8 dwelling units per acre.
3. Office, Industrial, and Commercial acreage estimated bsaed on average floor-area-ratio of 0.6.
4. Acreage for hotel development estimated based on available planning information and County of Monterey parcel database.

The tables and figures included in this Master Plan document the respective land use planning agency General Plan maps, with input from District staff. However, and in adherence to the LSA, developable acreages were adjusted to reflect the most recent planning data, and as provided by multiple jurisdictions within the District service area were consolidated into single residential and commercial categories.

The existing and future land use conditions are graphically summarized on **Figure 2.2** and **Figure 2.3.** It should be noted that **Figure 2.3** also includes the aforementioned Parker Flats – East Garrison LSA boundaries. The existing and future land use acreages, summarized on **Table 2.3**, can be broken down into the following categories:

- **Existing Development:** These acreages represent existing developed lands.
- **Existing Lands - Redeveloped:** These acreages represent existing developed lands expected to redevelop into other land use types under the buildout land use development condition.
- **Existing Development - Unchanged:** These acreages represent the total existing acreages expected to remain under the buildout land use development condition.
- **New Lands - Redevelopment:** These acreages represent lands that have redeveloped from a prior use and into a new respective category.
- **New Development:** These acreages represent gains from the development of existing vacant lands.

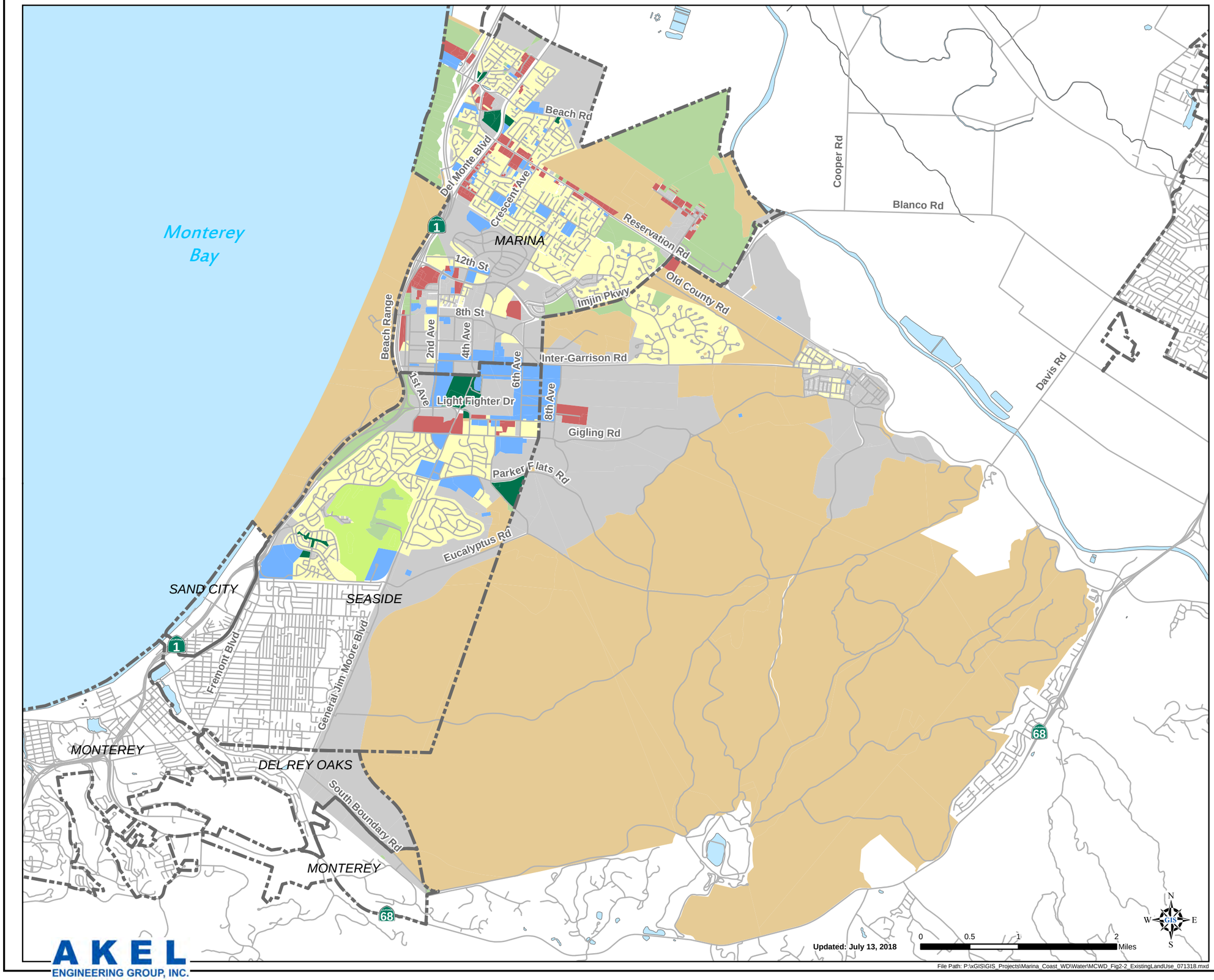
The total existing and future land use acreages are summarized below and shown on **Table 2.3**:

- 4,776 acres of developed lands inside the service area.
- 5,113 acres of undeveloped lands inside the service area.

2.3 HISTORICAL AND FUTURE GROWTH

According to the District's 2015 UWMP the 2015 service area population was approximately 32,375. The District's 2015 UWMP utilized varying annual growth rates and projected a 2035 population of 70,161. For the purpose of this master plan, District staff chose to utilize a set growth rate of 3.0 percent, which results in a 2035 population of 58,473. Assuming 3.0 percent growth, the District service area is not expected to reach the UWMP 2035 population until the year 2041.

Based on the land use estimated in this master plan, there is a population capacity of approximately 83,300 people, which is discussed in detail in Chapter 5. Based on an annual growth rate of 3.0 percent, the District service area will not reach the buildout population until the year 2047. The District's historical and projected population estimates are summarized on **Table 2.4**.



Legend

- Municipal Boundaries

Existing Land Use

- Residential
- Commercial
- Institutional/School
- Open Space
- Designated Open Space
- Park/Sports Field
- Golf Course
- Planned Development Area
- Rivers/Streams
- Waterbodies

PRELIMINARY

Figure 2.2
Existing Land Use

Water Master Plan
Marina Coast Water District

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Note: Future Land Use based on the following:
- General Plan documents for the following: City of Marina, City of Seaside, City of Del Rey Oaks, CSU Monterey Bay, and County of Monterey
- Fort Ord Reuse Authority planning documents
- Additional review and comments from MCWD staff

Central Marina
Cypress Knolls
Dunes Phase 1, 2, & 3
Main Gate
Campus Town Specific Plan
Seaside Resort
Seaside East
Del Rey Oaks
Monterey
UC MBEST
East Garrison
Sea Haven

Monterey Bay
MARINA
SEASIDE
SAND CITY
MONTEREY
DEL REY OAKS
MONTEREY

Beach Rd
Del Monte Blvd
Crescent Ave
Reservation Rd
Cooper Rd
Blanco Rd
12th St
8th St
Imjin Pkwy
Old County Rd
Beach Range
2nd Ave
4th Ave
1st Ave
6th Ave
8th Ave
Inter-Garrison Rd
Light Fighter Dr
Gigling Rd
Parker Flats Rd
Davis Rd
Eucalyptus Rd
Fremont Blvd
General Jim Moore Blvd
South Boundary Rd

1
68

Legend

- Municipal Boundaries
- 10-Year Development Areas
- Parker Flats Land Use Swap

Future Land Use

- Residential
- Commercial
- Industrial
- AirportRunway
- Institutional/School
- Planned Development
- Mixed Use District
- Open Space
- Designated Open Space
- Park/Sports Field
- Golf Course
- Serviced by Others
- Rivers/Streams
- Waterbodies

PRELIMINARY

Updated: March 22, 2019

0 0.5 1 2 Miles

N W GIS E S

File Path: P:\xGIS\GIS_Projects\Marina_Coast_WD\Water\MCWD_Fig2-3_FutureLandUse_032219.mxd

Figure 2.3
Future Land Use

Water Master Plan
Marina Coast Water District

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Table 2.3 Existing and Future Service Areas

Water Master Plan

Marina Coast Water District

PRELIMINARY

Land Use Classification	Existing Development			Future Development				Total Development at Buildout of Study Area	Development Outside of Future Study Area	Planning Area Total
	Existing Development	Existing Lands - Redeveloped	Subtotal Existing Development - Unchanged	New Lands - Redevelopment	New Development: Inside Existing Service Area	New Development: Outside Existing Service Area	Subtotal Future Development			
	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)
Residential										
Residential	2,574	-196	2,378	85	1,167	1,033	2,285	4,663	0	4,663
Non-Residential										
Commercial	349	-40	309	21	235	139	395	704	1	705
Park	103	-5	98	103	156	222	481	579	0	579
Institutional	689	-148	541	23	191	58	272	813	1	814
Planned Development Mixed Use District	0	0	0	134	475	726	1,336	1,336	0	1,336
Other										
Bayonet Golf Course	322	-15	307	0	0	0	0	307	0	307
Open Space - Other	438	0	438	46	0	0	46	484	0	484
Designated Open Space[5]	45	0	45	0	0	0	0	45	17,754	17,799
ROW	33	-8	25	0	1	0	1	26	0	26
Airport Runway	224	0	224	0	0	0	0	224	0	0
Parker Flats LU Swap	0	0	0	0	0	709	709	709	0	0
Total										
	4,776	**-412**	**4,364**	**412**	**2,225**	**2,888**	**5,524**	**9,889**	**17,756**	**26,712**

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1/25/2019

Note:

1. Designated Open Space includes lands not planned for development, based on directions from District staff.

Table 2.4 Historical and Projected Population

Water Master Plan

Marina Coast Water District

PRELIMINARY

Year	Population[1,2]	Annual Growth (%)
Historical Population		
2005	29,477	-
2006	29,154	-1.1%
2007	29,065	-0.3%
2008	29,533	1.6%
2009	29,743	0.7%
2010	30,840	3.7%
2011	31,141	1.0%
2012	31,445	1.0%
2013	31,752	1.0%
2014	32,062	1.0%
2015	32,375	1.0%
2016	33,346	3.0%
2017	34,347	3.0%
2018	35,377	3.0%
Projected Population		
2019	36,438	3.0%
2020	37,531	3.0%
2021	38,657	3.0%
2022	39,817	3.0%
2023	41,012	3.0%
2024	42,242	3.0%
2025	43,509	3.0%
2026	44,815	3.0%
2027	46,159	3.0%
2028	47,544	3.0%
2029	48,970	3.0%
2030	50,439	3.0%
2031	51,952	3.0%
2032	53,511	3.0%
2033	55,116	3.0%
2034	56,770	3.0%
2035	58,473	3.0%
2036	60,227	3.0%
2037	62,034	3.0%
2038	63,895	3.0%
2039	65,812	3.0%
2040	67,786	3.0%
2041	69,820	3.0%
2042	71,914	3.0%
2043	74,072	3.0%
2044	76,294	3.0%
2045	78,583	3.0%
2046	80,940	3.0%
2047	83,368	3.0%

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Note:

1. Population for years 2005 - 2015 extracted from Marina Coast Water District 2015 Urban Water Management Plan
2. Population for years 2016 - 2047 calculated assuming annual growth rate of 3.0% as directed by District staff.

CHAPTER 3 - SYSTEM PERFORMANCE AND DESIGN CRITERIA

This chapter presents the District's performance and design criteria, which was used in this analysis for identifying current system capacity deficiencies and for sizing proposed distribution mains, storage reservoirs, and wells.

3.1 HISTORICAL WATER USE TRENDS

The historical domestic water consumption per capita was calculated to determine the average water use per capita per day. This was accomplished by dividing the District's historical water production, from groundwater production records and the previous master plan, by the historical population served for the respective year.

The District's historical per capita consumption factors, for the period 2005-2017, are listed in **Table 3.1**. The District's per capita consumption has varied annually since 2005, with a maximum per capita consumption of 140 gallons per day per capita (gpcd) in 2007 and a minimum of 80 gpcd in 2016. This recent decrease in per capita consumption is largely attributed to the District's effort of implementing water conservation measures in response to the recent state-wide drought. **Table 3.2** lists three years (2014-2016) of monthly water production in the District, documenting the on-going impacts of the severe drought. This selection was chosen based on the initial impacts of the drought (2014), and what is generally considered the most severe impact (2016).

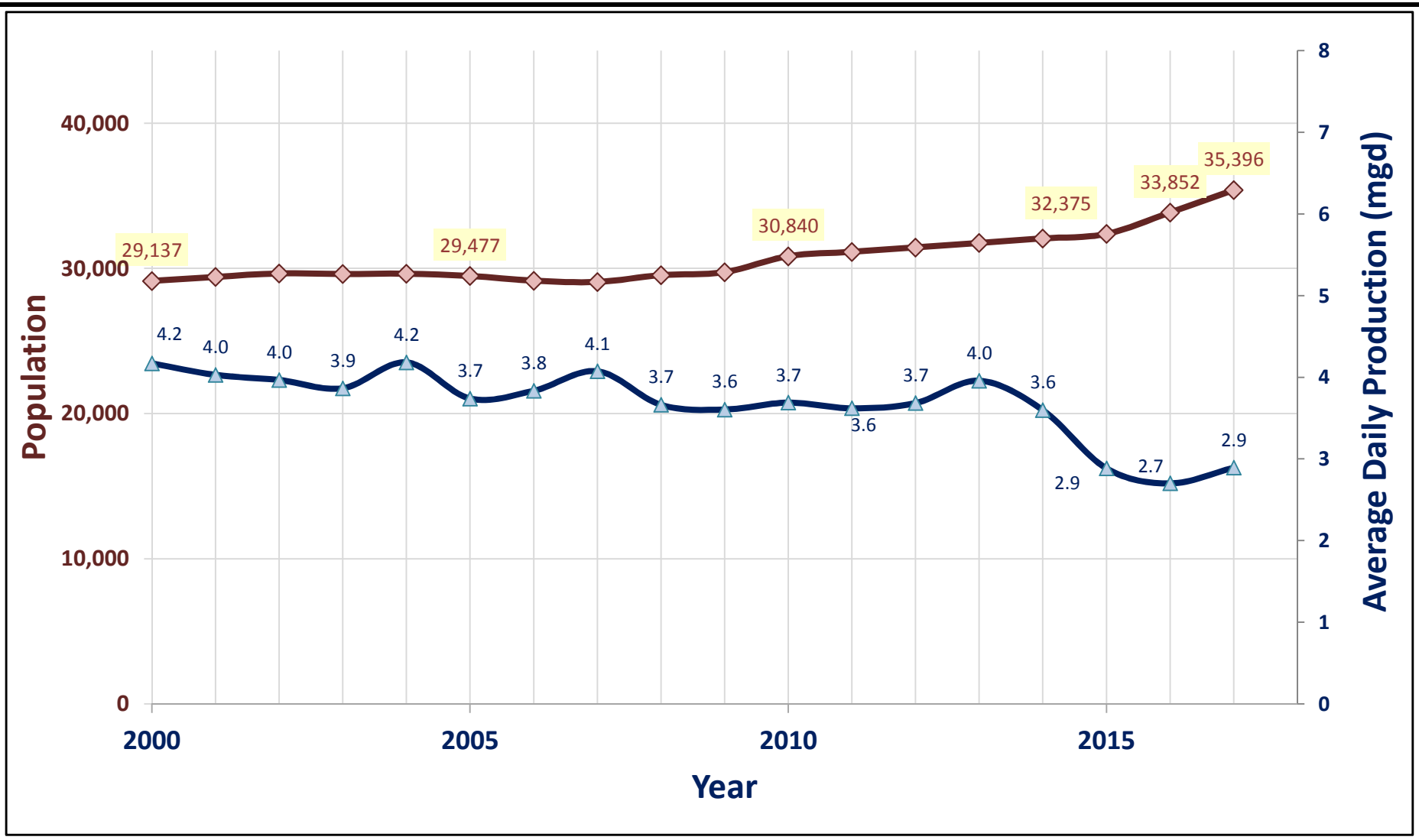
This master plan forecasts domestic water demands for residential and non-residential land uses based on net acreages. However, to generalize trends in the District's water use, per capita water use was documented. **Figure 3.1** displays the historical population in relation to average daily water production. **Figure 3.2** displays a comparison in the per capita water use and average daily water production.

3.2 SUPPLY CRITERIA

In determining the adequacy of the domestic water supply facilities, the source must be large enough to meet the varying water demand conditions, as well as provide sufficient water during potential emergencies such as power outages and natural or created disasters.

Ideally, a water distribution system should be operated at a constant water supply rate with consistent supply from the water source. On the day of maximum demand, it is desirable to maintain a water supply rate equal to the maximum day rate. Water required for peak hour demands or for fire flows would come from storage.

The District is currently utilizing groundwater as their sole source of supply. The existing storage in the system is expected to supply water during peak period usage, while supply wells should be capable of meeting maximum day demand with the largest supply well out of service. Consistent



LEGEND

Population

Average Daily Production (mgd)

PRELIMINARY

January 17, 2019

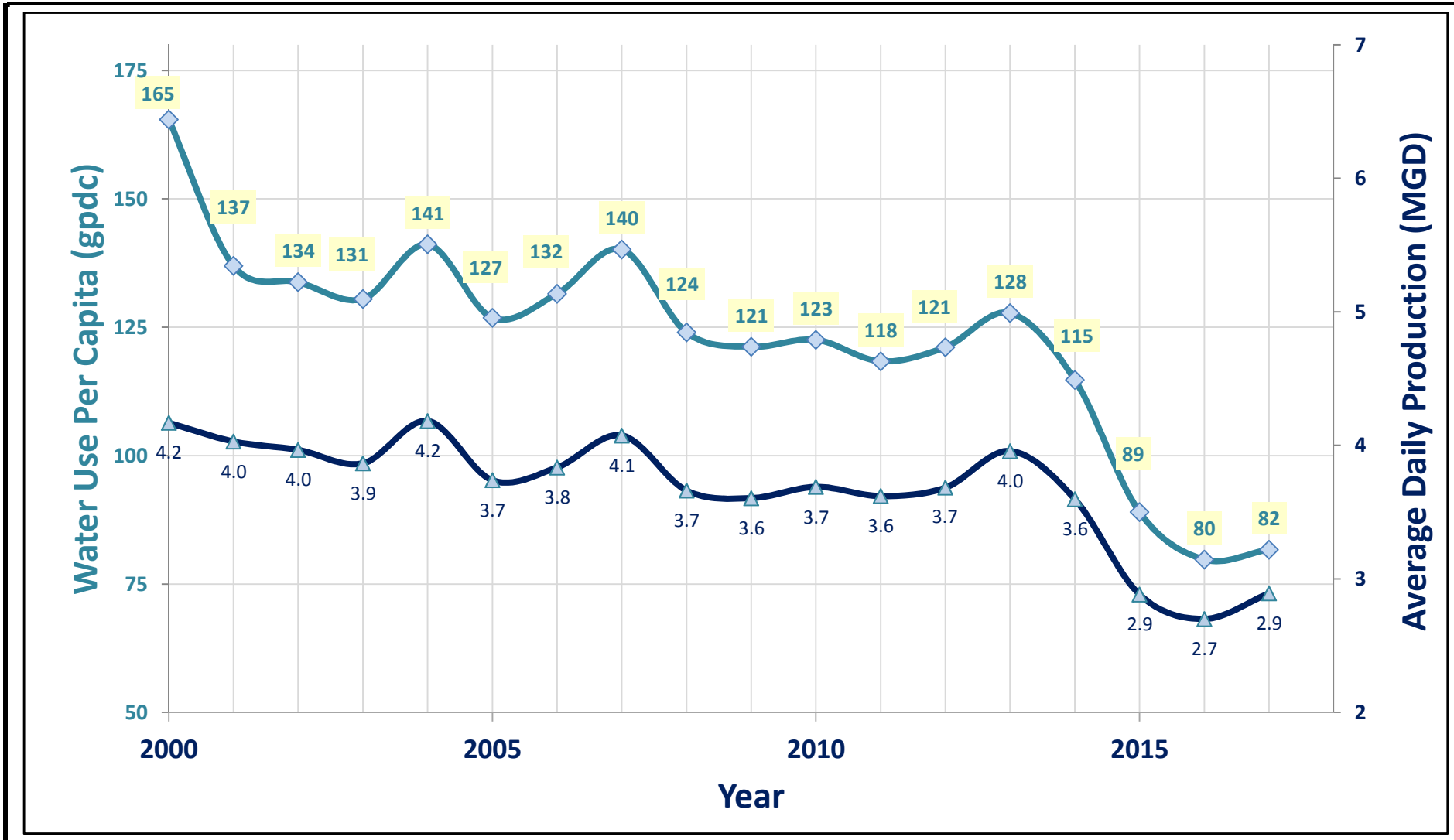
Figure 3.1

Historical Population vs. Average Daily Production

Water Master Plan

Marina Coast Water District

AKEL ENGINEERING GROUP, INC.



LEGEND

Water Use Per Capita (gpdc)

Average Daily Production (mgd)

PRELIMINARY

January 17, 2019

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Figure 3.2

Water Use Per Capita vs. Average Daily Production

Water Master Plan

Marina Coast Water District

Table 3.1 Historical Annual Water Production and Peak Day Peaking Factors (2005-2017)

Water Master Plan

Marina Coast Water District

PRELIMINARY

Year	Population[1]	Annual Change	Historical Water Production									Average Per Capita Water Use
			Annual Production[2,3,4]			Maximum Month Production				Maximum Day Production		
						Maximum Monthly Production		Month of Occurrence	Max to Avg Ratio	Total	Max to Avg Ratio	
		(%)	(MG/year)	(mgd)	(gpm)	(MG/month)	(mgd)			(MGD)		(gpdc)
2005	29,477	-	1,365	3.74	2,596							127
2006	29,154	-1.1%	1,400	3.83	2,663							132
2007	29,065	-0.3%	1,487	4.07	2,829							140
2008	29,533	1.6%	1,337	3.66	2,543							124
2009	29,743	0.7%	1,316	3.60	2,503							121
2010	30,840	3.7%	1,347	3.69	2,562							123
2011	31,141	1.0%	1,321	3.62	2,514	148.4	4.95	July	1.37	6.39	1.76	118
2012	31,445	1.0%	1,344	3.68	2,558	148.2	4.94	July	1.34	7.56	2.05	121
2013	31,752	1.0%	1,444	3.96	2,748	147.1	4.90	May	1.24	6.33	1.60	128
2014	32,062	1.0%	1,313	3.60	2,498	139.1	4.64	July	1.29	6.36	1.77	115
2015	32,375	1.0%	1,053	2.88	2,003	99.1	3.30	April	1.15	4.59	1.59	89
2016	33,852	4.6%	986	2.70	1,875	94.0	3.13	September	1.16	3.92	1.45	80
2017	35,396	4.6%	1,056	2.89	2,008							
Historical Maximum Peaking Factors												
5-year Maximum			1,444	3.96	2,748	148	4.94		1.34	7.56	2.05	128
3-year Maximum			1,313	3.60	2,498	139	4.64		1.29	6.36	1.77	115
2016 Maximum			986	2.70	1,875	94	3.13		1.16	3.92	1.45	80
Recommended Criteria												
Current Design Criteria[5]											2.00	117[6]
Recommended Criteria									1.30		2.00	

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8/17/2017

Notes:

1. Source: 2015 Urban Water Management Plan
2. Year 2005-2010 : Annual production extracted from 2015 UWMP.
3. Year 2011-2016 : Annual production extracted from daily well production records provided by District staff.
4. Production for years 2010-2015 includes irrigation demands from the Bayonet golf course, which are met by a private well in other years.
5. Source: District "Procedures Guidelines and Design Requirements", Revised July 2015.
6. Source: 2020 water use target extracted from 2015 UWMP.

Table 3.2 Historical Monthly Water Production (2014-2016)

Water Master Plan

Marina Coast Water District

PRELIMINARY

Month	2014				2015				2016			
	Daily Production	Monthly		Peaking Factor	Daily Production	Monthly		Peaking Factor	Daily Production	Monthly		Peaking Factor
	Average Day	Production	Percent of Annual	Month to Avg Factor	Average Day	Production	Percent of Annual	Month to Avg Factor	Average Day	Production	Percent of Annual	Month to Avg Factor
	(mgd)	(MGM)	(%)		(mgd)	(MGM)	(%)		(mgd)	(MGM)	(%)	
January	3.44	107	8%	0.97	2.60	80.7	8%	0.92	2.23	69	7%	0.84
February	2.73	76	6%	0.70	2.81	78.7	7%	0.90	2.44	68	7%	0.83
March	3.07	95	7%	0.87	3.11	96.3	9%	1.10	2.24	69	7%	0.84
April	3.61	108	8%	0.99	3.30	99.1	9%	**1.13**	2.71	81	8%	0.99
May	4.48	139	11%	1.27	2.93	90.9	9%	1.04	2.79	87	9%	1.05
June	4.46	134	10%	1.22	2.96	88.9	8%	1.01	3.01	90	9%	1.10
July	4.49	139	11%	**1.27**	3.14	97.4	9%	1.11	2.98	92	9%	1.13
August	4.34	135	10%	1.23	3.11	96.4	9%	1.10	3.01	93	9%	1.14
September	3.97	119	9%	1.09	3.11	93.3	9%	1.06	3.13	94	10%	**1.14**
October	3.65	113	9%	1.04	2.87	88.8	8%	1.01	2.86	89	9%	1.08
November	2.68	80	6%	0.73	2.37	71.0	7%	0.81	2.77	83	8%	1.01
December	2.18	67	5%	0.62	2.30	71.2	7%	0.81	2.23	69	7%	0.84
Total		**1,313**				**1,053**				**986**		
Average Value	**3.59**	**109**			**2.88**	**88**			**2.70**	**82**		
Maximum Value		**139**		**1.27**		**99**		**1.13**		**94**		**1.14**

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7/21/2017

Notes:

1. Source: 2014, 2015, and 2016 Production Extracted from Well Production records provided by District staff April 13, 2017.

with the MCWD 2007 WSMP for Central Marina, future system supply improvements are assumed to have a supply capacity of 1,500 gallons per minute (gpm) for planning purposes. Design criteria for water supply are documented on **Table 3.3**.

3.3 STORAGE CRITERIA

The intent of domestic water storage is to provide supply for operational equalization, fire protection, and other emergencies, such as power outages or supply outages. Operational or equalization storage provides the difference in quantity between the customer's peak hour demands and the system's available reliable supply.

3.3.1 Typical Storage Criteria

Typical storage criteria consist of three main elements: operational, emergency, and fire flow.

Operational Storage

Operational or equalization storage capacity is necessary to reduce the variations imposed on the supply system by daily demand fluctuations. Peak hour demands may require up to 2 times the amount of maximum day supply capacity. With storage in place, this increase in demand can be met by the operational storage rather than by increasing production from the supply sources.

Equalization storage also stabilizes system pressures for enhancing the service. Equalization storage requirements typically range from 25 percent to 50 percent of maximum day demand. The District criterion requires that 25 percent of the maximum day demand be reserved for operational storage.

Emergency Storage

Emergency storage is the volume of water stored to meet demand during emergency situations such as pipe failures, distribution main failures, pump failures, power outages, natural disasters, or other cases in which the supply sources are not able to meet the demand condition.

The amount of water reserved for emergencies is determined by policies adopted by the District and is based on an assessment of the costs and benefits including the desired degree of system reliability, risk during an emergency situation, economic considerations, and water quality concerns.

In California, the amount of emergency storage reserve in municipal water systems is usually between 50 percent and 100 percent of the maximum day demand. The District criterion requires that 50 percent of the maximum day demand be reserved for emergency storage.

Fire Storage

Fire storage is also needed to maintain acceptable service pressures within a pressure zone in the event of a fire flow, which may occur during the maximum day demand. The recommended

Table 3.3 Design and Planning Criteria Summary

Water Master Plan

Marina Coast Water District

PRELIMINARY

Design Parameter	Criteria	
Supply	Supply to meet Maximum Day Demand with largest unit out or service	
	Future groundwater wells are assumed to have a capacity of 1,500 gpm	
Storage	Total Required Storage = Operational + Fire + Emergency	
	Operational Storage	25% of Maximum Day Demand
	Emergency Storage	50% of Maximum Day Demand
	Fire Storage	
	Residential	0.18 MG (1,500 gpm for 2 hours)
	Light/Neighborhood Commercial	0.54 MG (3,000 gpm for 3 hours)
	Commercial/Industrial/Airport	0.96 MG (4,000 gpm for 4 hours)
Distribution Mains	Distribution mains should be designed to satisfy the following criteria:	
	Maximum Pipeline Velocity:	
	Peak Hour Demand	5 ft/s
	Maximum Day Demand + Fire Flow	7 ft/s
	Maximum Pipeline Headloss:	
	Pipeline diameter $\leq$ 16"	10 ft/kft
	Pipeline diameter > 16"	3 ft/kft
Pump Stations	Meet Maximum Day Demand with largest unit out of service	
	Hydropneumatic systems to meet Maximum Day Demand plus fire flow	
PRVs	PRVs should be designed to meet the greater of:	
	Peak Hour Demand, or Maximum Day Demand + Fire Flow	
Service Pressures	Maximum Pressure	100 psi
	Minimum Pressure	
	Maximum Day Demand	40 psi
	Peak Hour Demand	40 psi
	Fire Flows	20 psi
Demand Peaking Factors	Maximum Month Demand	1.5 x Average Day Demand
	Maximum Day Demand	2.0 x Average Day Demand
	Peak Hour Demand	3.5 x Average Day Demand
Fire Flows[1]	Residential	1,500 gpm for 2 hours
	Light/Neighborhood Commercial	3,000 gpm for 3 hours
	Commercial/Industrial/Airport	4,000 gpm for 4 hours

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8/1/2017

Notes:

1. Fire flow criteria reviewed and confirmed by local fire officials.

fire storage capacity varies by pressure zone and land use type, and is usually higher for commercial and industrial areas. Fire flow provisions for each pressure zone were calculated based on the governing (highest) land use type within a reservoir service area as follows:

- Residential: 1,500 gpm for 2 hours = 0.18 MG
- Light Commercial: 3,000 gpm for 3 hours = 0.30 MG
- Commercial/Industrial: 4,000 gpm for 4 hours = 0.96 MG

Total Storage Requirement

The total storage is the summation of operational (equalization), fire, and emergency storage requirements as follows:

Qs = 25% MDD (operational) + 50% MDD (emergency) + fire flow (varies)

where:

Qs is the Total Required Storage, in gallons

MDD is the Maximum Day Demand, in gallons

3.4 PRESSURE CRITERIA

Acceptable service pressures within distribution systems vary depending on District criteria and pressure zone topography. It is essential that the water pressure in a consumer's residence or place of business be maintained within an acceptable range. Low pressures below 30 psi can cause undesirable flow reductions when multiple faucets or water using appliances are used at once.

Excessively high pressures can cause faucets to leak and valve seats to wear out prematurely. Additionally, high service pressures can cause unnecessarily high flow rates, which can result in wasted water and high utility bills. The criteria for pressures in the domestic water system include the following:

- Maximum pressure, usually experienced during low demands and winter months
- Minimum pressure, usually experienced during peak hour demands and summer months
- Minimum pressure during fire flows and during the maximum day demand

The American Water Works Association Manual on Computer Modeling and Water Distribution System (AWWA M-32) indicates that maximum pressures are usually in the range of 90-110 pounds per square inch (psi). In some communities, the maximum pressure may be limited to 100 psi to mitigate the impact on internal plumbing. In this case, the distribution system is usually sized for the higher pressures, and individual pressure-reducing valves are installed on service lines where the pressure may be exceeded.

The minimum acceptable pressure is usually in the range of 40-50 psi, which generally provides for sufficient pressures for second story fixtures. When backflow preventers are required, they may reduce the pressures by approximately 5-15 psi. The recommended minimum pressure during fire flows is 20 psi, as established by the National Fire Protection Association (NFPA).

The District's pressure criteria are summarized as follows:

- **Maximum Pressure:** 100 psi
- **Minimum Pressure:**
    - Maximum Day Demand: 40 psi
    - Peak Hour Demand, Existing Development: 35 psi
    - Peak Hour Demand, Future Development: 40 psi
    - Maximum Day Demand + Fire Flow: 20 psi

3.5 UNIT FACTORS

Domestic water demand unit factors are coefficients commonly used in planning level analysis to estimate future average daily demands for areas with predetermined land uses. The unit factors are multiplied by the net acreages for residential categories and non-residential categories to yield the average daily demand projections.

There are several methods for developing the unit factors. This analysis relied on the District's 2016 water consumption billing records, which lists the monthly water consumption per customer account throughout the District, to estimate the unit factors within the District service area. The distribution of water demand and total demand by account type were extracted from these 2016 billing records. For planning purposes, and based on discussions with District staff, the total demand was adjusted to reflect 2014 production minus 10%. This adjustment was made due to the extreme drought having an undue influence on water consumption in the 2015-2017 time frame. However, **Figure 3.1** indicates demands are trending back up from the 2016 low. Thus, 2014 less 10% is considered a reasonable and conservative planning number. Additional adjustments were made to account for distribution system losses and vacancies in existing land uses.

The existing unit factor analysis is shown on **Table 3.4** and generally indicates that existing residential land uses have higher consumptive use factors than that of non-residential land uses. The water demand unit factors are summarized on **Table 3.5**.

Table 3.4 Water Demand Unit Factor Analysis

Water Master Plan

Marina Coast Water District

PRELIMINARY

Land Use Classification	Existing Development within Service Area	Existing Average Daily Water Demand Unit factors									
		Consumption[1,2]			Production (Consumption + 10% Losses)		Production at 100% Occupancy			Water Unit Factor	
		Annual Consumption	Unadjusted Unit Factor	Balance to Consumption			Vacancy Rate[3,4]	Projected Production at 100% Occupancy		Recommended Factor	Balance Using Recommended Unit Factor
	(acres)	(gpd)	(gpd/acre)		(gpd/acre)	(gpd)	(%)	(gpd/acre)	(gpd)	(gpd/acre)	(gpd)
Residential											
Residential	2,560	2,246,565	878	2,246,565	975	2,496,183	8.0%	1,053	2,695,878	1,060	2,713,123
Subtotal	2,560	2,246,565		2,246,565		2,496,183			2,695,878		2,713,123
Non-Residential											
Commercial	345	393,510	1,139	393,510	1,266	437,233	9.4%	1,385	478,333	1,390	480,168
Institutional	719	139,302	194	139,302	215	154,780	9.4%	236	169,329	240	172,542
Park	140	136,456	974	136,456	1,082	151,618	0.0%	1,082	151,618	1,090	152,771
Subtotal	1,205	669,268		669,268		743,631			799,280		805,481
Non-Demand Generating											
Open Space	0	0	0	0	0	0	0.0%	0	0	0	0
Designated Open Space	0	0	0	0	0	0	0.0%	0	0	0	0
Other[5]	362	0	0	0	0	0	0.0%	0	0	0	0
Subtotal	362	0		0		0			0		0
Totals											
	4,126	**2,915,832**		**2,915,832**		**3,239,814**			**3,495,157**		**3,518,604**

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10/5/2017

Note:

1. Water demand distribution was based on the 2016 Water Billing Records. These demands were verified and their distribution does not vary greatly from year to year.
2. Consumption based on 2014 production minus 10%.
3. Residential vacancy rate extracted from California Department of Finance Sheet E-5 published 2016. (Average of City of Marina and City of Seaside : 8.0 % Vacancy Rate).
4. Commercial/Institutional vacancy rate extracted from market study by Cushman and Wakefield, dated first quarter of 2016. Vacancy rates shown are average of rates for the cities of Marina, Del Rey Oaks, Seaside, and Sand City.
5. Other Land use classification includes non-demand generating landuse types, including the Bayonet Golf Course and ROW.

Table 3.5 Water Demand Unit Factor

Water Master Plan

Marina Coast Water District

PRELIMINARY

Land Use Type	Water Demand Unit Factor (gpd/acre)
Residential	1,060
Commercial	1,390
Institutional	240
Planned Development Mixed Use District[1]	1,160
Park	1,090
Open Space	0
Designated Open Space	0

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11/6/2017

Note:

1. Water Demand Unit Factor assumes development consists of 70% Residential and 30% Commercial.

3.6 SEASONAL DEMANDS AND PEAKING FACTORS

Domestic water demands within municipal water systems vary with the time of day and month of the year. It is necessary to quantify this variability in demand so that the water distribution system can be evaluated and designed to provide reliable water service under these variable demand conditions.

Water use conditions that are of particular importance to water distribution systems include the average day demand (ADD), the maximum month demand (MMD), the maximum day demand (MDD), the peak hour demand (PHD), and the winter demand.

The average day demand represents the annual water demand, divided by 365 days, since it is expressed in daily units. The winter demand typically represents the low month water demands and is used for simulating water quality analysis.

3.6.1 Maximum Month Demand

The maximum month demand (MMD) is the highest demand that occurs within a calendar month during a year. The District's MMD usually occurs in the summer months in either July or August. The MMD is used primarily in the evaluation of supply capabilities.

Historical monthly water production records, obtained for the period between 2011 and 2016 (**Table 3.1**), indicate the maximum month to average month ratio ranging between 1.16 and 1.37. To appropriately characterize the historical maximum month demand, an MMD factor of 1.30 was deemed representative of District trends. The following equation is recommended for estimating the maximum month demand, given the average day demand:

Maximum Month Demand = **1.30** x Average Day Demand

3.6.2 Maximum Day Demand

The maximum day demand (MDD) is the highest demand that occurs within a 24 hour day during a year. The District's MDD, which usually occurs during the summer months, is typically used for the evaluation and design of storage facilities, distribution mains, pump stations, and pressure reducing valves. The MDD, when combined with fire flows, is one of the highest demands that these facilities should be able to service while maintaining acceptable pressures within the system.

The maximum day demands were obtained from the District's water production records. Groundwater well production records indicate the date of occurrence and magnitude of the maximum day demand for each calendar year, as listed in **Table 3.1**. The maximum day to average day demand ratios for the period between 2011 and 2016 ranged from 1.45 to 2.05 and occurred in July or August.

Consistent with District standards, a maximum day to average day ratio of 2.0 would be used in this master plan; this peaking factor is also consistent with the peaking factor used in the 2007

WSMP. The following equation is then used to estimate the maximum day demand, given the average day demand:

Maximum Day Demand = **2.0** x Average Day Demand

3.6.3 Peak Hour Demand

The peak hour demand (PHD) is another high demand condition that is used in the evaluation and design of water distribution systems. The peak hour demand is the highest demand that occurs within a one hour period during a year. The peak hour demand is considered to be the largest single measure of the maximum demand placed on the distribution system. The PHD is often compared to the MDD plus fire flow to determine the largest demand imposed on the system for the purpose of evaluating distribution mains.

The following equation is then used to estimate the peak hour demand, given the average day demand:

Peak Hour Demand = **3.5** x Average Day Demand

3.7 FIRE FLOWS

Fire flows are typically based on land use, with the potential for increased fire flow based on the building type. The following are the criteria for fire flows:

- **Category 1.** Fire flows for residential areas were calculated at 1,500 gpm for two hours.
- **Category 2.** Fire flows for light/neighborhood commercial areas were calculated at 3,000 gpm for three hours.
- **Category 3.** Fire flows for commercial/industrial areas were calculated at 4,000 gpm for four hours.

3.8 TRANSMISSION AND DISTRIBUTION MAIN CRITERIA

Transmission and distribution mains are usually designed to convey the maximum expected flow condition. In municipal water systems, this condition is usually the greater of either the peak hour demand or the maximum day demand plus fire flow. The hydrodynamics of pipe flow create two additional parameters that are taken into consideration when evaluating or sizing water mains: head loss and velocity.

Head loss is a loss of energy within pipes that is caused by the frictional effects of the inside surface of the pipe and friction within the moving fluid itself. This loss in energy is translated into a loss in pressure, which is undesirable in water distribution systems. Head loss, by itself, is not an important factor as long as the pressure criterion has not been violated. However, high head loss may be an indicator that the pipe is nearing the limit of its carrying capacity and may not have

sufficient capacity to perform under stringent conditions. The criteria for maximum pipeline headloss are summarized as follows:

- Pipelines 16-inch diameter and smaller: 10 ft/kft
- Pipelines larger than 16-inch diameter: 3 ft/kft

Since high flow velocities can cause damage to pipes and lead to high head loss, it is desirable to keep the velocity below a predetermined limit. The criteria for maximum pipeline velocity are summarized as follows:

- Peak Hour Demand: 5 ft/s
- Maximum Day Demand + Fire Flow: 7 ft/s

CHAPTER 4 - EXISTING DOMESTIC WATER FACILITIES

This chapter provides a description of the District's existing domestic water system facilities including the existing wells, pressure zones, distribution mains, storage reservoirs, and booster pump stations.

4.1 EXISTING WATER SYSTEM OVERVIEW

The District's municipal water system consists of 7 active groundwater wells, 7 ground level storage tanks totaling 9.2 million gallons in storage, distribution mains, and fire hydrants. The District's topography generally slopes towards the coastline from east to west; based on this topography, the water distribution system is comprised of 5 pressure zones.

The District's existing domestic water distribution system is shown in **Figure 4.1**, which displays the existing system by pipe size. This figure provides a general color coding for the distribution mains, as well as labeling the existing wells and the storage reservoirs.

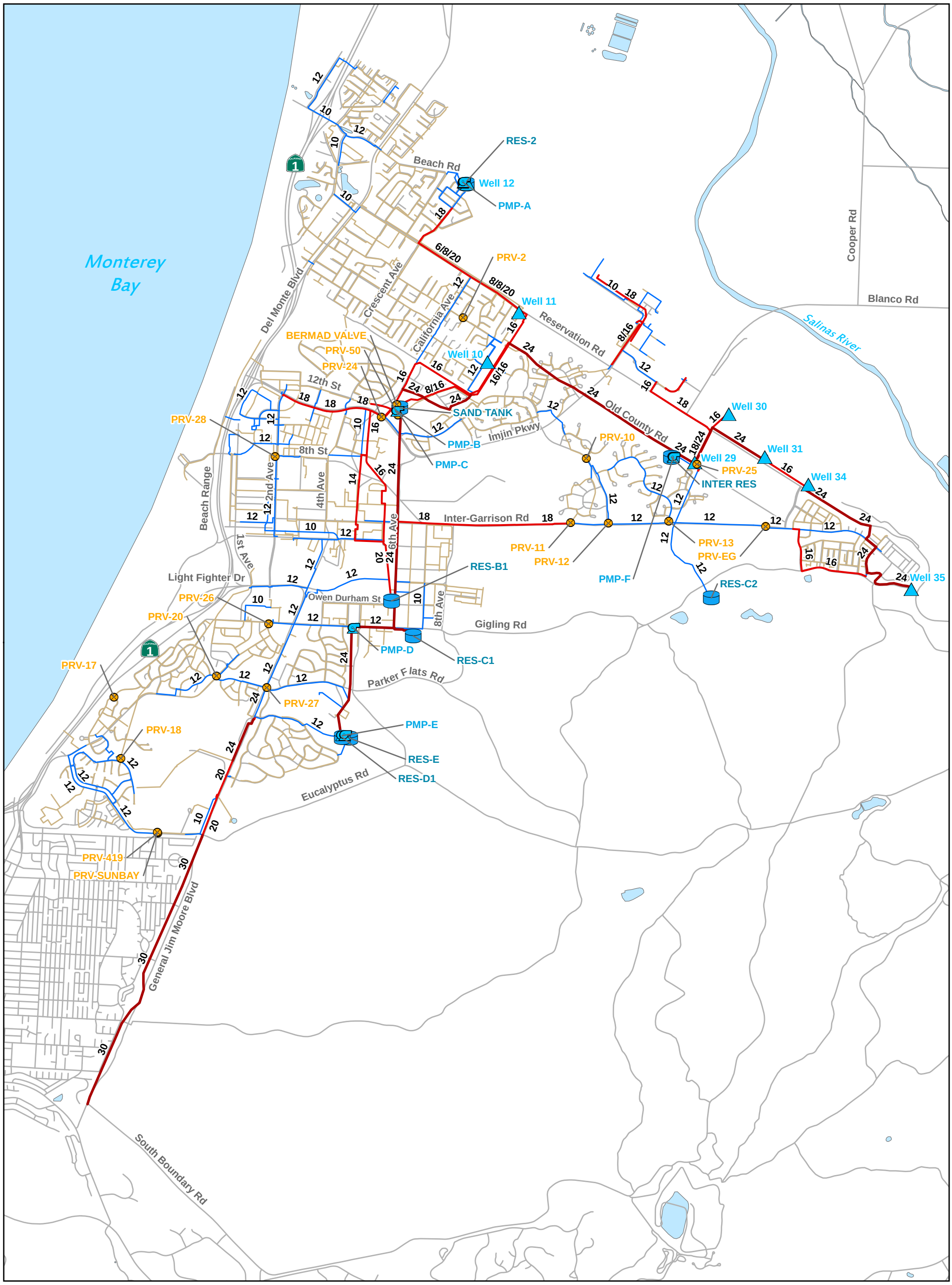
4.2 SOURCE OF SUPPLY

The District currently uses groundwater as the sole source of supply. There are 7 active groundwater wells that are used to supply water to existing customers (**Figure 4.1**). During the preparation of this Master Plan, District staff provided historical well pump tests for estimating the current well production capacity. It should be noted that, over time, well efficiencies may vary based on equipment conditions and groundwater levels. In periods of prolonged drought, well efficiency ratings may decrease due to a decline in groundwater levels. The opposite may occur in wet periods, as well efficiencies may increase as the groundwater levels recover. As such, the District should monitor the well efficiencies on a frequent basis to adequately manage the groundwater supply. If periods of prolonged drought persist, it may be necessary to construct additional wells to maintain adequate supply capacity.

Table 4.1 lists the District's current total rated supply at approximately 18.4 million gallons per day (mgd). Consistent with the system performance and design criteria, the firm capacity was calculated as the capacity with the largest well out of service. The firm capacity of the well supply is estimated at 14.9 mgd.

4.3 PRESSURE ZONES

The District's existing water system serves land ranging from sea level to more than 500 feet above mean sea level in elevation. To adequately provide water in this service area, the District is divided into five pressure zones; four of these pressure zones are served by ground level storage tanks while the highest zone, Zone E, is serviced by a pressure tank. **Figure 4.2** shows the



Legend

Existing Modeled System

- Tanks
- Wells
- Boosters
- PRV

Pipes by Diameter

- 8" and Smaller
- 10" - 12"
- 16" - 20"
- 24" - 48"

- Streets
- Rivers/Streams
- Waterbodies

PRELIMINARY

Update: April 11, 2019

0 0.25 0.5 1 Mile

N W GIS E S

Figure 4.1
Existing Modeled Water System

Water Master Plan
Marina Coast Water District

AKEL ENGINEERING GROUP, INC.

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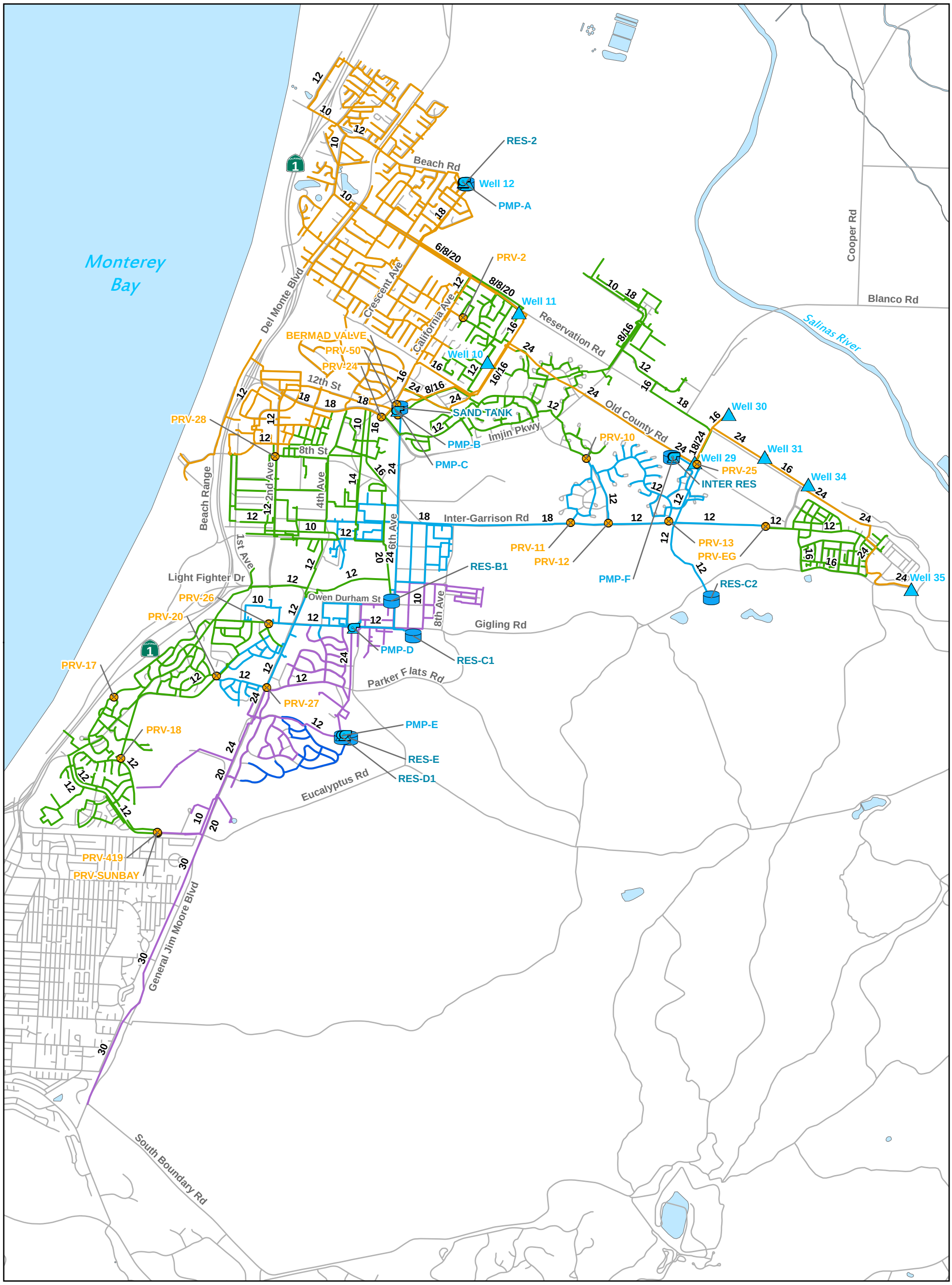


Legend

Existing Modeled System

- Tanks
- Wells
- Boosters
- PRV

Pipes by Pressure Zone

- Zone A
- Zone B
- Zone C
- Zone D
- Zone E

- Streets
- Rivers/Streams
- Waterbodies

PRELIMINARY

0 0.25 0.5 1 Mile

N W GIS E S

Update: January 2, 2019

AKEL ENGINEERING GROUP, INC.

File Path: P:\xGIS\GIS_Projects\Marina_Coast_WD\Water\MCWD_Fig4-2_PipesPZ_010219.mxd

Figure 4.2
Modeled Pipes by Pressure Zone

Water Master Plan
Marina Coast Water District

Table 4.1 Existing Wells

Water Master Plan

Marina Coast Water District

PRELIMINARY

Supply Well	Location	Design Capacity				Additional Information				Pump Test Capacity[1]			
		Rated		HP	Pump Depth	Well Depth	Date Drilled	Date Rehabilitated	NaClO Dosing	Flow Rate		Total Dynamic Head	Test Year
		(gpm)	(mgd)	(HP)	(ft)	(ft)	(Year)	(Year)	(mg/L)	(gpm)	(mgd)	(ft)	
Fort Ord													
Well 29	Old County Rd	1,500	2.16	200		555	1985		0.8	1,500	2.16	252	2017
Well 30	Reservation Rd	1,500	2.16	150	410	550	1985	2016	0.8	1,528	2.20	277	2018
Well 31	Reservation Rd	2,400	3.46	250		490	1985		0.8	2,315	3.33	225	2017
Well 34	Reservation Rd	2,000	2.88	350	460	1110	2011		0.8	2,480	3.57	380	2017
Well 35	Watkins Gate & Reservation Rd	2,000	2.88	350	502	675	2011		0.8	2,494	3.59	374	2016
City of Marina													
Well 10	Bayer Avenue and Ridgeview	1,350	1.94	250	480	1550	1993	2007	1.5	1,458	2.10	434	2017
Well 11	Reservation Rd & Salinas Ave	2,000	2.88	300		1660	1986	2014	1.5	2,025	2.92	348	2017
Well 12 (Inactive)	Top of Beach Rd	1,900	2.74	300		1970	1989		8.5	2,022	2.91	430	2008
System Well Supply Capacity													
	Total Well Capacity	**12,750**	**18.4**							**13,800**	**19.9**		
	Firm Well Capacity (largest unit out of service)	**10,350**	**14.9**							**11,306**	**16.3**		

AKEL ENGINEERING GROUP, INC.

3/27/2019

Notes:

1. Source: Pump tests received from District staff

existing modeled system pipes categorized by existing pressure zone while **Figure 4.3** shows the boundaries and names for these pressure zones.

All of the District's groundwater wells are located in Zone A, with a majority of the service connections located in Zone A and Zone B. From Zone A, booster stations are used to supply water to the higher pressure zones serving the remainder of the District service area. It should be noted that some zones are served from higher pressure zones through pressure reducing valves (PRVs), which are summarized on **Table 4.2**.

A brief description of the different pressure zones in the District's service area is as follows:

4.3.1 Zone A

Zone A is the northernmost zone in the District's service area. It is generally bounded by Aaron Way to the north, Highway 1 to the west, California Avenue to the east, and Imjin Parkway to the south.

Elevations served in this pressure zone approximately range from sea level to 140 feet. This zone is supplied from 7 groundwater wells (Well 29, 30, 31, 34, 35, 10, and 11). Zone A has 2 active ground level storages tanks for a total storage capacity of 1.17 million gallons (MG). It should be noted that a portion of Zone A, generally south of Patton Parkway and west of California Avenue, relies on a PRV connection from Zone B as its sole source of supply.

4.3.2 Zone B

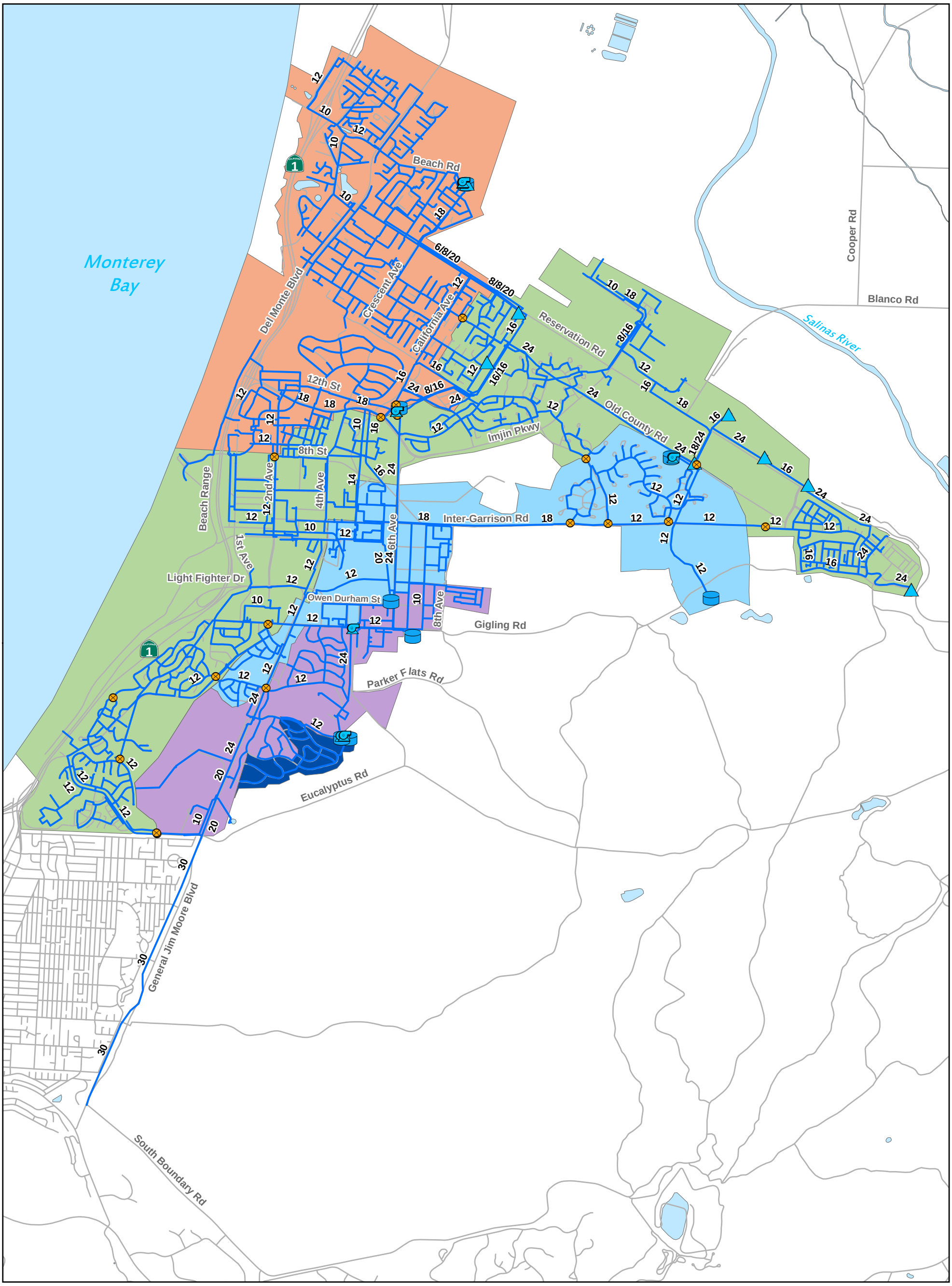
Zone B has the largest service area of the five District pressure zones. Zone B can generally be divided into a northern and western portion. The northern portion of Zone B is generally north of Imjin Road and east of California Avenue, serving development along Imjin Road and Reservation Road. The western portion of Zone B is generally west of California Avenue and serves development along California Avenue, General Jim Moore Boulevard, and Highway 1.

Elevations served in this pressure zone approximately range from 140 feet to 220 feet. This zone is supplied from Booster Station B, which pumps water from the Sand Tank located in Zone A. Zone B has one ground level storage tank for a total storage capacity of 2.0 MG.

It should be noted that a portion of Zone B, east of the intersection of Reservation Road and Inter-Garrison Road, relies on a PRV connection from Zone C as its sole source of supply. This service area is separately identified as Pressure Zone B-EG.

4.3.3 Zone C

Pressure Zone C is located in the center of the District's service area and encompasses the area generally bounded to the west by General Jim Moore Boulevard, to the east by Schnoover Road, to the north by Reservation Road and to the south by Gigling Road.



Legend

Existing Modeled System

- Tanks
- Wells
- Boosters
- PRV
- Pipes

Pressure Zones

- Zone A
- Zone B
- Zone C
- Zone D
- Zone E

- Streets
- Rivers/Streams
- Waterbodies

PRELIMINARY

N W GIS E S

0 0.25 0.5 1 Mile

Update: January 2, 2019

AKEL ENGINEERING GROUP, INC.

File Path: P:\xGIS\GIS_Projects\Marina_Coast_WD\Water\MCWD_Fig4-3PressureZones_010219.mxd

Figure 4.3
Existing Pressure Zones

Water Master Plan
Marina Coast Water District

MARINA COAST WATER DISTRICT

Table 4.2 Existing Pressure Reducing Valves

Water Master Plan

Marina Coast Water District

PRELIMINARY

Location	PRV ID	Elevation (ft)	Pressure Zone Upstream	Pressure Zone Downstream	Valve Size (in)	Downstream Setpoint[2] (psi)
Sand Tank	Bermad Valve	141	A	Sand Tank		-
Carmel Ave at Crumpton Ln	PRV-2	126	B	A	8	43
12th St near DX Dr	PRV-24	167	B	A	10	30
8th St at 2nd Ave	PRV-28	110	B	A	10	47
Monterey Rd at Normandy Rd	PRV-20	190	C	B	8	53
8-inch pipeline s/o Sand Tank	PRV-50	110	C	B	6	66
Old County Rd near Well 29	PRV-25	175	C	B	10	35
					4	40
Gigling Rd at 6th Division Cir	PRV-26	228	C	B	8	38
Abrams Dr at Bunker Hill Dr	PRV-10	190	Schoonover Park	B	8	35
					3	37
Inter-Garrison Rd near Spotsylvania Ct	PRV-11	250	C	Schoonover Park	8	43
					3	44
Inter-Garrison Rd at Abrams Dr	PRV-12	241	C	Schoonover Park	6	43
Inter-Garrison Rd at Schoonover Dr	PRV-13	237	C	Schoonover Park	12	44
					3	48
Inter-Garrison Rd. to East Garrison	PRV-EG	216	C	B	12	50
		216	C	B	4	56
Kiska Rd at Buna Rd	PRV-17	178	C	Seaside Highlands	8	44
					4	49
Peninsula Point Dr at Bay Crest Cir	PRV-18	161	C	Seaside Highlands	12	46
					4	51
Coe Ave to Upper Seaside Highlands	PRV-19	233	C	Seaside Highlands	12	17
					4	20
General Jim Moore Blvd at Normandy Dr	PRV-27	310	D	C	8	20
Coe Ave to Sunbay Apartments	PRV-SUNBAY	233	D	Sunbay	8	40
					2	45

AKEL ENGINEERING GROUP, INC.

3/27/2019

Notes:

1. Source: "MCWD EOC Charts", received from District staff on December 13, 2016
2. Source: "PRV Setpoints" received from District staff March 16, 2018.

Elevations served in this pressure zone approximately range from 230 feet to 305 feet. This zone is supplied from Booster Station C, which pumps water from the Sand Tank located in Zone A.

It should be noted that the existing Schoonover Park and a portion of Fredericks Park are served from Pressure Zone C by PRV along Inter-Garrison Road. This region includes service elevations that are between the bottom of Pressure Zone C and the top of Pressure Zone B

4.3.4 Zone D

Pressure Zone D is located in the southeastern portion of the District's service area and encompasses the area generally bounded by Gigling Road to the north and Coe Avenue to the south, serving development along General Jim Moore Boulevard.

Elevations served in this pressure zone approximately range from 310 feet to 410 feet. This zone is supplied from Pump Station D, which pumps water from Reservoir C1 located in Zone C. Zone D has one ground level storage tank for a total storage capacity of 2.0 MG.

4.3.5 Zone E

Pressure Zone E is the southernmost pressure zone in the District's service area and is currently the District's only operating hydropneumatic zone. It is generally bounded by Ardennes Circle to the north, Arloncourt Road to the east, and General Jim Moore Boulevard to the west.

Elevations served in this pressure zone approximately range from 410 to 505 feet. This zone is supplied from Booster Station E, which pumps water from Reservoir D1 located in Zone D. Zone E has a hydropneumatic tank located adjacent to Reservoir D1.

4.4 WATER DISTRIBUTION PIPELINES

Groundwater is pumped into the District's distribution system via more than 160 miles of pipeline. An inventory of existing modeled pipes, extracted from the GIS-based hydraulic model and used in this analysis, is included in **Table 4.3**. For each pipe diameter, the inventory lists the length in feet, as well as the total length in units of miles. It should be noted the hydraulic model went through an extensive vetting process, that included the following: a review of CMMS data, multiple reviews with District staff, a review of previous hydraulic modeling efforts, and a review of District maintained CAD maps.

4.5 STORAGE RESERVOIRS

Storage reservoirs are typically incorporated in the water system to provide water supply for operation during periods of high demand, for meeting fire flow requirements, and for other emergencies, as defined in the District's planning criteria.

The District's existing storage reservoirs are summarized in **Table 4.4**, along with their volumes, construction year and type, height, diameter, bottom elevations, and overflow height and

Table 4.3 Existing Model Pipe Inventory

Water Master Plan

Marina Coast Water District

PRELIMINARY

Pipe Diameter	Total Length by Diameter (ft)	(miles)
4	8,599	1.6
6	227,135	43.0
8	336,113	63.7
10	30,558	5.8
12	132,848	25.2
14	4,483	0.8
16	30,649	5.8
18	23,541	4.5
20	10,137	1.9
24	39,999	7.6
30	11,180	2.1
48	0	0.0
Total	**855,242**	**162.0**

AKEL ENGINEERING GROUP, INC.

3/27/2019

Note:

1. Length and Diameter information extracted from hydraulic model developed by Akel Engineering Group.

Table 4.4 Existing Storage Facilities

Water Master Plan

Marina Coast Water District

PRELIMINARY

Pressure Zone	Tank Name	Location	Installation Year (yr)	Volume (MG)	Tank HWL[2] (ft)	Construction Type	Diameter[3] (ft)	Overflow Elevation (ft)	Bottom Elevation[2] (ft)
A	Reservoir 2	Crescent Ave, Marina	1980	2.00	165	Steel	80	166	110
A	Intermediate	Above Schoonover Park	1984	0.17	221	Steel	30	224	190
A	Sand Tank	California Ave	1952	1.00	132	Concrete	120	132	120
B	B1	6th & Durham	1942	2.00	314	Concrete	117	314	296
C	C1	7th and Giggling	1964	2.00	400	Concrete	130	400	376
C	C2 (old F)	Off Watkins Gate Rd.	1990	2.00	400	Concrete	108	400	370
D	D1	Above Fitch Park	2008	2.00	510	Steel	132	501	475
D	Huffman	BLM- Huffman Ranch	1961	0.06	-	Steel	-	-	-
E	Hydropneumatic	Above Fitch Park	1961	0.01	-	Steel	-	-	-
		Total Storage Capacity (Active Facilities)		**9.2**	**MG**				

AKEL ENGINEERING GROUP, INC.

3/16/2018

Notes :

1. Unless noted otherwise, information extracted from "MCWD EOC Charts" received from District staff on December 13, 2016.
2. Source: Hydraulic profile received from District staff December 14, 2016.
3. Source: Previous water system hydraulic model received December 13, 2016.

elevations. These reservoirs are also shown on the existing system hydraulic profile schematic (**Figure 4.4**), with the HWL and bottom tank elevations.

4.6 BOOSTER STATIONS

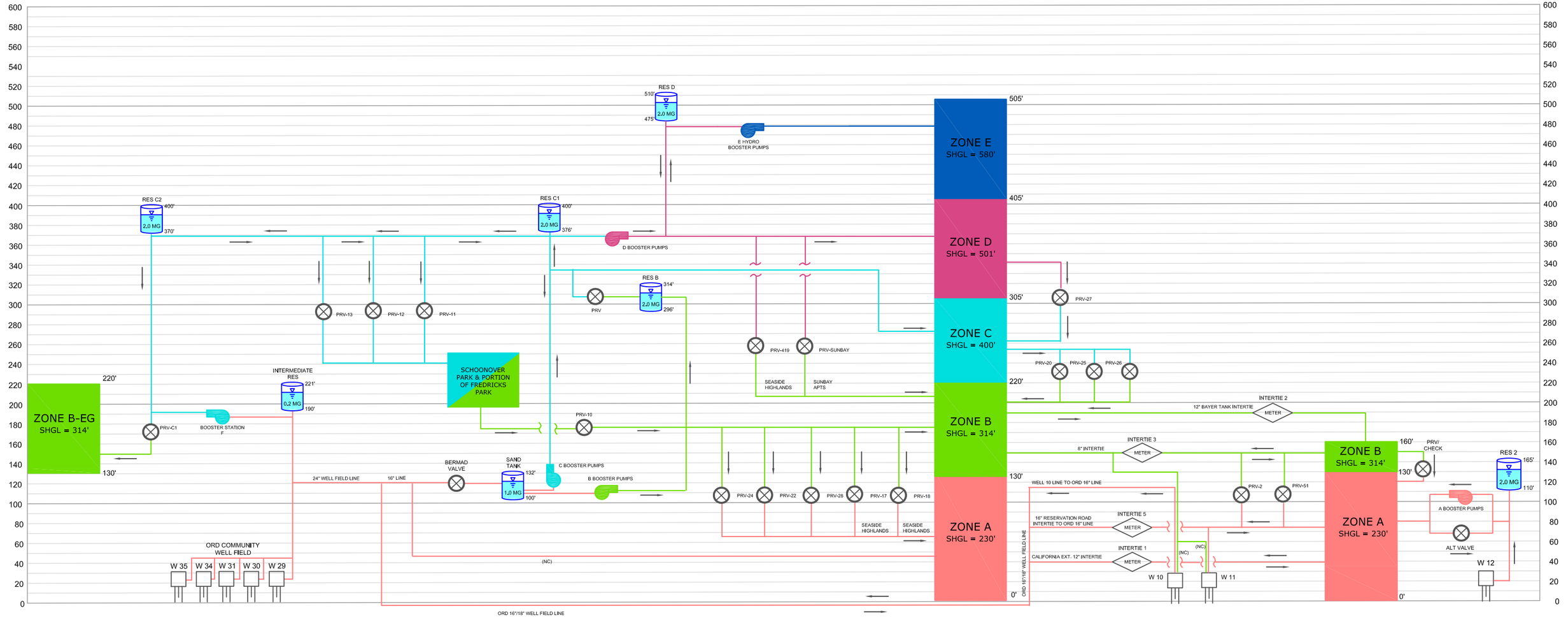
Water is conveyed from the lower supply pressure zones to the higher pressure zones via a series of booster pump stations (**Table 4.5**). There are 4 active and 1 inactive booster stations in the District and **Table 4.5** lists their ground elevation, source and destination pressure zones, pump capacities, and additional station information.

4.7 PRESSURE REDUCING VALVES

The District has several areas that require pressure reducing valves as either the primary source or as reliability sources of supply. The pressure reducing valve locations are shown on **Figures 4.1** and **4.2**, and their zone interconnectivity is documented on **Figure 4.4**. **Table 4.2** documents the pressure reducing valve locations, identification number, approximate elevation, the pressure zone serviced, and the size and setpoint.

ORD COMMUNITY WATER SYSTEM

MARINA WATER SYSTEM



LEGEND

- RESERVOIR (HWL / # MG / LOW) — HWL: HIGH WATER LEVEL; # MG: RESERVOIR CAPACITY; LOW: BOTTOM ELEVATION
- BOOSTER PUMPING STATION
- PRESSURE REGULATING VALVE
- TRANSMISSION MAIN
- PRESSURE ZONE (ZONE # / SHGL) — SHGL: STATIC HYDRAULIC GRADE LINE; HIGH: HIGHEST SERVICE ELEVATION; LOW: LOWEST SERVICE ELEVATION
- WELL ACTIVE
- WELL INACTIVE

Figure 4.4

Existing Hydraulic Profile Schematic

2019 WATER MASTER PLAN

MARINA COAST WATER DISTRICT

AKEL ENGINEERING GROUP, INC.

Last Updated: 04/09/19

PRELIMINARY

Table 4.5 Existing Booster Pumping Stations

Water Master Plan

Marina Coast Water District

PRELIMINARY

Name	Location	Elevation (ft)	Source Pressure Zone	Destination Pressure Zone	Design Capacity[1] Rated (gpm)	Rated (mgd)	Head (ft)	Individual Pump Horsepower (hp)	Operational Capacity (Historical Pump Tests)[2] Flow (gpm)	Head (ft)	Individual Pump Horsepower (hp)	Test Year
City of Marina												
A-Booster[3]	Reservoir 2	109	A	A	1,500	2.2		100	1,799			2008
					1,500	2.2		100	1,718			2008
					1,500	2.2		100	1,805			2008
Fort Ord												
B-Booster	Sand Tank	110	A	B	2,800	4.0		125	1,660	181	119	2016
					2,800	4.0		125	1,593	192	115	2017
					2,800	4.0		125	1,561	190	125	2017
C-Booster	Sand Tank	110	A	C	2,000	2.9		125	1,127	218	121	2017
					1,800	2.6		125				
					1,800	2.6		125				
					1,800	2.6		125	1,344	263	142	2017
					1,800	2.6		125	982	278	135	2017
D-Booster	Intersection of Giggling Road and Parker Flats	300	C	D	4,800	6.9		100	2,120	113	110	2013
					2,000	2.9		50	1,051	106	48	2013
E-Booster	D1 Tank	475	D	E	120	0.2		10	95	171	6	2017
					120	0.2		10	93	137	6	2017
					120	0.2		10	115	111	6	2017
					2,150	3.1		125	2,180	116	87	2017
					2,150	3.1		125	2,189	117	87	2017
F-Booster[2] (Inactive)	Intermediate Tank	190	A	C	1,500	2.2		150	1,504			2008
					1,500	2.2		150	1,510			2008

AKEL ENGINEERING GROUP, INC.

1/23/2017

Notes:

1. "MCWD EOC Charts" received from District staff on December 13, 2016.
2. Unless noted otherwise, pump tests provided by District on June 15, 2017.

CHAPTER 5 –WATER DEMAND AND SUPPLY CONSTRAINTS

This chapter summarizes existing domestic water demands and projects the future domestic water demands.

5.1 EXISTING DOMESTIC WATER DEMANDS

The distribution of existing water demands used for this master plan was based on the District's 2016 water billing consumption records. For evaluation purposes these demands were adjusted to match 2014 total annual production minus 10%, which is expected to reflect the system-wide usage of the existing customers as growth continues. This adjustment also takes into account system losses that occur between the groundwater wells and the customer service connections. The existing average day domestic water demands used for evaluation are equal to 3.2 mgd and are summarized by pressure zone on **Table 5.1**.

To determine the existing demand distribution by pressure zone, GIS was used to geocode each customer account to its physical location. Based on this location the existing pressure zone of each account was identified; the accounts were then sorted by pressure zone and the total demand in each zone was calculated.

5.2 FUTURE DOMESTIC WATER DEMANDS

Future demands were projected using the unit factors for residential and non-residential land uses and included the developments within the Future Service Area, as identified in Chapter 2. These demands were used in sizing the future infrastructure facilities, including distribution mains, storage reservoirs, and booster stations. Demands were also used for allocating and reserving capacities in the existing or proposed facilities. The following sections document the future domestic water demands based on the development limits prepared by FORA as well as the buildout development horizon.

5.2.1 Near-Term Domestic Water Demands

The potential development area associated with the FORA development limits was previously summarized on **Table 2.2**. Using the water demand factors for residential and non-residential land uses the future average day demands for the near-term developments are summarized on **Table 5.2**. The total average day domestic water demands due to the near-term developments is estimated to be 1.0 mgd.

5.2.2 Buildout Domestic Water Demands

Table 5.3 organizes the future land use categories and their corresponding domestic water demands for the buildout development horizon. It should be noted that the water demands attributed to existing land uses in **Table 5.3** were calculated using the recommended water unit

Table 5.1 Existing Demands by Pressure Zone

Water Master Plan

Marina Coast Water District

PRELIMINARY

Pressure Zone	Existing Demands		
	Average Day[1] (mgd)	Maximum Day[2] (mgd)	Peak Hour[3] (mgd)
A	1.6	3.1	5.5
B	1.0	2.0	3.5
B-EG[4]	0.1	0.1	0.2
C	0.3	0.6	1.0
D	0.3	0.5	0.9
E-HYD	0.1	0.1	0.2
Total	**3.2**	**6.5**	**11.3**

AKEL ENGINEERING GROUP, INC.

11/2/2017

Notes:

1. Source: Consumption data received from District staff May 11, 2017
2. Maximum Day Demand = 2.0 x Average Day Demand
3. Peak Hour Demand = 3.5 x Average Day Demand
4. B-EG pressure zone represents East Garrison development area currently suppli Zone C via PRV on Inter-Garrison Rd.

Table 5.2 Near-Term Development Demands

Water Master Plan

Marina Coast Water District

PRELIMINARY

Development Areas	Development Limits[1]			Estimated Development Area				Estimated Average Day Demand[5]
	Residential	Office, Industrial, Commercial	Hotel	Residential[2]	Office, Industrial, Commercial[3]	Hotel[4]	Total	
	(du)	(sf)	(rooms)	(acres)	(acres)	(acres)	(acres)	(mgd)
1	2	3	4	5	6	7	8	10
Campus Town Specific Plan	388	180,000	300	48.5	6.9	2.5	57.9	0.06
Cypress Knolls	712	0	0	89.0	0.0	0.0	89.0	0.09
Del Rey Oaks	691	400,000	550	86.4	15.3	38.6	140.2	0.17
Dunes Phase 1, 2, & 3	847	1,049,000	394	105.9	40.1	12.9	158.9	0.19
East Garrison	721	102,000	0	90.1	3.9	0.0	94.0	0.10
Main Gate	145	150,000	350	18.1	5.7	7.8	31.6	0.04
City of Monterey	0	937,800	0	0.0	35.9	0.0	35.9	0.05
Sea Haven	929	0	0	116.1	0.0	0.0	116.1	0.12
Seaside East	310	90,000	0	38.8	3.4	0.0	42.2	0.05
Seaside Resort	122	10,000	398	15.3	0.4	16.8	32.4	0.04
UC MBEST	240	1,090,000	0	30.0	41.7	0.0	71.7	0.09
Total	**5,105**	**4,008,800**	**1,992**	**638.1**	**153.4**	**78.5**	**870.0**	**1.00**

AKEL ENGINEERING GROUP, INC.

3/15/2019

Notes:

1. Development limits based on development Forecasts documented in FORA "FY 2018-2019 Capital Improvement Program", Table 6 and Table 7 and reflect remaining entitlements.
2. Residential acreage estimated based on average residential density of 8 dwelling units per acre.
3. Office, Industrial, and Commercial acreage estimated bsaed on average floor-area-ratio of 0.6.
4. Acreage for hotel development estimated based on available planning information and County of Monterey parcel database.
5. Estimated demand based on residential and non-residential unit factors consistent with master plan unit factors.

Table 5.3 Average Daily Water Demands

Water Master Plan
Marina Coast Water District

PRELIMINARY

Land Use Classifications	Buildout Water Demands																
	Existing Development			Future Development within Service Area								Future Development Outside of Future Service area			Total	
	Lands Retained by Existing Development	Water Unit Factor	Average Daily Demand	Lands Gained from Redevelopment	New Development		Subtotal Future Development	Water Unit Factor	Average Daily Demand	Total Development at Buildout of Service Area	Total Average Daily Demand	Development Outside of Future Service Area	Water Unit Factor	Average Daily Demand	Total Development within Planning Study Area	Average Daily Demand
					Inside Existing Service Area	Outside Existing Service Area										
	(acre)	(gpd/acre)	(gpd)	(acre)	(acre)	(acre)	(acre)	(gpd/acre)	(gpd)	(gpd/acre)	(gpd)	(acre)	(gpd/acre)	(gpd)	(acre)	(gpd)
Residential																
Residential	2,378	1,060	2,520,469	85	1,167	1,033	2,285	1,060	2,421,951	4,663	4,942,420	0	1,060	50	4,663	4,942,470
Subtotal Residential	2,378		2,520,469	85	1,167	1,033	2,285			4,663	4,942,420	0		50	4,663	4,942,470
Non-Residential																
Commercial	309	1,390	429,218	21	235	139	395	1,390	549,113	704	978,331	1	1,390	1,420	705	979,751
Park	98	1,090	106,302	103	156	222	481	1,090	524,525	579	630,827	0	1,090	0	579	630,827
Institutional	541	240	129,932	23	191	58	272	240	65,246	813	195,178	1	240	220	814	195,398
Planned Development Mixed Use District	0	1,160	0	134	475	726	1,336	1,160	1,549,438	1,336	1,549,438	0	1,160	0	1,336	1,549,438
Subtotal Non-Residential	948		665,453	280	1,058	1,146	2,484		2,688,322	3,432	3,353,774	2		1,640	3,433	3,355,415
Other																
Bayonet Golf Course	307	0	0	0	0	0	0	0	0	307	0	0	0	0	307	0
Open Space - Other	438	0	0	46	0	0	46	0	0	484	0	90	0	0	574	0
Designated Open Space	45	0	0	0	0	0	0	0	0	45	0	18,238	0	0	18,283	0
ROW	25	0	0	0	1	0	1	0	0	26	0	0	0	0	26	0
Airport Runway	224	0	0	0	0	0	0	0	0	224	0	0	0	0	224	0
Parker Flats LU Swap	0	0	0	0	0	709	709	0	0	709	0	0	0	0	709	0
Subtotal Other	1,039	0	0	46	1	709	756	0	0	1,794	0	18,328	0	0	20,122	0
Totals	4,364	431	**3,185,922**	412	2,225	2,888	5,524	0	0	9,889	**8,296,194**	18,330	0	1,690	28,218	**8,297,884**

Table 5.4 Average Annual Demand Projections

Water Master Plan

Marina Coast Water District

PRELIMINARY

Year	Population[1,2]	Annual Growth (%)	Average Annual Demand[3,4] (mgd)
Historical Population			
2005	29,477	-	3.74
2006	29,154	-1.1%	3.83
2007	29,065	-0.3%	4.07
2008	29,533	1.6%	3.66
2009	29,743	0.7%	3.60
2010	30,840	3.7%	3.69
2011	31,141	1.0%	3.62
2012	31,445	1.0%	3.68
2013	31,752	1.0%	3.96
2014	32,062	1.0%	3.60
2015	32,375	1.0%	2.88
2016	33,346	3.0%	2.70
2017	34,347	3.0%	2.89
2018	35,377	3.0%	3.57
Projected Population			
2019	36,438	3.0%	3.68
2020	37,531	3.0%	3.79
2021	38,657	3.0%	3.90
2022	39,817	3.0%	4.02
2023	41,012	3.0%	4.14
2024	42,242	3.0%	4.27
2025	43,509	3.0%	4.39
2026	44,815	3.0%	4.53
2027	46,159	3.0%	4.66
2028	47,544	3.0%	4.80
2029	48,970	3.0%	4.94
2030	50,439	3.0%	5.09
2031	51,952	3.0%	5.25
2032	53,511	3.0%	5.40
2033	55,116	3.0%	5.57
2034	56,770	3.0%	5.73
2035	58,473	3.0%	5.90
2036	60,227	3.0%	6.08
2037	62,034	3.0%	6.26
2038	63,895	3.0%	6.45
2039	65,812	3.0%	6.65
2040	67,786	3.0%	6.84
2041	69,820	3.0%	7.05
2042	71,914	3.0%	7.26
2043	74,072	3.0%	7.48
2044	76,294	3.0%	7.70
2045	78,583	3.0%	7.94
2046	80,940	3.0%	8.17
2047	83,368	3.0%	8.42

Note:

1. Population for years 2005 - 2015 extracted from Marina Coast Water District 2015 Urban Water Management Plan.
2. Population for years 2016 - 2047 calculated assuming annual growth rate of 3.0% as directed by District staff.
3. Average annual demand for 2018 - 2047 based on projected population and 2014 per capita water use less 10% (approximately 101 gpcd).

Table 5.5 Buildout Demands by Pressure Zone

Water Master Plan

Marina Coast Water District

PRELIMINARY

Pressure Zone	Future Demands		
	Average Day (mgd)	Maximum Day[1] (mgd)	Peak Hour[2] (mgd)
A	2.2	4.4	7.8
B	2.3	4.6	8.1
B-EG	0.2	0.4	0.6
C	1.4	2.7	4.8
D	1.8	3.6	6.3
E-HYD	0.3	0.6	1.1
EG-HYD	0.1	0.2	0.3
Total	**8.3**	**16.5**	**28.9**

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1. Maximum Day Demand = 2.0 x Average Day Demand
2. Peak Hour Demand = 3.5 x Average Day Demand

factors and reflect an average day demand equal to 2014 production minus 10%. The total average day domestic water demands from existing and future developments is estimated to be 8.3 mgd.

Based on the buildout average day demand of 8.3 mgd, and the 2014 less 10% per capita water use factor of approximately 101 gpcd, the District's buildout population capacity is estimated to be approximately 83,300 people. Assuming a constant population growth rate of 3% as discussed in Chapter 2 it is estimated that the District will reach this buildout population capacity in the year 2047. **Table 5.4** documents the annual population estimates and includes estimated annual average water demand, based on projected population and a per capita water use of 101 gpcd.

Table 5.5 summarizes the buildout water demand for each pressure zone. It should be noted that **Table 5.5** includes demands for future pressure zone EG-HYD, which is a planned hydropneumatic pressure zone to serve potential future development south of the existing East Garrison development; this pressure zone is discussed in more detail in Chapter 7.

5.3 MAXIMUM DAY AND PEAK HOUR DEMANDS

The maximum day and peak hour demands for the existing and future demands were calculated using the average day demands and District peaking factor criteria. The maximum day to average day ratio of 2.0, and peak hour to average day ratio of 3.5, were applied to the average day demands to obtain estimates of the higher demand conditions. The maximum day and peak hour demand estimates for the buildout of the Future Service Area are 16.6 mgd and 29.0 mgd, respectively.

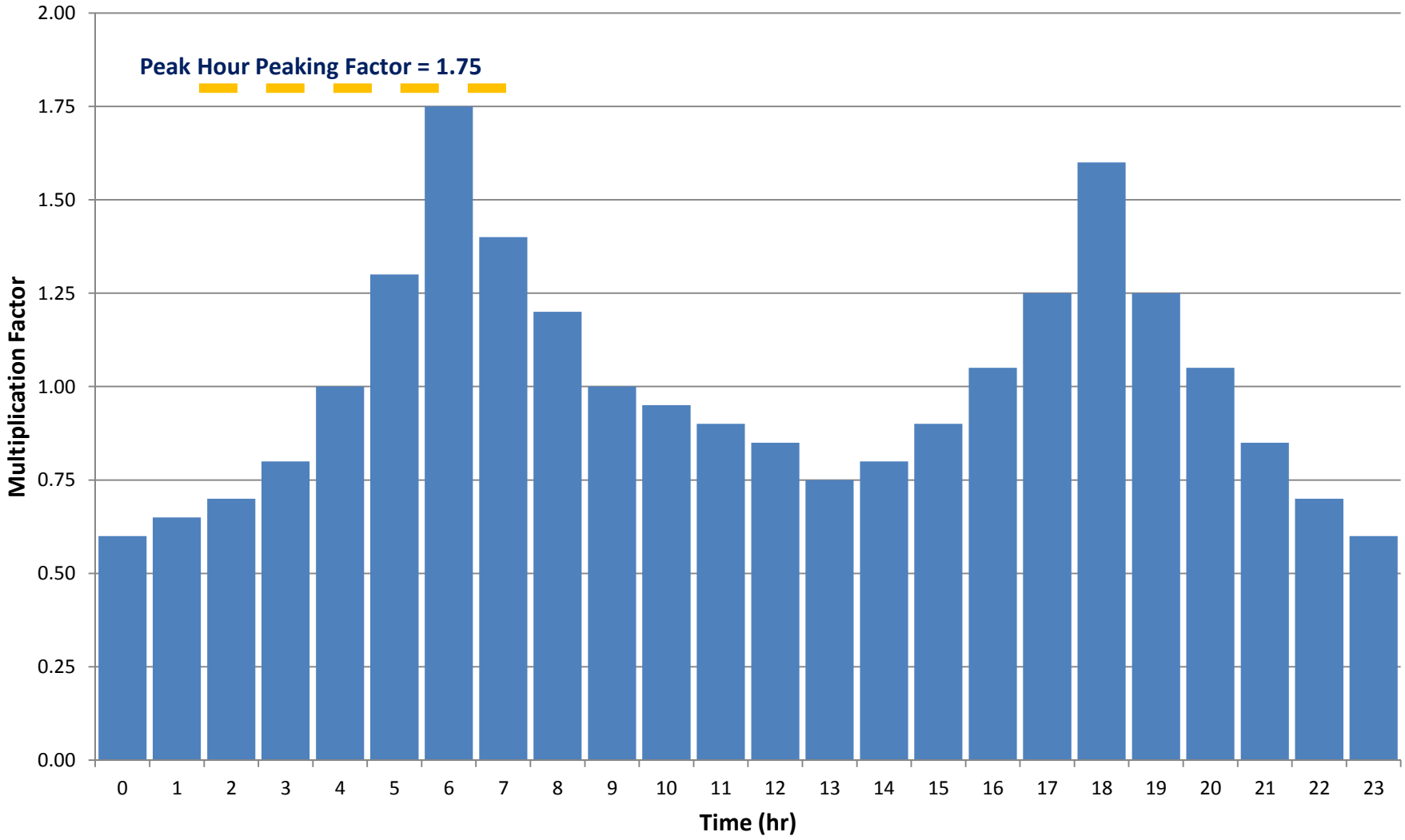
5.4 DIURNAL DEMAND PATTERNS

Water demands vary with the time of day and by account type according to the land use designation. These fluctuations were accounted for in the modeling effort and evaluation of the water distribution system. The diurnal demand patterns affect the water levels in storage reservoirs and amount of flow through distribution mains. The diurnal demand pattern utilized in this master plan was based on the pattern developed as part of the 2007 WSMP, with an adjustment made to the peak hour factor for consistency with the District's design standards; the diurnal demand pattern is shown on **Figure 5.1**. The diurnal pattern was confirmed during the calibration effort of the District's hydraulic model and corresponding SCADA information.

5.5 GROUNDWATER SUPPLY

As documented in a previous section, the District currently utilizes groundwater as the sole source of supply. As a part of this Master Plan, GHD reviewed potential sources of groundwater contamination as well as documented the District's ongoing monitoring and testing practices. The following sections are intended to briefly summarize the report prepared by GHD, which is included in full in **Appendix A**.

Diurnal Water Use



LEGEND

PRELIMINARY

Note: Water system diurnal curve is consistent with 2007 Water Master Plan and has been adjusted to reflect updated Peak Hour Peaking Factor

March 28, 2018

Figure 5.1
Diurnal Pattern
Water Master Plan
Marina Coast Water District

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5.5.1 Groundwater Quality and Contamination

The District actively monitors and mitigates groundwater contaminants that may adversely impact their supply reliability. Three of the District wells located in Marina draw from the deep (900 foot) aquifer, while the 5 wells located in Fort Ord draw from the various levels of the Salinas Valley Groundwater basin, and receive chlorination treatment. The following sections briefly discuss local water quality monitoring, known contaminations, and mitigation efforts.

5.5.2 Water Quality Monitoring

The District operates a state-certified laboratory for the purpose of monitoring the existing water quality of the City of Marina and Fort Ord water supplies. Monitoring and testing is performed in a manner consistent with Title 22 of the California Water Code, with 20 sampling sites in the City of

Marina and 20 sites in Fort Ord. Some of the constituents the District's laboratory monitors include chloride, fluoride, nitrate, bromide, and sulfate.

The District has four wells that are located in the Salinas Valley Groundwater Basin. This basin is listed as an impaired basin due to nitrate contamination and seawater intrusion. Additionally, the surface waters which help recharge the basin are listed as 303(d) impaired waters, including up to 19 impairments. Much of the contamination issues stem from agricultural sources, including toxicity, pesticides, nutrient loading and indicator bacteria.

5.5.3 Water Quality Mitigation Efforts

Current mitigation efforts include both regulatory and volunteer efforts to improve water quality impacts from agricultural practices in the region.

Regulatory

The Central Coast Regional Water Quality Control Board (RWQCB) adopted and subsequently updated their Irrigated Lands Order that prioritizes conditions controlling pollutant loading in areas where water quality impairment is documented on the 303(d) list. This order is managed by the RWCQB for all agricultural growers within the jurisdictional limit, and dischargers are required to implement management practices to maintain compliance.

Additionally, the State Water Resources Control Board (SWRCB) has adopted a Recycled Water Policy that requires local stakeholders to manage salt and nutrient management plans. Currently, no plan has been completed for this region.

Voluntary

The Greater Monterey Integrated Regional Water Management Plan (IRWMP) includes discussion regarding the Agriculture and Rural Lands Action Plan, which consists of agricultural industry groups, environmental groups, and resource agencies that provides six categories defining strategies for increasing water quality:

1) identification and adoption of more effective management practices through development of industry networks;
2) expansion and coordination of technical assistance/outreach;
3) public education and public relations;
4) regulatory coordination/permit streamlining for conservation measures;
5) improved funding mechanisms and tax incentives;
6) strategies for public lands and rural roads

The Agricultural Water Quality Alliance was formed in 1999 in an effort to implement the strategies included in the Agriculture and Rural Lands Action Plan. This group has worked to reduce nutrient loading, sedimentation of watersheds, and reduction in pesticide runoff. Examples of the accomplishments of this group are included in the GHD document.

5.5.4 Fort Ord Contamination Mitigation

Based on the discovery of groundwater contamination in 1990, the former Fort Ord area was designated as a National Priority List federal Superfund Site by the Environmental Protection Agency. The District actively monitors wells in the vicinity of the site for TCE and other contaminants. The District also tracks the plume migration and works with the US Army Corps of Engineers (USACE), who are responsible for the groundwater cleanup efforts. USACE published an update to their mitigation efforts in February of 2017, which documented the contamination plumes. Groundwater contaminations generally consist of trichloroethylene (TCE), Perchloroethylene (PCE), and Carbon Tetrachloride (CT).

The District and the USACE actively monitor the contamination sites and associated groundwater quality. Thus far, the Department of Public Health has not taken any additional action due to the contaminant levels being below the Maximum Contaminant Level (MCL).

5.5.5 Seawater Intrusion

While currently operational and meeting the demand requirements, the District has groundwater wells that may be adversely impacted by seawater intrusion if groundwater overdraft continues in the Salinas Valley Groundwater Basin. The average groundwater overdraft during non-drought years is estimated at 50,000 acre-feet (AF) per year, and during drought years has climbed to as much as 300,000 AF. Due to this overdraft, fresh water levels have declined and allowed seawater to intrude into the 180 foot and 400 foot groundwater aquifers.

Historically, the influence of the seawater intrusion front has been documented as areas where concentrations exceed 500 milligrams per liter (mg/L). This area of influence has been gradually moving farther inland, and into the deeper groundwater aquifers. While reductions in overdraft are expected over the next 10 years, seawater intrusion issues are expected to worsen. Furthermore, much of the groundwater modeling completed to date does not account for sea level rise due to global climate change. Sea levels have risen approximately 7 inches in the past 100 years, and are expected to rise 14 inches by 2050 and 55 inches by 2100. This sea level rise will greatly

increase the pressure gradient, and is expected to increase seawater intrusion into the local aquifer.

As sea water intrusion has progressed, the District has continued to migrate wells into deeper aquifers. Currently, the Marina wells are located in the deep (900 foot) aquifer due to intrusion into the 180 foot and 400 foot aquifers. The Ord wells are generally located farther inland and have not experienced as much of an impact as the Marina wells due to seawater intrusion. On-going monitoring by the Monterey County Water Resources Agency (MCWRA) has noted that seawater influence has continued to migrate inland, in particular in the 180 foot aquifer. Some of the areas behind the front have improved water quality generally south of the Salinas River. The District currently owns a monitoring well located in the deep aquifer between the Marina wells and the Monterey Bay. If seawater intrusion is noted in the monitoring well, this will serve as an early warning sign for potential impacts to the Marina wells, and the District can begin projects to supplement supply should production be impacted.

Finally, the MCWRA published six recommendations in October 2017 that are intended as guidance for minimizing further intrusion of seawater in the Salinas Valley Groundwater Basin. The six recommendations were presented as follows:

1) Eliminate extractions in the area of impact within the 400 foot groundwater aquifer (shown in the appendix).

2) Enhance and expand the Castroville Seawater Intrusion Program (CSIP).

3) Once CSIP is expanded, eliminate all pumping in the 180 foot and 400 foot aquifer, with some exceptions.

4) Initiate and proceed with the destruction of wells in Agency Zone 2B (map included in appendix).

5) An immediate moratorium on new groundwater well extractions within the deep aquifer (below the 400 foot aquifer) until further investigation is completed and addition long-term viability has been explored for the deep aquifer.

6) Initiate and proceed with an investigation of the hydraulic properties and the long-term viability of the Deep Aquifer.

It should be noted that the District is currently participating in the 6 management practices set forth by MCWRA. Implementation of the Sustainable Groundwater Management Act will provide additional focus on the Marina and North Marina Subbasins, and in particular, the 180 and 400 foot aquifer zones.

CHAPTER 6 - HYDRAULIC MODEL DEVELOPMENT

This chapter describes the development and calibration of the District's domestic water distribution system hydraulic model. The hydraulic model was used to evaluate the capacity adequacy of the existing system and to plan its expansion to service anticipated future growth.

6.1 OVERVIEW

Hydraulic network analysis has become an effectively powerful tool in many aspects of water distribution planning, design, operation, management, emergency response planning, system reliability analysis, fire flow analysis, and water quality evaluations. The District's hydraulic model was used to evaluate the capacity adequacy of the existing system and to plan its expansion to service anticipated future growth.

6.2 MODEL SELECTION

The District's hydraulic model combines information on the physical characteristics of the water system (pipelines, groundwater wells, and storage reservoir) and operational characteristics (how they operate). The hydraulic model then performs calculations and solves series of equations to simulate flows in pipes and calculate pressures at nodes or junctions.

There are several network analysis software products that are released by different manufacturers, which can equally perform the hydraulic analysis satisfactorily. The selection of a software depends on user preferences, the distribution system's unique requirements, and the costs for purchasing and maintaining the software.

The District's previous model was developed using Innovyze's (previously MWHSoft) H20Map, which utilizes the effective EPANET hydraulic engine for processing the hydraulic calculations. As part of this master plan, the hydraulic model has been updated and redeveloped into the GIS-based hydraulic model InfoWater by Innovyze. The model has an intuitive graphical interface and is directly integrated with ESRI's ArcGIS (GIS).

6.3 HYDRAULIC MODEL DEVELOPMENT

Developing the hydraulic model included skeletonization, digitizing and quality control, developing pipe and node databases, and water demand allocation.

6.3.1 Skeletonization

Skeletonizing the model refers to the process where pipes not essential to the hydraulic analysis of the system are stripped from the model. Skeletonizing the model is useful in creating a system that accurately reflects the hydraulics of the pipes within the system, while reducing complexities

of large systems, which will reduce the time of analysis while maintaining accuracy, but will also comply with limitations imposed by the computer program.

6.3.2 Pipes and Nodes

Computer modeling requires the compilation of large numerical databases that enable data input into the model. Detailed physical aspects, such as pipe size, pipe elevation, and pipe lengths, contribute to the accuracy of the model.

Pipes and nodes represent the physical aspect of the system within the model. A node is a computer representation of a place where demand may be allocated into the hydraulic system, while a pipe represents the distribution and transmission aspect of the water demand. In addition, reservoir dimensions and capacities, and groundwater well capacity and design head, were also included in the hydraulic model.

6.3.3 Digitizing and Quality Control

The District's existing domestic water distribution system was digitized in GIS using several sources of data and various levels of quality control. The data sources included the District's AutoCAD water system maps as maintained by District staff, as well as the previously developed hydraulic model and additional as-builts provided by District staff.

After reviewing the available data sources the hydraulic model was updated. Resolving discrepancies in data sources was accomplished by graphically identifying discrepancies and submitting it to engineering and operations staff for review and comments. District comments were incorporated in the verified model.

It should be noted that this hydraulic model underwent multiple efforts for validating the pipelines, and included reviews of planned subdivision mapping, a review of existing CAD mapping, a review of previous hydraulic models, and review of operations and maintenance GIS shapefiles. No GIS was available at the start of the project, and thus this team developed GIS for the District to integrate into their future management and review of the system.

6.3.4 Demand Allocation

Demand allocation consists of assigning water demand values to the appropriate nodes in the model. The goal is to distribute the demands throughout the model to best represent actual system response.

The existing demand distribution was obtained from the water billing records. Using GIS, each customer account was geocoded and spatially joined within its existing pressure zone. The accounts were then sorted by pressure zone and the total demand in each zone was calculated.

Domestic water demands from each anticipated future development, as presented in a previous chapter, were also allocated to the model for the purpose of sizing the required future facilities. The demands from the greater Future Study Area were allocated based on proposed land use

and the land use acreages. As many of the areas were very large in size, demands were allocated evenly to the demand nodes within each area. Infill areas, redevelopment areas, and vacant lands were also included in the future demand allocation.

6.4 MODEL CALIBRATION

Calibration is intended to instill a level of confidence in the pressures and flows that are simulated. Calibration generally consists of comparing model predictions to field measured results and making necessary adjustments.

6.4.1 Calibration Plan and SCADA

In order to calibrate the hydraulic model pressure SCADA data was collected for points throughout the water distribution system, as well as water level data for the District's storage reservoirs. District staff provided flow and pump operational data for each groundwater well and booster station as well as 15-minute water level data for the District's storage reservoirs. The locations that were included in the calibration for tanks, booster stations, and wells are identified on **Figure 6.1**.

6.4.2 EPS Calibration

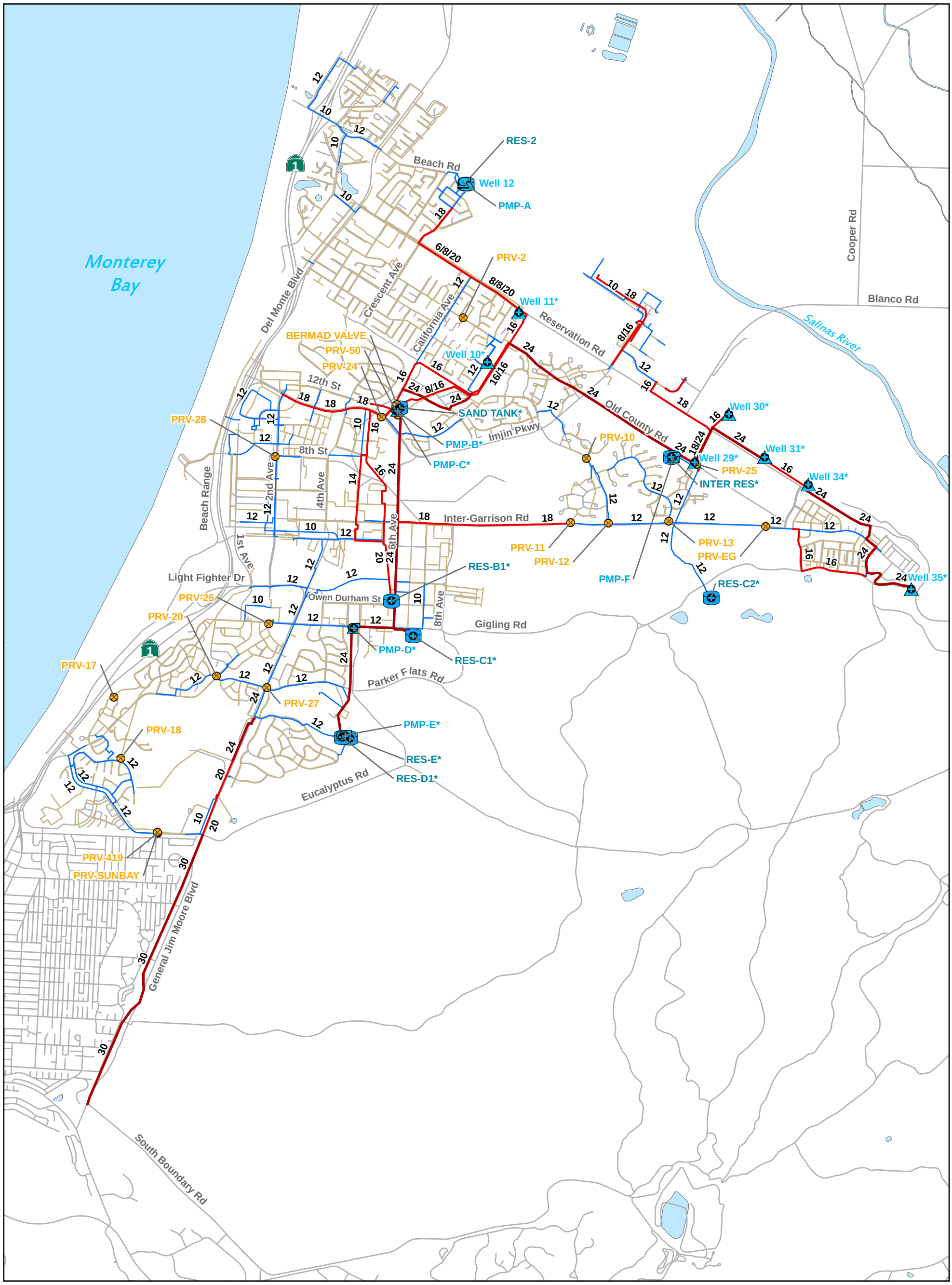
Calibration can be performed for steady state conditions or for extended period simulations (EPS). In steady state calibration, the model is compared to field monitoring results consisting of a single value, such as a single hydrant test. EPS calibration consists of comparing model predictions to diurnal operational changes in the water system.

The calibration process was iterative and resulted with satisfactory comparisons between the field measurements and the hydraulic model predictions at each well site and the water tank. The calibration results were graphically summarized for each site and included in **Appendix B**.

Representative extracts from **Appendix B** are shown on **Figure 6.2** for calibration points at the Zone B and Zone C tanks.

6.4.3 Use of the Calibrated Model

The calibrated hydraulic model was used as an established benchmark in the capacity evaluation of the existing water distribution system. The model was also used to identify improvements necessary for mitigating existing system deficiencies and for accommodating future growth. This valuable investment will continue to prove its value to the District as future planning issues or other operational conditions surface. It is recommended that the model be maintained and updated with recent construction to preserve its integrity.



Legend

- *Model Calibration Point

Existing Modeled System

- Tanks
- Wells
- Boosters
- PRV

Pipes by Diameter

- 8" and Smaller
- 10" - 12"
- 16" - 20"
- 24" - 48"

- Streets
- Rivers/Streams
- Waterbodies

PRELIMINARY

Update: January 2, 2019

0 0.25 0.5 1 Mile

N W GIS E S

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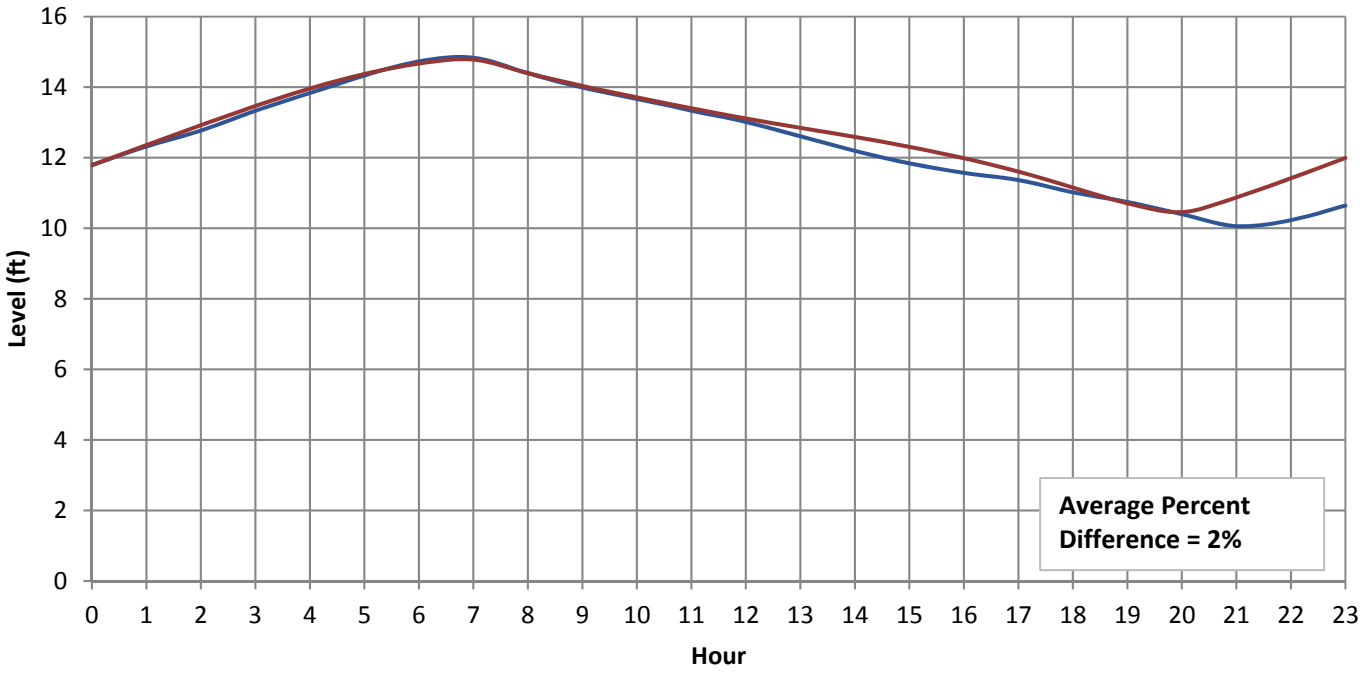
File Path: P:\xGIS\GIS_Projects\Marina_Coast_WD\Water\MCWD_Fig6-1ModelCalibration_010219.mxd

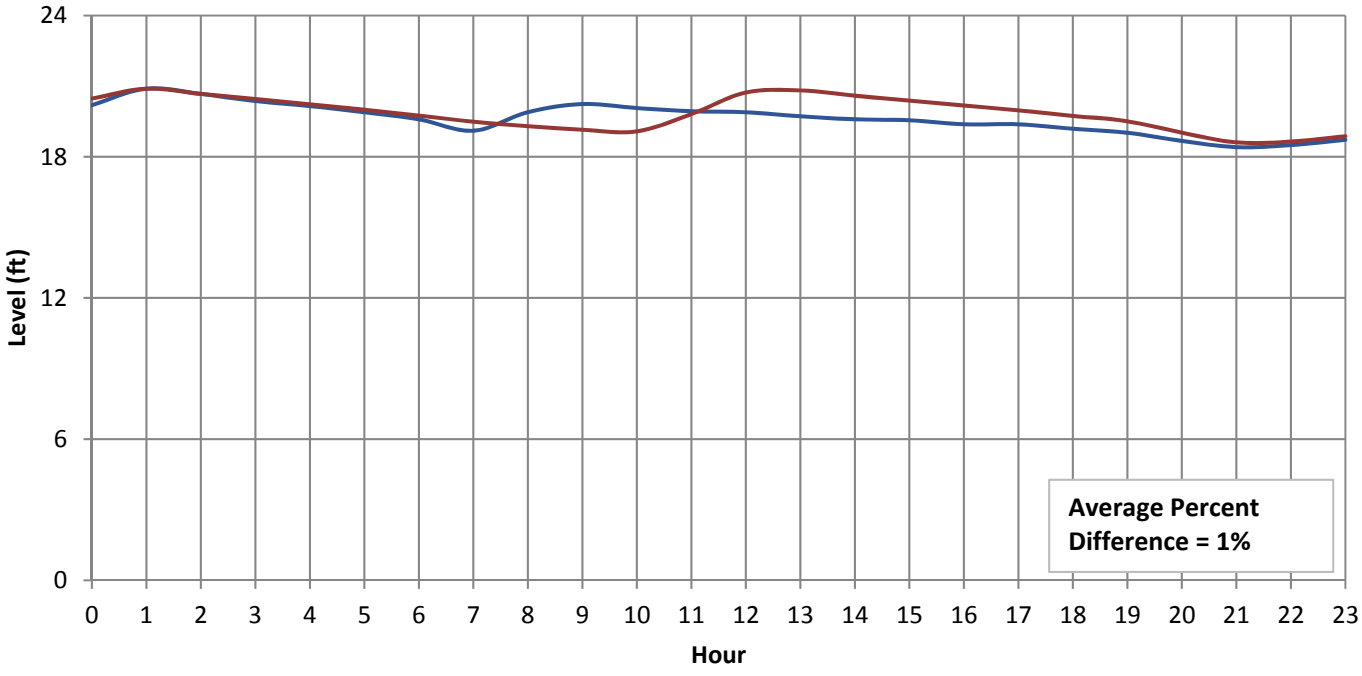
Figure 6.1
Hydraulic Model Calibration Program

Water Master Plan
Marina Coast Water District

B Tank - Level



C1/C2 Tank - Level



LEGEND

SCADA

Hydraulic Model

PRELIMINARY

Figure 6.1
Tank Calibration
Water Master Plan
Marina Coast Water District

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CHAPTER 7 - EVALUATION AND PROPOSED IMPROVEMENTS

This section presents a summary of the domestic water system evaluation and identifies improvements needed to mitigate existing deficiencies, as well as improvements needed to expand the system and service growth.

7.1 OVERVIEW

The calibrated hydraulic model was used for evaluating the distribution system for capacity deficiencies during peak hour demand and during maximum day demands in conjunction with fire flows. Since the hydraulic model was calibrated for extended period simulations, the analysis duration was established at 24 hours for analysis.

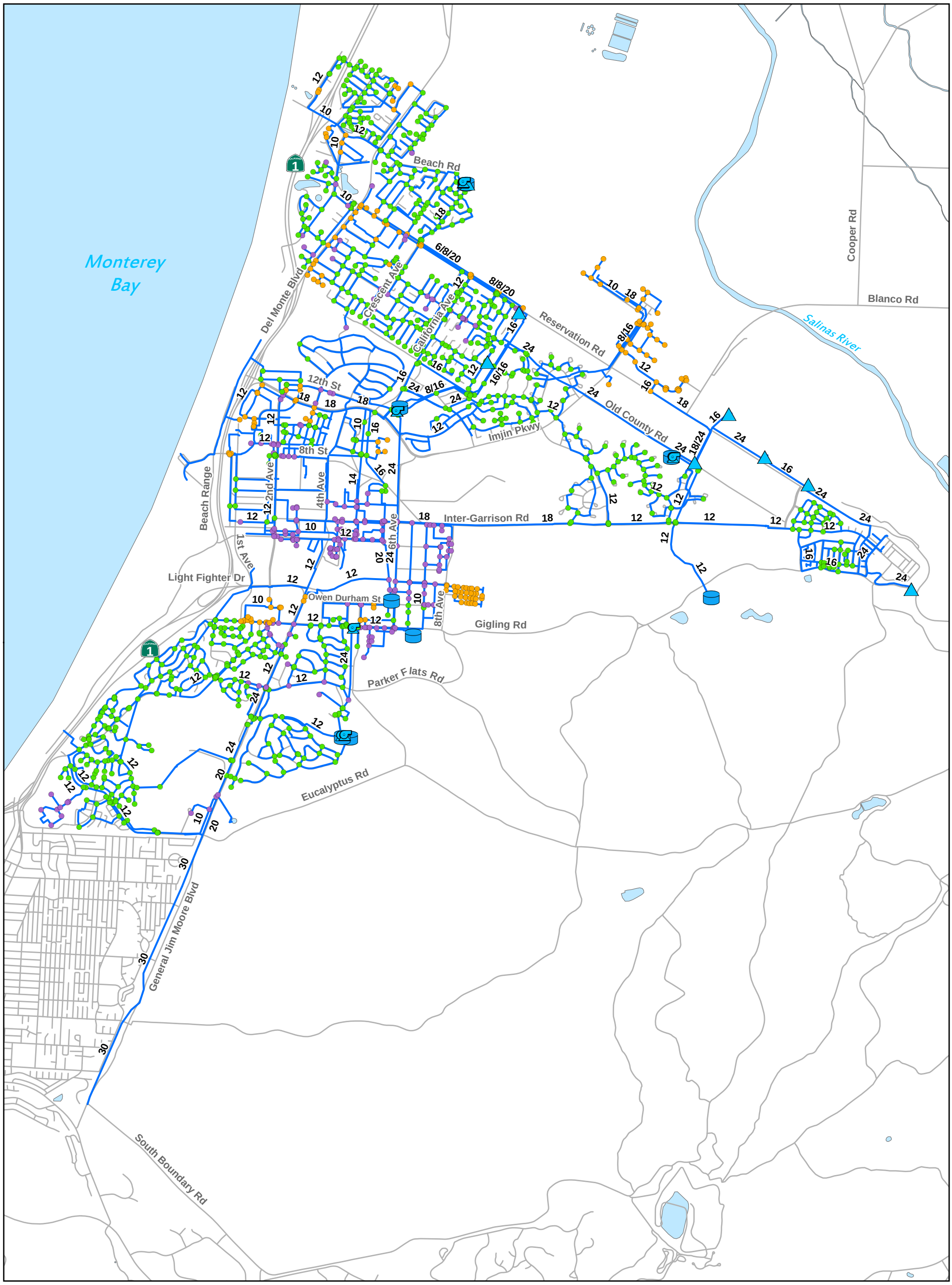
The criteria used for evaluating the capacity adequacy of the domestic water distribution system facilities (transmission mains, storage reservoirs, and booster stations) were discussed and summarized in the System Performance and Design Criteria chapter.

7.2 FIRE FLOW ANALYSIS

The fire flow analysis consisted of using the maximum day demand in the hydraulic model and applying hypothetical fire flows. The magnitude and duration of each fire flow was based on the governing land use type within proximity to the fire location. The criteria for fire flows were also summarized in the System Performance and Design Criteria chapter. **Figure 7.1** summarizes the hypothetical fire flow values simulated throughout the existing water system. Fire flows were assigned at model junctions in proximity to existing system hydrants and were assigned a flow value consistent with land use in close proximity to the hydrant.

Figure 7.2 documents the areas of the existing system with residual fire flow pressures less than 20 psi during the hypothetical fire flow as well as pipelines that are expected to exceed the maximum pipeline velocity of 7 feet per second (ft/s). **Figure 7.3** documents the available fire flows at the modeled junctions based on a minimum residual pressure of 20 psi and a maximum pipeline velocity of 7 ft/s. It should be noted that the results shown on **Figure 7.2** and **Figure 7.3** differentiate between deficiencies at modeled junctions at the end of cul-de-sac pipelines and on the gridded distribution system.

The hydraulic model identified several areas throughout the District's existing distribution system that experience minimum residual pressure less than 20 psi under fire flow conditions. A majority of these deficiencies are located within the City of Marina and are due to small diameter mains that are unable to carry the high flows during a fire event. Several improvements planned for construction in the near future, including a new 12-inch pipeline in the City of Marina's 2nd Avenue extension project as well as the construction of the new Pressure Zone A storage reservoirs, are expected to mitigate these fire flow deficiencies.



Legend

PRELIMINARY

Fire Flow Requirement

- 1,500 gpm for 2 Hours
- 3,000 gpm for 3 Hours
- 4,000 gpm for 4 Hours

Existing Modeled System

- Tanks
- Wells
- Boosters
- Pipes

- Streets
- Rivers/Streams
- Waterbodies

N, W, GIS, E, S

0 0.25 0.5 1 Mile

Update: April 10, 2019

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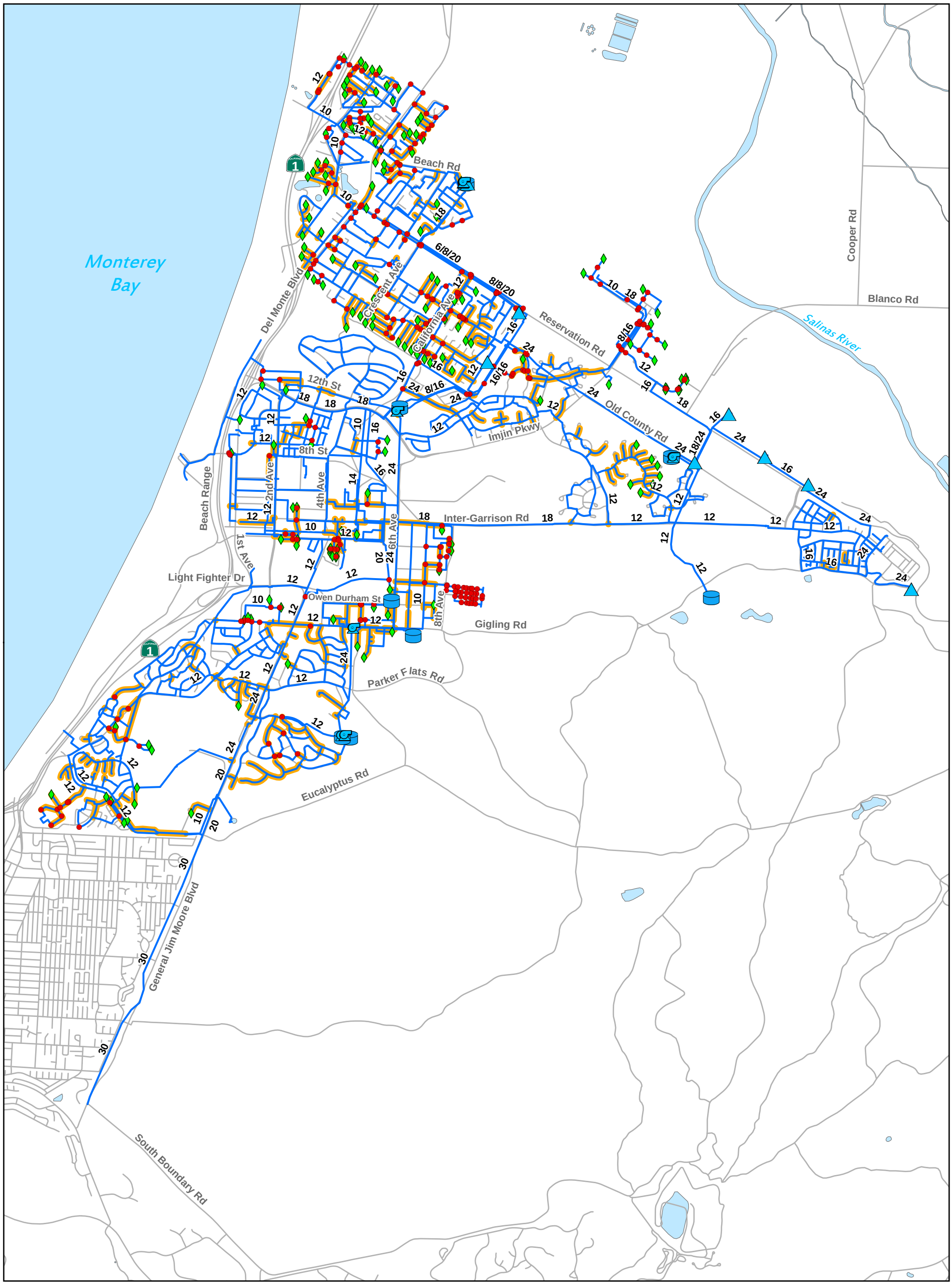
File Path: P:\xGIS\GIS_Projects\Marina_Coast_WD\Water\MCWD_Fig7-1_ExFF-Requirement_041019.mxd

Figure 7.1
Existing Fire Flow Requirement

Water Master Plan
Marina Coast Water District

MARINA COAST WATER DISTRICT



Legend

- Residual Pressure <20 psi
- Cul-de-sac Residual Pressure <20 psi
- Pipe Velocities >7 ft/sec

Existing Modeled System

- Tanks
- Wells
- Boosters
- Pipes
- Streets
- Rivers/Streams
- Waterbodies

PRELIMINARY

0 0.25 0.5 1 Mile

N W GIS E S

Update: April 10, 2019

Figure 7.2
Fire Flow Analysis

Water Master Plan
Marina Coast Water District

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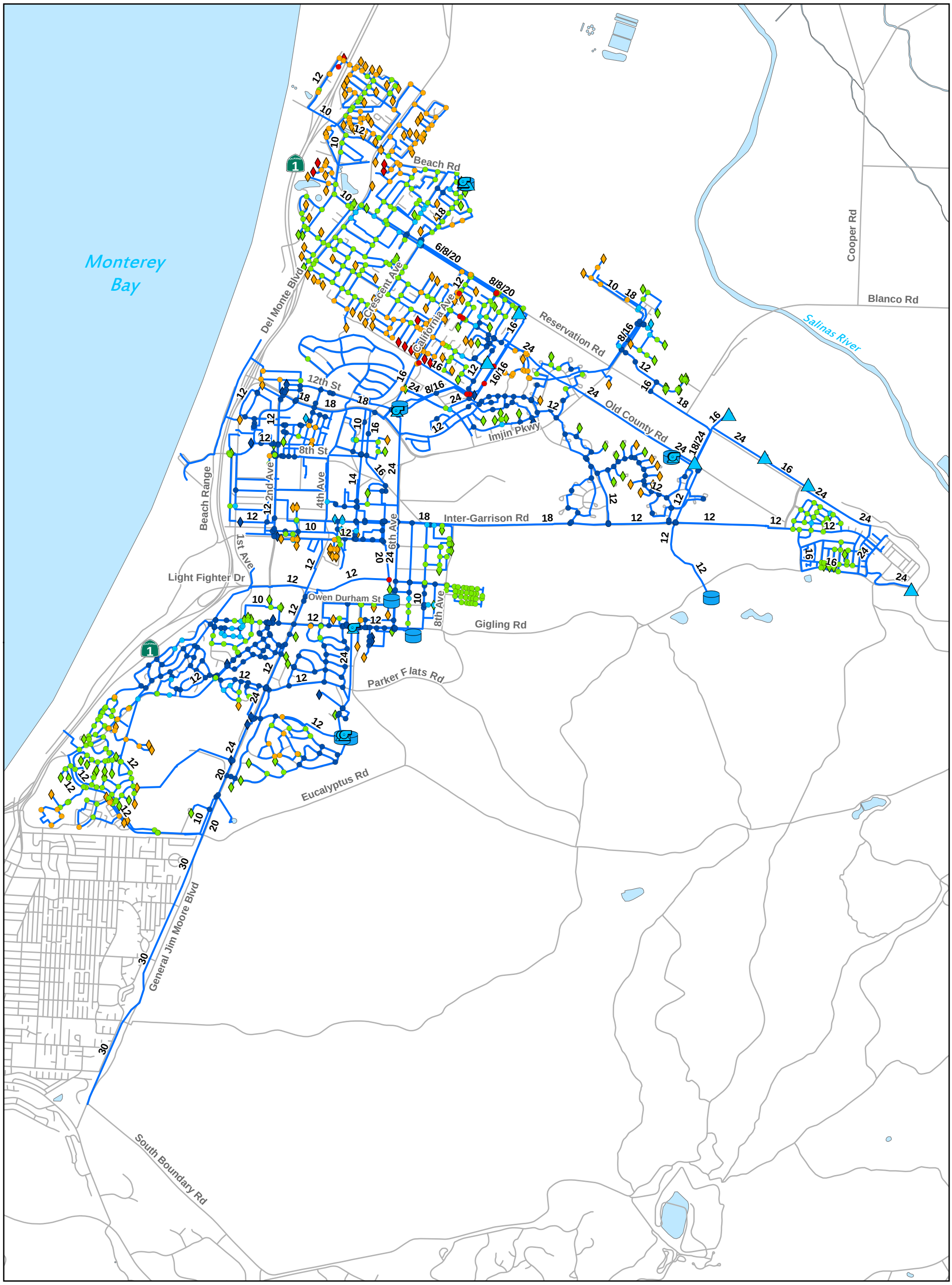

Legend

Available Flow (gpm)	Cul-de-sac Available Flow (gpm)
< 500	< 500
500 - 1,500	500 - 1,500
1,500 - 3,000	1,500 - 3,000
3,000 - 3,400	3,000 - 3,400
> 3,400	> 3,400

Existing Modeled System

- Tanks
- Wells
- Boosters
- Pipes
- Streets
- Rivers/Streams
- Waterbodies

PRELIMINARY

Update: April 10, 2019

0 0.25 0.5 1 Mile

N W GIS E S

Figure 7.3
Available Fire Flow

Water Master Plan
Marina Coast Water District

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File Path: P:\xGIS\GIS_Projects\Marina_Coast_WD\Water\MCWD_Fig7-3_AvailableFireFlow_041019.mxd

7.3 LOW PRESSURES ANALYSIS

The hydraulic model was also used to determine if the existing domestic water distribution system meets the District's System Performance and Design Criteria for maximum day and peak hour pressures, as discussed in a previous chapter. During maximum day demands the minimum pressure requirement is 40 psi, while during the peak hour demand, the minimum pressure requirement is 35 psi. The hydraulic analysis indicated the District's existing system performed reasonably well during under maximum day (**Figure 7.4**) and peak hour (**Figure 7.5**) operating conditions.

7.4 FUTURE SYSTEM ANALYSIS

The Master Plan evaluated the water system infrastructure requirements to service potential future development at the buildout of the District service. Two alternatives were evaluated to serve the buildout of the District's service area. These alternatives are discussed in the following:

7.4.1 Alternative 1 – Develop Eastern Well Field

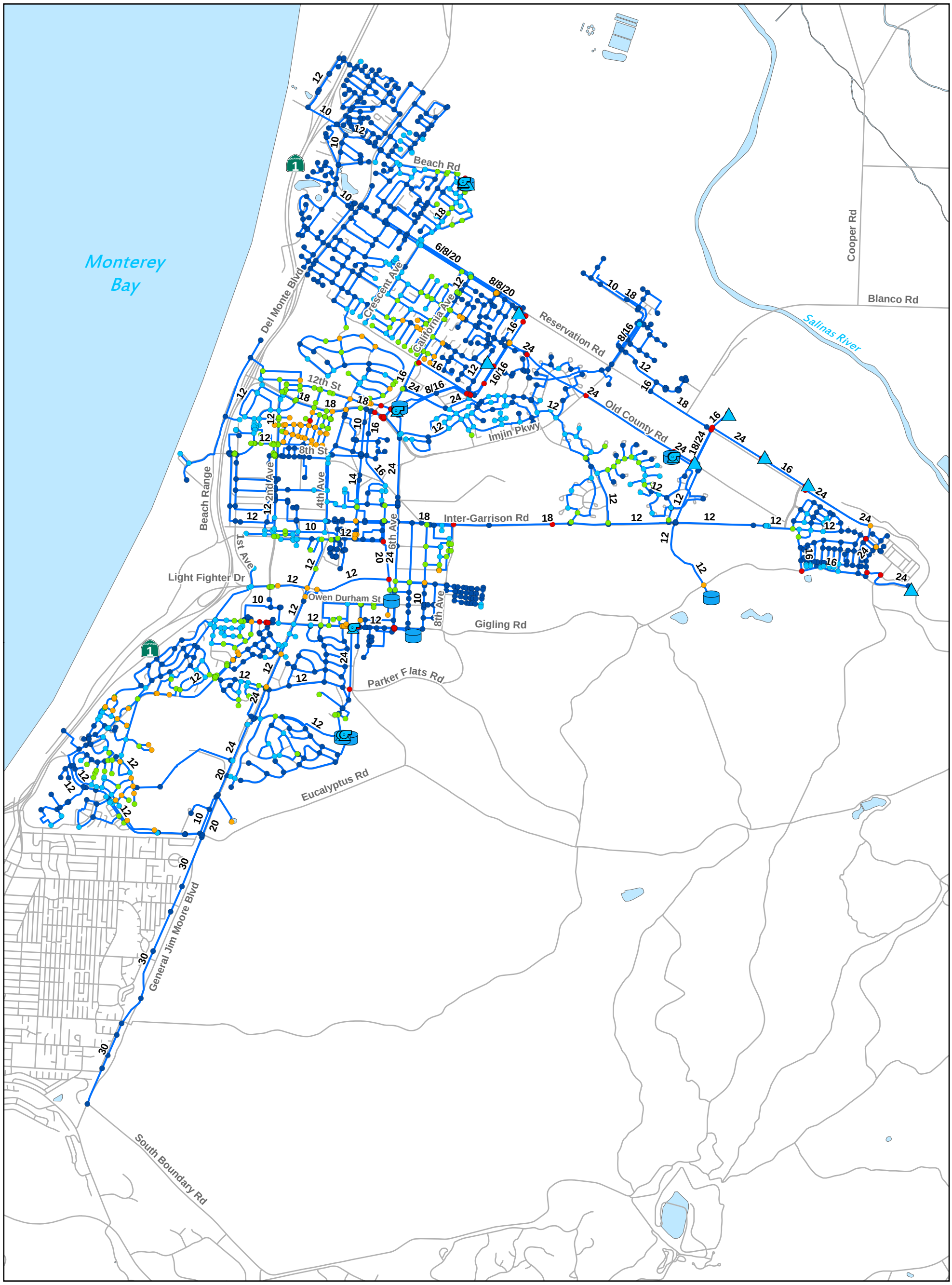
As discussed in a previous chapter, there are ongoing concerns about the intrusion of seawater into the shallow aquifers, and the potential for eventual intrusion into the deep aquifer. This seawater intrusion would likely render the existing wells inoperable due to total dissolved solid and salinity issues. The District has historically planned In order to mitigate this issue by abandoning the existing wells and constructing a new well field east of the existing service area, also known as the Eastern Well Field.

This Eastern Well Field would convey water to a future forebay reservoir at the existing East Garrison development before being pumped to Pressure Zone A and Pressure Zone B by new pump station facilities. This would require substantial transmission main improvements along Inter-Garrison Road, as well as large pumping facilities located within the East Garrison community. Additionally, this alternative would require the abandonment of existing well facilities and the construction of all new wells in the Eastern Well Field. The improvement recommendations for this alternative are shown graphically on **Figure 7.6**

This alternative will require the following general improvements:

- 35.4 miles of new pipeline ranging in size from 12 to 36 inches in diameter.
- 8.5 million gallons of new storage.
- 8 new water supply wells.
- 34,700 gpm of new boosting capacity.

As a part of this master plan, preliminary costs were prepared as a means of comparing infrastructure improvement alternatives. The total estimated cost for this alternative is estimated at 140 million dollars.



Legend

Junction Pressures
- < 35
- 35 - 45
- 45 - 55
- 55 - 65
- > 65

Existing Modeled System
- Tanks
- Wells
- Boosters
- Pipes

- Streets
- Rivers/Streams
- Waterbodies

PRELIMINARY

Update: April 10, 2019

0 0.25 0.5 1 Mile

N W GIS E S

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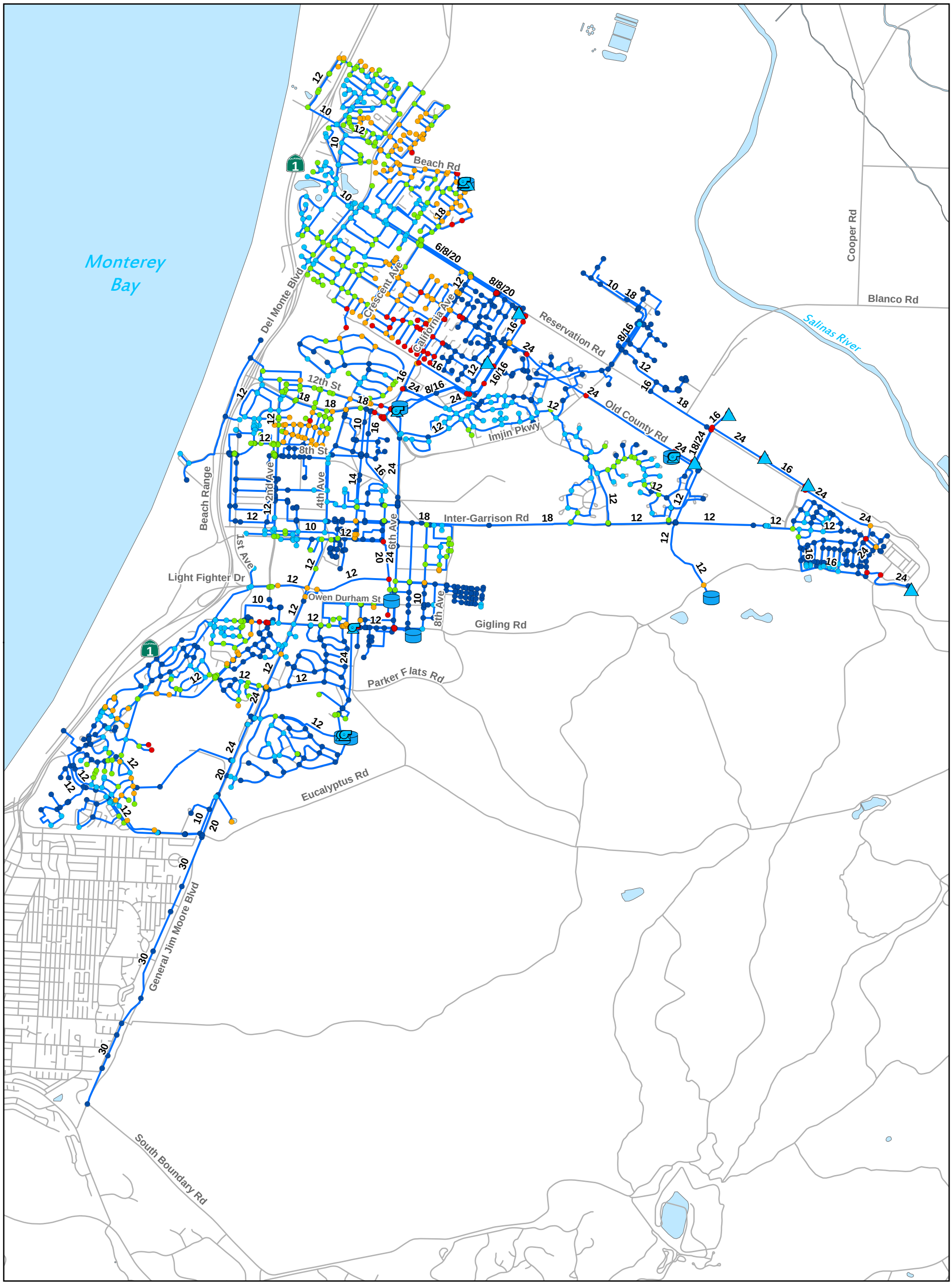
File Path: P:\xGIS\GIS_Projects\Marina_Coast_WD\Water\MCWD_Fig7-4_MDD_041019.mxd

Figure 7.4
Maximum Day Pressures

Water Master Plan
Marina Coast Water District



Legend

Junction Pressures

- < 35
- 35 - 45
- 45 - 55
- 55 - 65
- > 65

Existing Modeled System

- Tanks
- Wells
- Boosters
- Pipes

- Streets
- Rivers/Streams
- Waterbodies

PRELIMINARY

Update: April 10, 2019

0 0.25 0.5 1 Mile

N W GIS E S

File Path: P:\xGIS\GIS_Projects\Marina_Coast_WD\Water\MCWD_Fig7-5_PHD_041019.mxd

AKEL ENGINEERING GROUP, INC.

Figure 7.5
Peak Hour Pressures

Water Master Plan
Marina Coast Water District

Monterey Bay

Reservoir 2 Fill Valve

B-PS
(Total Capacity: 4 x 1,100 gpm)
C-PS
(Total Capacity: 4 x 1,600 gpm)

T-A1 (1.60 MG)
T-A2 (1.60 MG)
Zone B to A Emergency PRV

A-ASP-PS
(Total Capacity: 4 x 1,050 gpm)
B-ASP-PS
(Total Capacity: 4 x 2,900 gpm)

T-B2 (2.5 MG)

T-B-EG (1.0 MG)

Zone C to B Reliability PRV

T-ASP Forebay (0.1 MG)

Zone C to B Reliability PRV

D-PS
(Total Capacity: 4 x 1,500 gpm)

T-D2 (1.7 MG)

E-HYDPS
(Total Capacity: 3 x 400 gpm)

EG-HYDPS
(Total Capacity: 3 x 200 gpm + 1 x 3,000 gpm)

Detail A

Well 33:
350 gpm
Eastern Well Field:
7 x 1,500 gpm

Beach Rd
Reservation Rd
California Ave
Del Monte Blvd
Crescent Ave
12th St
8th St
2nd Ave
4th Ave
6th Ave
7th Ave
8th Ave
1st Ave
Beach Range
Light Fighter Dr
Owen Durham St
Inter-Garrison Rd
Imjin Pkwy
Old County Rd
Cooper Rd
Blanco Rd
Salinas River
Watkins Gate Rd
Gigling Rd
Parker Flats Rd
Eucalyptus Rd
General Jim Moore Blvd
South Boundary Rd

Legend

Future Improvements
- Tanks
- Wells
- Boosters
- Valves
- Pipes

Future to be Abandoned
- Tanks
- Wells
- Boosters
- Pipes

Existing Modeled System
- Tanks
- Wells
- Boosters
- Pipes

- Streets
- Rivers/Streams
- Waterbodies

PRELIMINARY

Update: March 29, 2019

0 0.25 0.5 1 Mile

N W GIS E S

Figure 7.6
Future System Improvements Alternative 1

Water Master Plan
Marina Coast Water District

AKEL ENGINEERING GROUP, INC.

File Path: P:\xGIS\GIS_Projects\Marina_Coast_WD\Water\MCWD_Fig7-6_FutureSystem-Alt1_032919.mxd

7.4.2 Alternative 2 – Construct New Groundwater Wells

As an alternative to the Eastern Well Field, and assuming seawater intrusion does not adversely impact the existing water supply wells, the District chose to explore the option of utilizing the existing wells and rehabilitating them as necessary to service future growth.

This alternative utilizes the existing transmission system to convey the supply to the City of Marina in Pressure Zone A where booster stations will convey water to the higher pressure zones. The current transmission system capacity is limited due to a single 24-inch and the buildout supply requirement will exceed the available capacity by more than 4,000 gpm under peak demand conditions. In an effort to avoid costly transmission main parallel or replacement improvements, this alternative recommends constructing a new booster station at the Intermediate Reservoir, and pumping water to the C-2 tank. From there, water is conveyed via a new pump station to Pressure Zone D through a new 18-inch transmission main along Watkins Gate Road. These improvements eliminate the need for significant transmission main improvements from Zone A to Zone D, as well as improving water quality in the existing storage reservoir C2. The improvement recommendations for this alternative are shown graphically on **Figure 7.7**

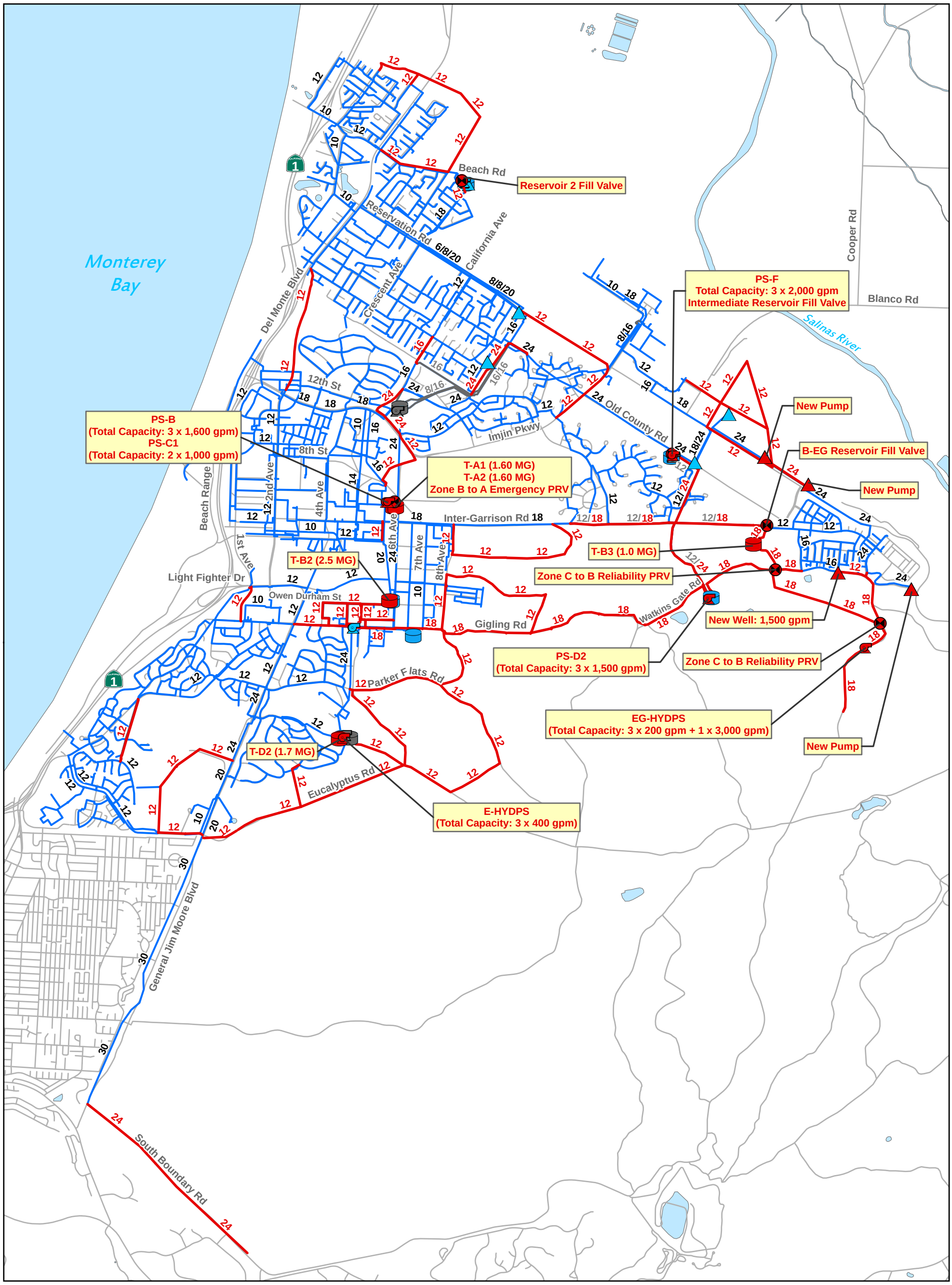
This alternative will require the following general improvements:

- 33.5 miles of new pipeline ranging in size from 12 to 24 inches in diameter.
- 8.4 million gallons of new storage.
- 1 new water supply well.
- 20,600 gpm of new boosting capacity.

As a part of this master plan, preliminary costs were prepared as a means of comparing infrastructure improvement alternatives. The total estimated cost for this alternative is estimated at 90 million dollars.

Due to lower capital improvement costs and construction feasibility, this alternative was selected by District staff for further evaluation and detailed capital improvement recommendations. The following sections evaluate the supply, pump station, and pipeline improvements for this future system alternative. A hydraulic profile is included on **Figure 7.8** to document the schematic representation of the system operations, the proposed pressure zone connectivity, and the booster station and tank improvements.

It should be noted that improvements recommended in this master plan expanded and altered the existing pressure zone boundaries. As such, the proposed pipelines by pressure zone are documented in **Figure 7.9** and the boundaries of the pressure zones are shown in **Figure 7.10**. This master plan also included a new future pressure zone called the East Garrison Hydropneumatic zone. This is a small area south of East Garrison that will be served by a small hydropneumatic pump station.



Legend

Future Improvements
- Tanks
- Wells
- Boosters
- Valves
- Pipes

Future to be Abandoned
- Tanks
- Boosters
- Pipes

Existing Modeled System
- Tanks
- Wells
- Boosters
- Pipes

- Streets
- Rivers/Streams
- Waterbodies

PRELIMINARY

Update: March 29, 2019

0 0.25 0.5 1 Mile

N W GIS E S

AKEL ENGINEERING GROUP, INC.

File Path: P:\xGIS\GIS_Projects\Marina_Coast_WD\Water\MCWD_Fig7-7_FutureSystem-Alt2_032919.mxd

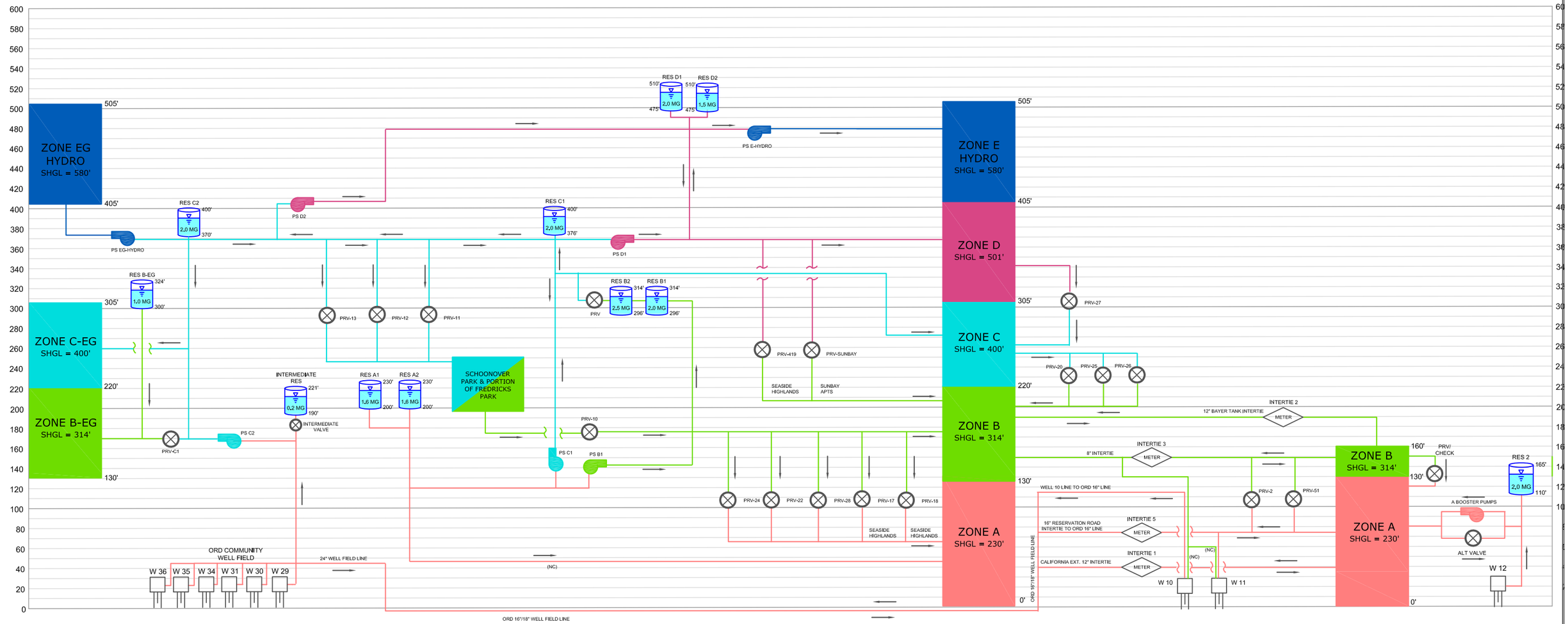
Figure 7.7
Future System Improvements Alternative 2

Water Master Plan
Marina Coast Water District

EAST GARRISON WATER SYSTEM

ORD COMMUNITY WATER SYSTEM

MARINA WATER SYSTEM



LEGEND

- RESERVOIR (HWL / # MG / LOW)
  - HWL: HIGH WATER LEVEL
  - # MG: RESERVOIR CAPACITY
  - LOW: BOTTOM ELEVATION
- BOOSTER PUMPING STATION
- PRESSURE REGULATING VALVE
- TRANSMISSION MAIN
- PRESSURE ZONE (ZONE # / SHGL; HIGH / LOW)
  - SHGL: STATIC HYDRAULIC GRADE LINE
  - HIGH: HIGHEST SERVICE ELEVATION
  - LOW: LOWEST SERVICE ELEVATION
- WELL ACTIVE
- WELL INACTIVE

Figure 7.8

Proposed Hydraulic Profile Schematic

2019 WATER MASTER PLAN

MARINA COAST WATER DISTRICT

AKEL ENGINEERING GROUP, INC.

Last Updated: 04/09/19

PRELIMINARY

Monterey Bay

Beach Rd
Reservation Rd
California Ave
Del Monte Blvd
Crescent Ave
12th St
8th St
2nd Ave
4th Ave
6th Ave
7th Ave
8th Ave
Beach Range
1st Ave
Light Fighter Dr
Owen Durham St
Inter-Garrison Rd
Imjin Pkwy
Old County Rd
Gigling Rd
Parker F lats Rd
Eucalyptus Rd
Watkins Gate Rd
Cooper Rd
Blanco Rd
Salinas River
General Jim Moore Blvd
South Boundary Rd

Legend

Future to be Abandoned
- Tanks
- Boosters
- Pipes

Potential Future Existing System
- Tanks
- Wells
- Boosters
- Valves

Pipes by Pressure Zone
- Zone A
- Zone B
- Zone C
- Zone D
- Zone E
- EG Hydro

- Streets
- Rivers/Streams
- Waterbodies

PRELIMINARY

0 0.25 0.5 1 Mile

N W GIS E S

Update: April 12, 2019

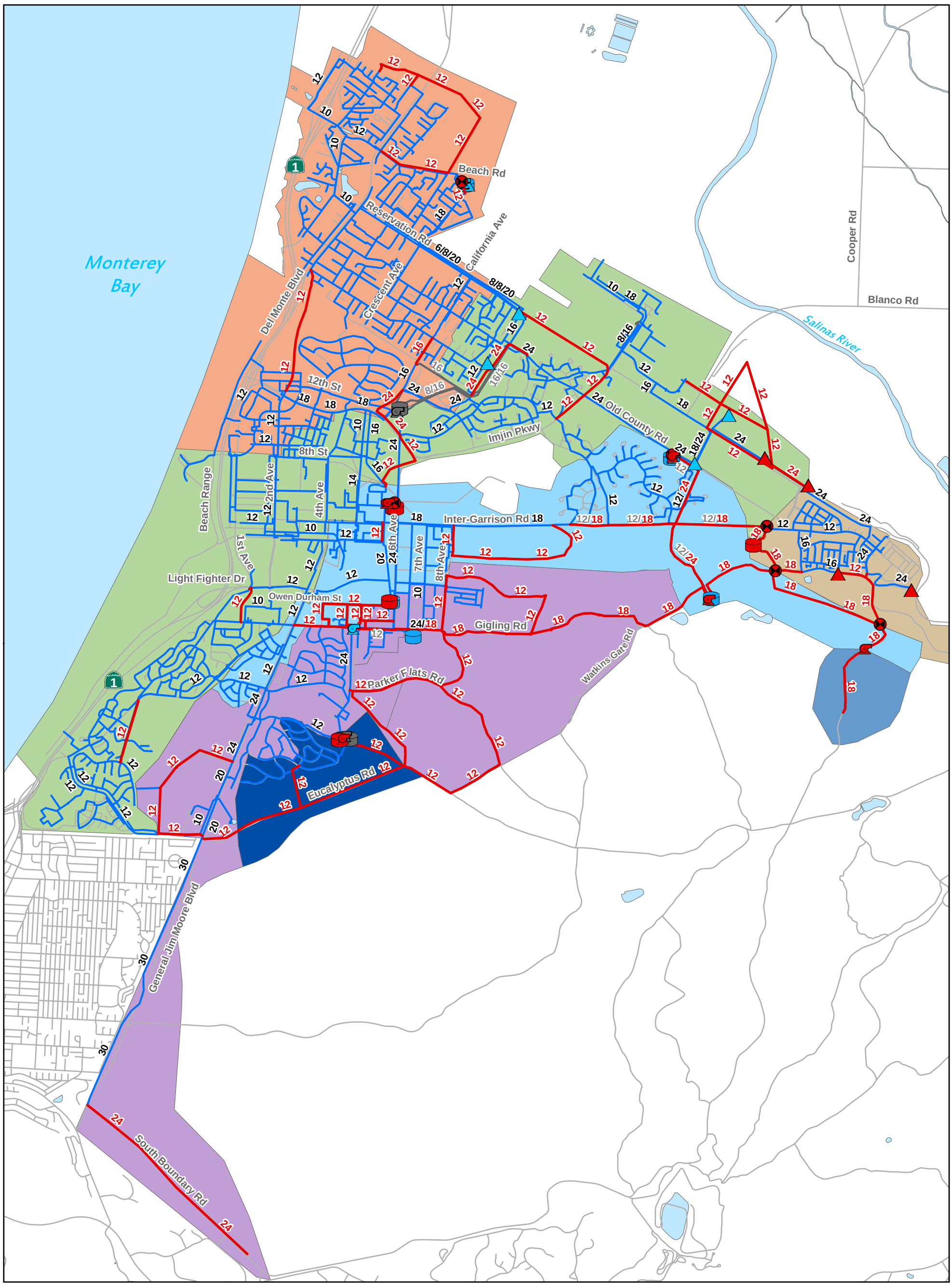
AKEL ENGINEERING GROUP, INC.

File Path: P:\xGIS\GIS_Projects\Marina_Coast_WD\Water\MCWD_Fig7-9_FutPipesbyPZ_041219.mxd

Figure 7.9
Future System Pipelines by Pressure Zone

Water Master Plan
Marina Coast Water District

MARINA COAST WATER DISTRICT



Legend

Future Improvements
- Tanks
- Wells
- Boosters
- Valves
- Pipes

Future Pressure Zones
- Zone A
- Zone B
- Zone B-EG
- Zone C
- Zone D
- Zone E
- Zone EG-HYD

Future to be Abandoned
- Tanks
- Boosters
- Pipes

Existing Modeled System
- Tanks
- Wells
- Boosters
- Pipes

- Streets
- Rivers/Streams
- Waterbodies

PRELIMINARY

N W GIS E S

0 0.25 0.5 1 Mile

Update: January 25, 2019

AKEL ENGINEERING GROUP, INC.

File Path: P:\xGIS\GIS_Projects\Marina_Coast_WD\Water\MCWD_Fig7-10_FutPressureZones-Alt2_012519.mxd

Figure 7.10
Future System Pressure Zones

Water Master Plan
Marina Coast Water District

MARINA COAST WATER DISTRICT

7.5 STORAGE ANALYSIS

This section documents the District's existing domestic water storage capacity. Additionally, this section identifies the existing and future storage requirements to meet the storage capacity criteria for each pressure zone.

7.5.1 Storage Requirements

The following sections summarize the storage requirements under existing and buildout development conditions. The storage requirements for each zone are calculated based on criteria discussed in the System Performance and Design Criteria chapter and are summarized for existing and buildout development conditions on **Table 7.1** and **Table 7.2**, respectively.

Existing Development

Existing storage requirements were identified for each pressure zone and are summarized on **Table 7.1**. The table lists the existing domestic water demands as well as the operational, emergency and fire flow storage requirements for each pressure zone. As summarized on this table the total required storage for existing domestic water demands is 8.46 MG.

Buildout Development

The storage requirements due to the buildout development of the District service area are summarized by pressure zone on **Table 7.2**. The table lists the additional domestic water demands due to buildout development as well as the operational, emergency, and fire flow storage requirements for each pressure zone. As summarized on **Table 7.2** the total required storage for buildout domestic water demands at 16.2 MG, which includes the demands due to existing development.

7.5.2 Storage Analysis and Recommended New Storage Facilities

The existing and future storage requirements, shown on **Table 7.1** and **Table 7.2**, were compared with existing storage facilities in each pressure zone to identify required storage facility improvements for the buildout development horizon, as summarized on **Table 7.3**. The following sections summarize the recommended storage facilities.

Pressure Zone A

Under existing conditions, the storage requirements for Pressure Zone A are provided by Reservoir 2 and the Sand Tank. Well 12 pumps directly into Reservoir 2 as an at-grade storage tank and Pump Station A discharges from the tank and pressurizes Zone A within Central Marina. For storage planning purposes it is assumed Pump Station A will operate at 3,000 gpm for 6 hours during peak demand conditions, providing a water volume of approximately 1.1 MG.

Under buildout conditions, two new storage tanks are planned to replace the existing Sand Tank and are intended to meet the storage requirements of both existing and buildout development. These tanks also mitigate existing peak hour pressure deficiencies that are shown on **Figure 7.5**.

Table 7.1 Existing Storage Requirements

Water Master Plan
Marina Coast Water District

PRELIMINARY

Pressure Zone	Existing Water Demands		Existing Water Storage Requirements			
	Average Day Demand (mgd)	Maximum Day Demand[1] (mgd)	Operational at 25% (MG)	Emergency at 50% (MG)	Fire Protection[2] (MG)	Total, By Pressure Zone (MG)
A	1.56	3.12	0.78	1.56	0.96	3.30
B	0.99	1.99	0.50	0.99	0.96	2.45
B-EG[3]	0.06	0.12	0.03	0.06	0.18	0.27
C	0.30	0.60	0.15	0.30	0.96	1.41
D	0.26	0.52	0.13	0.26	0.54	0.93
E-HYD[4]	0.06	0.13	0.03	0.06	0	0.10
Total Existing Storage Requirements						
	3.24	**6.48**	**1.62**	**3.24**	**3.60**	**8.46**

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8/9/2017

Notes:

1. Maximum Day Demand = 2.0 x Average Day Demand
2. Fire Protection requirement represents largest fire requirement for each zone, based on account types listed in water billing records
3. B-EG pressure zone represents East Garrison development area currently supplied from Zone C via PRV on Inter-Garrison Rd.
4. Hydropneumatic zone storage requirements to be provided by source pressure zone.

Table 7.2 Buildout Storage Requirements

Water Master Plan
Marina Coast Water District

PRELIMINARY

Pressure Zone	Water Demands for Future Growth		Water Storage Requirements for Future Growth			
	Average Day Demand (mgd)	Maximum Day Demand[1] (mgd)	Operational at 25% (MG)	Emergency at 50% (MG)	Fire Protection[2] (MG)	Total, By Pressure Zone (MG)
A	2.22	4.43	1.11	2.22	0.96	4.28
B	2.31	4.61	1.15	2.31	0.96	4.42
B-EG	0.18	0.36	0.09	0.18	0.54	0.81
C	1.36	2.72	0.68	1.36	0.96	3.00
D	1.80	3.60	0.90	1.80	0.54	3.24
E-HYD[3]	0.32	0.64	0.16	0.32	0	0.48
EG-HYD[3]	0.09	0.17	0.04	0.09	0	0.13
Total Existing Storage Requirements						
	8.18	**16.36**	**4.09**	**8.18**	**3.96**	**16.23**

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1/21/2019

Notes:

1. Maximum Day Demand = 2.0 x Average Day Demand
2. Fire Protection requirement represents largest fire requirement for each zone, based on account types listed in water billing records.
3. Hydropneumatic zone storage requirements to be provided by source pressure zone.

Table 7.3 Storage Capacity Analysis by Pressure Zone

Water Master Plan

Marina Coast Water District

PRELIMINARY

Pressure Zone	Existing Water Storage Requirements					Future Water Storage Requirements					Total Existing and Future Storage Requirement	Existing Storage Reservoirs									Storage Balance for Existing Demands	Proposed New Storage Reservoirs						Total Storage	Existing and Future Storage Balance
	Existing Average Day Demand	Existing Maximum Day Demand	Operational (25%) + Emergency (50%)	Fire Protection	Total	Future Average Day Demand	Future Maximum Day Demand	Operational + Emergency	Fire Protection	Total		Reservoir 2	Intermediate Reservoir	Sand Tank[1]	B1	C1	C2	D1	Huffman	Total		A1	A2	B2	B-EG	D2	Total		
	(MGD)	(MGD)	(MG)	(MG)	(MG)	(MGD)	(MGD)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)	(MG)
A	1.56	3.12	2.34	0.96	3.30	0.65	1.31	0.98	0.96	1.94	4.28	1.1[2]	0.2	1.0						2.25	-1.05	1.60	1.60				3.20	4.28	0.00
B	0.99	1.99	1.49	0.96	2.45	1.31	2.63	1.97	0.96	2.93	4.42				2.0					2.00	-0.45			2.50			2.50	4.50	0.08
B-EG	0.06	0.12	0.09	0.18	0.27	0.12	0.24	0.18	0.54	0.72	0.81	*East Garrison Supplied by Zone C Tanks[2]*								-	-				1.00		1.00	1.00	0.19
C	0.30	0.60	0.45	0.96	1.50	1.15	2.30	1.72	0.96	2.68	3.13					2.0	2.0			4.00	2.50						0.00	4.00	0.87
D[3]	0.32	0.65	0.49	0.54	1.03	1.80	3.59	2.69	0.54	3.23	3.72							2.0	0.1	2.06	1.03					1.70	1.70	3.76	0.04
Total	**3.24**	**6.48**			**8.55**	**5.03**	**10.06**			**11.51**	**16.36**									**10.31**	**2.03**						**8.40**	**17.54**	1.18

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1/17/2019

Notes:

1. Existing tank planned for abandonment.
2. Existing Reservoir 2 storage volume equal to 2.0 MG. Due to pumping limitations the reservoir's useable capacity is defined based on the following assumptions as approved by District staff:
   - Pump Station A to operate at firm capacity (3,000 gpm) for 6 hours during maximum day demand conditions, providing a daily volume of 1.1 MG under peak demand conditions.
3. Pressure Zone D required to provide storage requirements for Pressure Zone E.

Pressure Zone B

Under existing conditions, the storage requirements for Pressure Zone B are provided by reservoir B1. Based on the storage requirements for the existing demand, Pressure Zone has a 0.5 MG storage deficit. In order to mitigate this deficiency and meet the storage requirements for buildout development in the pressure zone, a new 2.5 MG storage reservoir is recommended.

Pressure Zone B-EG

Under existing conditions, the storage requirements for Pressure Zone B-EG are provided by Pressure Zone C through a PRV along Inter-Garrison Road. In order to meet the buildout development requirements, and to eliminate reliance on Zone C storage, a new 1.0 MG storage reservoir is recommended to service Zone B East Garrison.

Pressure Zone D

Under existing conditions the storage requirements for Pressure Zone D are provided by reservoir D2, which is sufficient to meet the existing storage requirements. In order to meet the storage requirements of the buildout development a new 1.7 MG storage tank is recommended.

The proposed storage reservoirs are summarized on **Table 7.4** and briefly described as follows:

- **G-T-A1, G-T-A2:** Construct two new 1.6 MG storage reservoirs northwest of the intersection of Inter-Garrison Road and 3rd Avenue.
- **G-T-B2:** construct one new 2.5 MG storage tank adjacent to the existing B1 reservoir.
- **O-B-EG:** Construct one new 1.0 MG storage reservoir on the existing Camp Tank Site south of Inter-Garrison Road.
- **O-T-D2:** Construct one new 1.7 MG storage reservoir adjacent to the existing D1 reservoir.

7.6 WATER SUPPLY REQUIREMENTS

The District's existing domestic water system supply capacity is identified in this section. Additionally, this section identifies the additional supply capacity required to meet the supply requirement, and consistent with the District's System Performance and Design Criteria.

7.6.1 Existing Supply Requirements

Existing supply requirements were identified for the District and are summarized on **Table 7.5**. The District's existing water supply requirement, based on the existing land use and recommended water demand factors, is approximately 6.5 mgd. The existing firm supply capacity is approximately 16.1 mgd, which results in a supply surplus of 9.6 mgd. It should be noted that Well 12, located within the Central Marina service area, is currently out of service due to water quality issues. For planning purposes it is assumed that this well remain out of service under

Table 7.4 Proposed Storage Reservoirs

Water Master Plan

Marina Coast Water District

PRELIMINARY

Tank ID	Pressure Zone	Volume (MG)	Height (ft)	Diameter (ft)	Bottom Elevation (ft)
A1	A	**1.60**	30	95	200
A2	A	**1.60**	30	95	200
B2	B	**2.50**	18	153	296
B-EG	B (East Garrison)	**1.00**	24	84	300
D2	D	**1.70**	30	113	475
Total		**8.40**			

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3/16/2018

Table 7.5 Supply Capacity Analysis

Water Master Plan

Marina Coast Water District

PRELIMINARY

Demand and Supply	Year							
	2018 (MGD)	2020 (MGD)	2025 (MGD)	2030 (MGD)	2035 (MGD)	2040 (MGD)	2045 (MGD)	2047 (MGD)
Projected Demands								
Average Day Demands	3.2	3.6	4.5	5.3	6.2	7.1	7.9	8.3
Maximum Day Demands	6.5	7.2	8.9	10.7	12.4	14.2	15.9	16.6
Peak Hour Demands	11.3	12.6	15.6	18.7	21.7	24.8	27.8	29.0
Supply vs. Demand Analysis								
Available Supply								
Available Total Supply	19.87	-	-	-	-	-	-	-
Available Firm Supply	16.28	-	-	-	-	-	-	-
Required Supply								
Meet Maximum Day Demand with Firm Supply	6.5	7.2	8.9	10.7	12.4	14.2	15.9	16.6
Surplus / Deficiency								
With Existing Firm Supply	9.8	9.1	7.4	5.6	3.9	2.1	0.4	-0.3
With Recommended Total Supply	9.8	9.1	7.4	5.6	3.9	2.1	2.5	1.8
Recommended New Supply								
Recommended Staged Upgrade							1 New Well	
Recommended Total Supply	16.3	16.28064	16.3	16.3	16.3	16.3	18.4	18.4

existing and future conditions. However, District staff may rehabilitate this well in the future in order to increase the District-wide supply capacity.

7.6.1 Future Supply Requirements

A supply verses demand comparison was completed to document the well capacity needs from existing conditions to 2047. Buildout average day demands are estimated based on future land use conditions and water demand unit factors discussed in a previous chapter.

Based on this analysis of supply and demand, one additional well is needed by the year 2045 (Table 7.5). Please note that this does not account for well rehabilitation and improvements required to meet the new hydraulic grade lines of the pressure zones. The new required well is described as follows:

- **G-W36:** Construct a new 1,500 gpm groundwater well on Watkins Gate Road approximately 1,000 feet west of Camp Street. This facility will be located approximately 6,000 feet northeast of Monterey Avenue.

7.6.2 Recommended Well Pump Upgrades

Due to the current groundwater supply surplus as summarized on Table 7.5, the District cycles its groundwater wells to avoid premature pump burnout. As development occurs, it will ultimately require the continuous operation of the groundwater wells that are currently able to cycle. The concurrent operations are anticipated to increase the downstream head condition of the existing groundwater wells due to increased flows in the transmission system. In order to maintain efficient operations, it is recommended that the pumps at groundwater wells 31, 34, and 35 be replaced as development occurs, and in order to accommodate the increased pumping heads.

7.7 PUMP STATION CAPACITY ANALYSIS

This section identifies the District's existing pump station capacity, the existing and future pump station capacity requirements, and the recommended pump station improvements.

7.7.1 Existing Pump Station Capacity Requirements

Existing pump station capacity requirements were identified for each existing pump station and are summarized on Table 7.6. The table lists the existing pump station capacities and identifies

the required capacity based on the District criteria. The existing pump station capacity analysis indicates the District's existing pump stations have sufficient capacity to meet the requirements.

7.7.2 Future Pump Station Capacity Requirements

A booster station analysis was completed to document the impact of future development on the existing stations, and to document the capacity improvement requirements to meet those demands (Table 7.7). The booster station upgrades are summarized on Table 7.8 and discussed in the following sections.

Table 7.6 Existing Pump Station Capacity Analysis

Water Master Plan

Marina Coast Water District

PRELIMINARY

Name	Elevation	Pressure Zones		Pressure Zone Demands			Pump Station Capacity Analysis					
							Pump Station Capacity		Required Capacity[1]			Surplus/ Deficiency
		Source	Destination	Destination Zone	Supply Dependent Zones	Total[1]	Total	Firm	Operational	Fire Flow	Total	
	(ft)			(gpm)	(gpm)	(gpm)	(gpm)	(gpm)	(gpm)	(gpm)	(gpm)	(gpm)
Existing Pump Stations												
City of Marina												
A-Booster[2]	109	Reservoir 2	A	*Pump station to operate during peak demand conditions*								
Ord Community[3]												
B-Booster	110	A	B	1,378	0	1,378	4,814	3,154	1,378	0	1,378	**1,776**
C-Booster	110	A	C	414	535	948	3,453	2,109	948	0	948	**1,161**
D-Booster	300	C	D	362	89	451	3,171	1,051	451	0	451	**600**
E-Booster	475	D	E	155	0	155	4,672	2,483	155	1,500	1,655	**828**

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Notes:

1. Required firm pump station capacity equal to total Maximum Day Demand of all supply dependent zones. Required firm hydropneumatic pump station capacity also required to include fire flow requirement.
2. Pump Station A to operate at firm capacity (3,000 gpm) for 6 hours during maximum day demand conditions, providing a daily volume of 1.1 MG under peak demand conditions.
3. Pumping Capacity provided by Booster Station F is not including in this pump station analysis and is assumed to be used for emergency purposes only.

Table 7.7 Future Pump Station Capacity Analysis

Water Master Plan
Marina Coast Water District

PRELIMINARY

Name	Elevation	Pressure Zones		Pressure Zone Demands			Pump Station Capacity Analysis						
							Pump Station Capacity		Required Capacity[1]			Surplus/ Deficiency	Recommended Improvement
		Source	Destination	Destination	Supply Dependent	Total	Total	Firm	MDD[2]	Fire Flow	Total		
	(ft)			(gpm)	(gpm)	(gpm)	(gpm)	(gpm)	(gpm)	(gpm)	(gpm)	(gpm)	
City of Marina													
A-Booster[2]	109	Reservoir 2	A				*Pump station to operate during peak demand conditions*						
Fort Ord													
B-Booster[4]	110	A	B	3,202	0	3,202	0	0	3,202	0	3,202	-3,202	Construct New Pump Station: 3 x 1,600 gpm (2 Duty + 1 Standby)
C-Booster[4]	110	A	C	1,891	3,282	5,173	0	0	5,173	0	5,173	-5,173	Construct two new pump stations:
		A	C										2 x 1,000 gpm (1 Duty and 1 Standby)
		A	C										3 x 2,000 gpm (2 Duty and 1 Standby)
D Booster	300	C	D	2,498	784	3,282	1,660	1,660	3,282	0	3,282	-1,622	Construct new pump station: 2 x 1,500 gpm (1 Duty + 1 Standby)
E Hydro Booster[5]	475	D	E	784	0	784	303	188	784	0	784	-596	Replace Operational Pumps: 3 x 400 gpm (2 Duty + 1 Standby)
EG Hydro Booster		C	EG-HYD	408	0	408	0	0	408	3,000	3,408	-3,408	Construct new pump station: 3 x 200 gpm, 1 x 3,000 gpm (2 Duty + 1 Standby, 1 Fire Pump)

Notes:

1. Required firm pump station capacity equal to total Maximum Day Demand of all supply dependent zones. Required firm hydropneumatic pump station capacity also required to include fire flow requirement.
2. Demand requirement for hydropneumatic zones equal to Peak Hour Demand.

Table 7.8 Proposed Pump Stations

Water Master Plan

Marina Coast Water District

PRELIMINARY

Name	Elevation (ft)	Source Pressure Zone	Destination Pressure Zone	Pump Station Capacity Total (gpm)	Pump Station Capacity Firm (gpm)	No. of New Pumps (gpm)	Pump Status (gpm)	Design Capacity (gpm)
Pump Station Improvements								
B Booster	200	A	B	4,800	3,200	3	Duty	1,600
							Duty	1,600
							Standby	1,600
C1 Booster	200	A	C	2,000	1,000	2	Duty	1,000
							Standby	1,000
C2 Booster	192	A	C	6,000	4,000	3	Duty	2,000
							Duty	2,000
							Standby	2,000
D Booster	300	C	D	6,000	4,500	4	Duty	1,500
							Standby	1,500
E Hydro Booster	475	D	E-HYD	1,200	800	3	Duty	400
							Duty	400
							Standby	400
EG Hydro Booster	305	C	EG-HYD	3,600	3,400	4	Duty	200
							Duty	200
							Standby	200
							Fire	3,000

7.7.2.1 Pressure Zone B

The existing Booster Station B is located at the existing Sand Tank site. This booster station is planned for abandonment with the decommissioning of the Sand Tank, and the subsequent construction of the future Pressure Zone A reservoir site. A new B Booster Station will be constructed at the Zone A tank site, and will be sized to meet the booster station capacity requirements of Pressure Zone B. It should be noted that this booster station does not have any supply dependent pressure zones. The improvement description is as follows:

- **G-PS-B:** Construct one new booster station northwest of the intersection of Inter-Garrison Road and 3rd Avenue. This booster station is planned to include three 1,600 gpm boosters, three duty and one standby, for a total and firm capacity of 4,800 gpm and 3,200 gpm respectively

7.7.2.2 Pressure Zone C

The existing Booster Station C is also located at the existing Sand Tank site. This booster station is planned for abandonment with the decommissioning of the Sand Tank, and the subsequent construction of the future Pressure Zone A reservoir site. Due to the large increase in demands in Pressure Zones C, D, and E, as well as new East Garrison demands, two new C Zone booster stations will be required to meet the requirements of this Pressure Zone and it's supply dependent pressure zone, and discussed as follows:

- **O-PS-C1:** This booster station will replace the C Booster Station that will be abandoned as part of the Sand Tank demolition project. This booster station will be located at the new A Zone tank site and is planned to include two 1,000 gpm boosters, one duty and one standby, for a total and firm capacity of 2,000 gpm and 1,000 gpm respectively.

- **O-PS-C2:** This booster station will provide additional capacity to meet future demand needs in the expanded C, D, and E pressure zones. This station will be located at the existing Intermediate Reservoir site and is planned to include three 2,000 gpm boosters, two duty and one standby, for a total and firm capacity of 6,000 gpm and 4,000 gpm respectively. The Intermediate Reservoir will act as a forebay for the booster station, and water will be boosted via a new transmission main to the C-2 tank. It should be noted that this booster station accounts for reducing the demand on the existing Pressure Zone A 24-inch transmission main, and is thus slightly oversized for the pressure zone pumping needs. The additional capacity alleviates the need to parallel or replace the 24-inch main.

7.7.2.3 Pressure Zone D

In order to meet the future booster station capacity requirements of Pressure Zone D a new booster station is planned for construction at the existing reservoir C2 site. This booster station will serve future growth within areas of allowable development in Parker Flats, as well as the supply dependent Pressure Zone E. Additionally, this booster station will help to increase turnover in the C-2 tank and improve water age for Pressure Zone C.

O-PS-D1: Construct one new booster station at the existing C-2 Tank site. This booster station is planned to include two 1,500 gpm boosters, two duty and one standby, for a total and firm capacity of 3,000 gpm and 1,500 gpm respectively.

7.7.2.4 Pressure Zone E

In order to meet the future booster station capacity requirements of Pressure Zone E the existing operational boosters are planned for replacement with larger capacity pumps.

- **O-PS-EHYD:** Replace the existing 250 gpm operational boosters at the Pressure Zone E hydropneumatic booster station with three 400 gpm boosters, two duty and one standby, for a total and firm operational capacity of 1,200 gpm and 800 gpm respectively.

7.7.2.5 Pressure Zone East Garrison Hydropneumatic

In order to serve additional development in the southernmost portion of East Garrison, a new booster pump station and pressure zone are required to meet District service criteria. This pressure zone is generally within the Pressure Zone D hydraulic grade, however, no interconnections are planned, and thus, this area is planned for service by a new hydropneumatic system, with a fire pump to meet the commercial fire flow criteria.

- **O-PS-EGHYD:** Construct one new booster station on Barloy Canyon Road approximately 1,600 feet southwest of Crescent Bluff Road. This booster station is planned to include three 200 gpm operational pumps, two duty and one standby, for a total and firm capacity of 600 gpm and 400 gpm respectively. This booster station is also planned include one 3,000 gpm fire pump, which is intended to meet the commercial fire flow requirement.

7.8 RECOMMENDED VALVE IMPROVEMENTS

In order to manage pressures and regulate flow at various locations within the District's future water distribution system the following valve improvements, also summarized on **Table 7.9**, are recommended:

- **M-FILLV-A1:** Construct a new fill valve adjacent to the existing Reservoir 2 in Pressure Zone A. This valve is intended to regulate flow into the existing Reservoir 2 following the operation of the existing Pump Station A and is to be sized for a flow approximately equal to the firm capacity of Pump Station A.

- **G-PRV-B1:** This PRV is located at the new Pressure Zone A tank site, and is intended to reduce pressure from Pressure Zone B to Pressure Zone A and provide additional supply to Pressure Zone A in the event of an emergency. This PRV is located between 18-inch Pressure Zone B discharge line, and the 24-inch Pressure Zone A suction line.

- **O-FILLV-INTRES:** Construct a new fill valve adjacent to the existing Intermediate Reservoir. This valve is intended to regulate flow into the existing Intermediate Reservoir

Table 7.9 Proposed Valves

Water Master Plan

Marina Coast Water District

PRELIMINARY

Valve ID	Valve Type	Pressure Zone		Preliminary Elevation	Preliminary Valve Size	Preliminary Downstream Setpoint
		Upstream	Downstream	(ft)	(in)	(psi)
M-FILLV-A1	Level Control	A	Reservoir 2	110	8	-
G-PRV-B1	Pressure Reducing	B	A	185	8	10
O-FILLV-INTRES	Level Control	A	Intermediate Reservoir	190	8	-
O-FILLV-B-EG	Level Control	A	Reservoir 2	109	8	40
O-PRV-C1	Pressure Reducing	C	B-EG	220	8	35
O-PRV-C2	Pressure Reducing	C	B-EG	235	8	28

following the operation of future Pump Station C2 and is to be sized for a flow approximately equal to the firm capacity of Pump Station C2.

- **O-FILLV-B-EG:** Construct a new pressure reducing fill valve on Inter-Garrison Road. This valve is intended to reduce pressure from Pressure Zone C to Pressure Zone B-EG and maintain the level in future storage reservoir B-EG.
- **O-PRV-C1:** Construct a new pressure reducing valve on Watkins Gate Road. This valve is intended to reduce pressure from Pressure Zone C to Pressure Zone B-EG and provide additional supply to Pressure Zone B-EG in the event of an emergency.
- **O-PRV-C2:** Construct a new pressure reducing valve on Barloy Canyon Road. This valve is intended to reduce pressure from Pressure Zone C to Pressure Zone B-EG and provide additional supply to Pressure Zone B-EG in the event of an emergency.

7.9 PIPELINE IMPROVEMENTS TO SERVE FUTURE GROWTH

The buildout of the District's service area includes development outside of the extents of the existing water distribution system. Distribution pipelines are recommended to serve future growth as well as increase the hydraulic reliability of the water system. Each pipeline improvement is assigned a uniquely coded identifier, which is intended to aid in defining the location of the improvements for mapping purposes. The identifiers reflect the pressure zone, improvement type, and sequence in the improvement schedule. The pipeline improvements are summarized on Table 7.10 and described in detail on the following pages.

7.9.1 Central Marina Water System

This section documents pipeline improvements within the Central Marina water service area.

- **M-P1:** Construct a new 12-inch pipeline in the right-of-way from the existing Reservoir 2 Site to Crescent Avenue.
- **M-P2:** Construct a parallel 12-inch pipeline in Beach Road from De Forest Road to Del Monte Boulevard.
- **M-P3:** Construct a new 12-inch pipeline in within the Future Armstrong Ranch Development.
- **M-P4:** Replace the existing 12-with a new 16-inch pipeline along California Avenue from 3rd Avenue to Reindollar Avenue.

7.9.2 Ord Community Water System

This section documents pipeline improvements within the Ord Community water service area.

Table 7.10 Schedule of Improvements

Water Master Plan

Marina Coast Water District

PRELIMINARY

Improvement No.	Improv. Type	Pressure Zone	Alignment	Limits	Improvement Details			
Central Marina Water System								
Pipeline Improvements					Existing Diameter (in)	New/Parallel/ Replace	Diameter (in)	Length (ft)
M-P1	Reliability	Zone A	ROW	From existing Reservoir 2 Site to Crescent Ave	-	New	12	425
M-P2	Reliability	Zone A	Beach Rd	From De Forest Rd to Del Monte Blvd	8	Parallel	12	2,725
M-P3	Development	Zone A	Armstrong Ranch	Future Armstrong Ranch Development	-	New	12	7,575
M-P4	Capacity	Zone A	California Ave	From approximately 500' n/o 3rd Ave to Reindollar Ave	12	Replace	16	1,225
Valve Improvements					New/Replace	Size (in)		
M-FILLV-A1	Operational	Zone A	Existing Reservoir 2 Site		New	8		
M-PRV-B1	Reliability	Zone B	Planned A1/A2 tank site, nw/o the intersection of Inter-Garrison Rd and 6th Avenue		New	8		
Ord Community Water System								
Pipeline Improvements					Existing Diameter (in)	New/Parallel/ Replace	Diameter (in)	Length (ft)
O-P1	Fire Flow	Zone C	5th St	From 3rd Rd to 1st St	8	Replace	12	750
O-P2	Reliability	Zone B	First Ave	From Lightfighter Dr to Gigling Ave	-	New	12	1,500
O-P3	Condition	Zone C	Gigling Rd	From General Jim Moore Blvd to Zone D Pump Station	12	Replace	12	2,300
O-P4	Fire Flow	Zone C	Planned Mixed Use Development	N/o Gigling Ave, between Malmedy Rd and Parker Flats Rd	6, 8	Replace	12	4,775
O-P5	Fire Flow	Zone D	Planned Mixed Use Development	N/o Gigling Ave, between Parker Flats Rd and 6th Ave	6, 8	Replace	12	3,500
O-P6	Fire Flow	Zone B	Existing ROW	From Monterey Rd to Leinbach Ave	8	Replace	12	2,425
O-P7	Development	Zone D	McClure Rd and ROW	From the intersection of General Jim Moore Blvd and McClure Rd to Coe Ave	-	New	12	5,325
O-P8	Capacity	Zone D	Coe Ave	From General Jim Moore Blvd to approx. 1,700' w/o General Jim Moore Blvd	8	Replace	12	1,725
O-P9	Development	Zone D	Eucalyptus Rd	From General Jim Moore Blvd to approx. 1,500' e/o General Jim More Blvd	-	New	12	1,350
O-P10	Development	Zone E	Eucalyptus Rd and Future ROW	Future Commercial Development, along and n/o Eucalyptus Rd	-	New	12	10,900
O-P11	Development	Zone D	Normandy Rd and Parker Flats Cutoff Rd	From Parker Flats Rd to Future ROW	-	New	12	5,750
O-P12	Development	Zone D	Parker Flats Cutoff Rd and Eucalyptus Rd	From Normandy Rd to Future ROW	-	New	12	7,525
O-P13	Development	Zone D	8th Ave	From Gigling Rd to Parker Flats Cutoff Rd	-	New	12	2,850
O-P14	Development	Zone D	Gigling Rd	From 8th Ave to existing C2 reservoir	-	New	18	15,275
O-P15	Development	Zone D	Future ROW	From Eucalyptus Rd to Parker Flats Rd	-	New	12	2,175
O-P16	Development	Zone D	Future Residential Development	E/o 8th Ave and n/o Gigling Rd	-	New	12	7,875
O-P17	Development	Zone C	Future Residential Development	E/o 8th Ave and s/o Inter-Garrison Rd	-	New	12	7,025
O-P18	Development	Zone C	Inter-Garrison Rd, Future ROW	From approx. 1,400' w/o Abrams Dr to future Reservoir B-EG (O-T-B-EG)	12	Replace	18	8,600
O-P19	Development	Zone C	Existing ROW	From existing Intermediate Reservoir to Inter-Garrison Rd	-	New	24	3,300
O-P20	Development	Zone C	Existing ROW	From Inter-Garrison Rd to existing C2 reservoir	12	Replace	18	3,625
O-P21	Development	Zone C	Watkins Gate Rd, Future ROW	From existing C2 Reservoir to future Barloy Canyon Rd	-	New	18	9,625

Table 7.10 Schedule of Improvements

Water Master Plan

Marina Coast Water District

PRELIMINARY

Improvement No.	Improv. Type	Pressure Zone	Alignment	Limits	Improvement Details			
O-P22	Development	Zone B-EG	Watkins Gate Rd	From future B-EG reservoir (O-T-B-EG) to to Watkins Gate Rd	-	New	18	2,375
O-P23	Development	Zone B-EG/ Zone C	Barloy Canyon Rd	From Watkins Gate Rd to future East Garrison Hydropneumatic Pump Station	-	New	18	2,050
O-P24	Development	Zone EG-HYD	Barloy Canyon Rd	From future East Garrison Hydropneumatic Pump Station to approx. 4,700' n/o Eucalyptus Rd	-	New	18	2,800
O-P25	Development	Zone B	Planned Mixed Use Development	N/o Reservation Rd and e/o Blanco Rd	-	New	12	13,525
O-P26	Reliability	Zone B	Imjin Rd, Neeson Rd	From Reservation Rd to approx. 700' ne/o Abrams Dr	-	New	12	2,725
O-P27	Development	Zone D	South Boundary Rd	From General Jim Blvd to approx. 8,300' se/o South Boundary Rd	-	New	24	8,275
Tank Improvements					**New/Replace**	**Capacity (MG)**		
O-T-B-EG	New Capacity	Zone B-EG	Existing Travel Camp tank site, s/o Inter-Garrison Rd approximately 1,700' w/o Camp St		New	1.00		
O-T-D2	New Capacity	Zone D	Existing D1 tank site		New	1.70		
Pump Station Improvements					**New/Upgrade/ Replace**	**Total Capacity (gpm)**		
O-PS-C1	New Capacity	Zone C	Planned A1/A2 tank site, nw/o the intersection of Inter-Garrison Rd and 6th Avenue		New	2,000		
O-PS-C2	New Capacity	Zone C	Existing Intermediate Reservoir site		New	6,000		
O-PS-D	New Capacity	Zone D	Existing C2 reservoir site		New	3,000		
O-PS-EHYD	Replace Capacity	Zone E	Existing PS-EHYD Pump Station Site		Replace	1,200		
O-PS-EGHYD	New Capacity	Zone EG-HYD	Barloy Canyon Rd, approximately 1,600' sw/o Crescent Bluff Rd		New	3,600		
Valve Improvements					**New/Replace**	**Size (in)**		
O-FILLV-INTRES	Operational	Zone C	Intermediate Reservoir		New	8		
O-FILLV-B-EG	Supply Capacity	Zone B-EG	Inter-Garrison Road		New	8		
O-PRV-C1	Reliability	Zone C	Watkins Gate Rd		New	8		
O-PRV-C2	Reliability	Zone C	Barloy Canyon Rd		New	8		
Combined Water System (General)								
Pipeline Improvements					**Existing Diameter (in)**	**New/Parallel/ Replace**	**Diameter (in)**	**Length (ft)**
G-P1	Capacity	Zone A	Future 2nd Ave Extension	From Imjin Rd to Reindollar Ave	-	New	12	4,775
G-P2	Capacity	Zone B	Planned Zone A Tank Site	From future PS-B to existing Zone B transmission main.	-	New	18	300
G-P3	Capacity	Zone C	Planned Zone A Tank Site	From future PS-C to existing Zone C transmission main.	-	New	24	300
G-P4	Capacity	Zone A	Planned Zone A Tank Site	From future Zone A tanks to future Zone A (existing Zone C) transmission main.	-	New	24	300
G-P5	Capacity	Zone A	Planned Zone A Tank Site	From future Zone A tanks to future Zone A (existing Zone C) transmission main.	-	New	24	300
G-P6	Reliability	Zone B	Imjin Road and Imjim Parkway	From the 8th St Cut-off to Abrams Dr	-	New	12	2,950
G-P7	Capacity	Zone A	Imjin Parkway	From Abrams Dr to Marina Heights Dr	-	New	24	2,550
G-P8	Capacity	Zone A	Marina Heights Development	From California Dr to approximately 600' n/o MacArthur Dr	-	New	24	3,300
G-P9	Development	Zone B	Reservation Rd	From Imjin Pwy to Salinas Ave	-	New	12	4,050

Table 7.10 Schedule of Improvements

Water Master Plan

Marina Coast Water District

PRELIMINARY

Improvement No.	Improv. Type	Pressure Zone	Alignment	Limits	Improvement Details			
G-P10	Capacity	Zone A	Reservation Rd	From existing Well 34 discharge to existing Well 31 discharge	16	Replace	24	2,000
G-P11	Capacity	Zone A	Watkins Gate Rd	From future Well 36 to Camp St	-	New	12	1,225
Tank Improvements					**New/Replace**	**Capacity (MG)**		
G-T-A1	Capacity	Zone A	Nw/o the intersection of Inter-Garrison Rd and 6th Avenue		Replace	1.6		
G-T-A2	Capacity	Zone A	Nw/o the intersection of Inter-Garrison Rd and 6th Avenue		Replace	1.6		
G-T-B2	New Capacity	Zone B	Existing B1 Tank site		New	2.50		
Pump Station Improvements					**New/Upgrade/ Replace**	**Total Capacity (gpm)**		
G-PS-B	New Capacity	Zone B	Planned A1/A2 tank site, nw/o the intersection of Inter-Garrison Rd and 6th Avenue		New	4,800		
Supply Improvements					**New/Replace**	**Total Capacity (gpm)**		
G-W31	Capacity	Zone A	Existing Well 31 site		Replace Pump			
G-W34	Capacity	Zone A	Existing Well 34 site		Replace Pump			
G-W35	Capacity	Zone A	Existing Well 35 site		Replace Pump			
G-W36	Capacity	Zone A	Watkins Gate Rd approx. 1,000' w/o Camp St		New Well	1,500 gpm		

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- **O-P1:** Replace the existing 8-inch pipeline with a new 12-inch pipeline along 5th Street from 3rd Road to 1st Street.
- **O-P2:** Construct a new 12-inch pipeline along First Avenue from Lightfighter Drive to Gigling Avenue.
- **O-P3:** Replace the existing 12-inch pipeline with a new 12-inch pipeline along Gigling Road from General Jim Moore Blvd to the Zone D pump Station. This improvement is intended to mitigate existing pipeline condition issues.
- **O-P4:** Replace the existing 6-inch and 8-inch pipeline with a new 12-inch pipeline in the planned mixed use development North of Gigling Avenue between Malmedy Road and Parker Flats Road.
- **O-P5:** Replace the existing 6-inch and 8-inch pipeline with a new 12-inch pipeline in planned mixed use development North of Gigling Avenue between Parker Flats Road and 6th Avenue.
- **O-P6:** Replace the existing 8-inch pipeline with a new 12-inch pipeline in the existing right-of-way from Monterey Road to Leinbach Avenue.
- **O-P7:** Construct a new 12-inch pipeline along McClure Road and right-of-way from the intersection of General Jim Moore Boulevard and McClure Road to Coe Avenue.
- **O-P8:** Replace the existing 8-inch pipeline with a new 12-inch pipeline along Coe Avenue from General Jim Moore Boulevard to approximately 1,700 feet west of General Jim Moore Boulevard.
- **O-P9:** Construct a new 12-inch pipeline along Eucalyptus Road from General Jim Moore Boulevard to approximately 1,500 feet east of General Jim Moore Boulevard.
- **O-P10:** Construct a new 12-inch pipeline along Eucalyptus Road and the future right-of-way east of General Jim Moore Boulevard
- **O-P11:** Construct a new 12-inch pipeline along Normandy Road and Parker Flats Cutoff Road from Normandy Road to the future right-of-way.
- **O-P12:** Construct a new 12-inch pipeline along Parker Flats Cutoff Road and Eucalyptus Road from Normandy Road to the future right-of-way.
- **O-P13:** Construct a new 12-inch pipeline along 8th Avenue from Gigling Road to Parker Flats Cutoff Road.
- **O-P14:** Construct a new 18-inch pipeline along Gigling Road from 8th Avenue to the existing C2 Reservoir.

- **O-P15:** Construct a new 12-inch pipeline along future right-of-way from Eucalyptus Road to Parker Flats Road.
- **O-P16:** Construct a new 12-inch pipeline to within the future residential development east of 8th Avenue and North of Gigling Road.
- **O-P17:** Construct a new 12-inch pipeline within the future residential development east of 8th Avenue and South of Inter-Garrison Road.
- **O-P18:** Replace the existing 12-inch pipeline with a new 18-inch pipeline along Inter-Garrison Road and the future right-of-way from approximately 1,400 feet West of Abrams Drive to the future Reservoir O-T-B-EG .
- **O-P19:** Construct a new 24-inch pipeline along the existing right-of-way from the existing Intermediate Reservoir to Inter-Garrison Road.
- **O-P20:** Replace the existing 12-inch pipeline with a new 24-inch pipeline along the existing right-of-way from Inter-Garrison Road to the existing C2 Reservoir.
- **O-P21:** Construct a new 18-inch pipeline along Watkins Gate Road and the future right-of-way from the existing C2 Reservoir to future Barloy Canyon Road.
- **O-P22:** Construct a new 18-inch pipeline along Watkins Gate Road from the future O-T-B-EG Reservoir to Watkins Gate Road.
- **O-P23:** Construct a new 18-inch pipeline along Barloy Canyon Road from Watkins Gate Road to the future Pressure Zone C-B reliability PRV.
- **O-P24:** Construct a new 18-inch pipeline along Barloy Canyon Road from the future East Garrison Hydropneumatic Pump Station to approximately 4,700 feet north of Eucalyptus Road.
- **O-P25:** Construct a new 12-inch pipeline along the planned mixed-use development from North of Reservation Road to East of Blanco Road.
- **O-P26:** Construct a new 12-inch pipeline along Imjin Road and Neeson Road from Reservation Road to approximately 700 feet Northeast of Abrams Drive.
- **O-P27:** Construct a new 24-inch pipeline along South Boundary Road from General Jim Boulevard to approximately 8,300 feet Southeast of South Boundary Road.

7.9.3 General Water System

This section documents pipeline improvements within the Fort Ord water service area.

- **G-P1:** Construct a new 12-inch pipeline along future 2nd Avenue extension from Imjin Road to Reindollar Avenue.

- **G-P2:** Construct a new 18-inch transmission main from the future Pressure Zone B pump station to the existing Zone B transmission main.
- **G-P3:** Construct a new 24-inch transmission main from the future Pressure Zone C pump station to the existing Zone C transmission main.
- **G-P4:** Construct a new 24-inch transmission main from the future Pressure Zone A tank to the existing Zone A transmission main.
- **G-P5:** Construct a new 24-inch transmission main from the future Pressure Zone A tank to the existing Zone A transmission main.
- **G-P6:** Construct a new 12-inch pipeline along Imjin Road and Imjim Parkway, from the 8th Street Cut-off to Abrams Drive.
- **G-P7:** Construct a new 24-inch transmission along Imjin Parkway from Abrams Drive to Marina Heights Drive.
- **G-P8:** Construct a new 24-inch transmission main within the future Marina Heights development from California Drive to approximately 600 feet north of MacArthur Drive.
- **G-P9:** Construct a new 12-inch pipeline along Reservation Road from Imjin Road to Salinas Avenue.
- **G-P10:** Replace the existing 16-inch transmission main with a new 24-inch transmission main from the existing Well 34 discharge to the existing Well 31 discharge.
- **G-P11:** Construct a 12-inch transmission main in Watkins Gate Road from the planned Well 36 to Camp Street.

CHAPTER 8 – CAPITAL IMPROVEMENT PROGRAM

This chapter provides a summary of the recommended domestic water system improvements to mitigate existing capacity deficiencies and to accommodate anticipated future growth. The chapter also presents the cost criteria and methodologies for developing the capital improvement program. Finally, a capacity allocation analysis, usually used for cost sharing purposes, is also included.

8.1 COST ESTIMATE ACCURACY

Cost estimates presented in the CIP were prepared for general master planning purposes and, where relevant, for further project evaluation. Final costs of a project will depend on several factors including the final project scope, costs of labor and material, and market conditions during construction.

The Association for the Advancement of Cost Engineering (AACE International), formerly known as the American Association of Cost Engineers has defined three classifications of assessing project costs. These classifications are presented in order of increasing accuracy: Order of Magnitude, Budget, and Definitive.

- **Order of Magnitude Estimate.** This classification is also known as an “original estimate”, “study estimate”, or “preliminary estimate”, and is generally intended for master plans and studies.

  This estimate is not supported with detailed engineering data about the specific project, and its accuracy is dependent on historical data and cost indexes. It is generally expected that this estimate would be accurate within -30 percent to +50 percent.

- **Budget Estimate.** This classification is also known as an “official estimate” and generally intended for predesign studies. This estimate is prepared to include flow sheets and equipment layouts and details. It is generally expected that this estimate would be accurate within -15 percent to +30 percent.

- **Definitive Estimate.** This classification is also known as a “final estimate” and prepared during the time of contract bidding. The data includes complete plot plans and elevations, equipment data sheets, and complete specifications. It is generally expected that this estimate would be accurate within -5 percent to + 15 percent.

Costs developed in this study should be considered “Order of Magnitude” and have an expected accuracy range of **-30 percent** and **+50 percent**.

8.2 COST ESTIMATE METHODOLOGY

Cost estimates presented in this chapter are opinions of probable construction and other relevant costs developed from several sources including cost curves, Akel experience on other master planning projects, and input from District staff on the development of public and private cost sharing. Where appropriate, costs were escalated to reflect the more current Engineering News Records (ENR) Construction Cost Index (CCI).

This section documents the unit costs used in developing the opinion of probable construction costs, the Construction Cost Index, the land acquisition costs, and markups to account for construction contingency and other project related costs.

8.2.1 Unit Costs

The unit cost estimates used in developing the Capital Improvement Program are summarized on **Table 8.1**. Domestic water pipeline unit costs are based on length of pipes, in feet. Storage reservoir unit costs are based on capacity, per million gallons (MG). Pump Station costs are based on an equation that replaces the pump curve.

The unit costs are intended for developing the Order of Magnitude estimate and do not account for site specific conditions, labor and material costs during the time of construction, final project scope, implementation schedule, detailed utility and topography surveys for reservoir sites, investigation of alternative routings for pipes, and other various factors. The capital improvement program included in this report accounts for construction and project-related contingencies as described in this chapter. It should be noted that some of the unit costs were updated to reflect recent construction projects completed by the District. These include both pipelines and storage reservoirs, and the costs are updated to reflect the bid tabs received.

8.2.2 Construction Cost Index

Costs estimated in this study are adjusted utilizing the Engineering News Record (ENR) Construction Cost Index (CCI), which is widely used in the engineering and construction industries.

The costs in this Water Master Plan were benchmarked using a 20-City national average ENR CCI of 11,089, reflecting a date of June 2018.

8.2.3 Construction Contingency Allowance

Knowledge about site-specific conditions for each proposed project is limited at the master planning stage; therefore, construction contingencies were used. The estimated construction costs in this master plan include a **48.5 percent** contingency allowance to account for unforeseen events and unknown field conditions.

Table 8.1 Unit Costs

Water Master Plan

Marina Coast Water District

PRELIMINARY

Pipelines	
Pipe Size (in)	**Cost**[1,2] ($/lineal foot)
12	$213
16	$256
18	$276
20	$316
24	$346
30	$383
36	$451
Pump Stations	
Estimated Pumping Station Unit Cost ($/gpm), where Q is equal to the total station capacity in gpm	
Construct New Pump Station	Unit Cost ($/gpm) = 191.99 x $e^{-0.0001 \times Q}$
Upgrade Existing Pump Station	Unit Cost ($/gpm) = 160.97 x $e^{-0.00008 \times Q}$
Pressure Reducing Valves	
	Cost ($)
PRV	$73,000
Storage Reservoirs[3]	
≤1.0 MG	$2.92
1.1 MG-3.0 MG	$2.33
3.1 MG - 5.0 MG	$1.68
> 5 MG	$1.25
Groundwater Wells	
Replace Pump	$55,000
1,500 gpm Capacity	$3,016,000

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2/7/2019

Notes:

1. Construction costs estimated using June 2018 ENR CCI of 11,089
2. Construction costs are based on Bid Tabs Results received from District staff on October 18, 2018.
3. Tank costs were adjusted to reflect recent construction for a 1.5 MG tank, as provided by District staff on 2/7/2019.

8.2.4 Project Related Costs

The capital improvement costs also account for project-related costs, comprising of engineering design, project administration (developer and District staff), construction management and inspection, and legal costs. The project related costs in this master plan were estimated by applying an additional **25 percent** to the estimated construction costs.

8.3 CAPITAL IMPROVEMENT PROGRAM

The schedule of improvements for the projects identified in this master plan for mitigating existing system deficiencies and for serving anticipated buildout future growth throughout the District are summarized on **Table 8.2**. Each improvement was assigned a unique coded identifier associated with the improvement type and is summarized graphically on **Figure 8.1**.

8.3.1 Near-Term Development Infrastructure Requirements

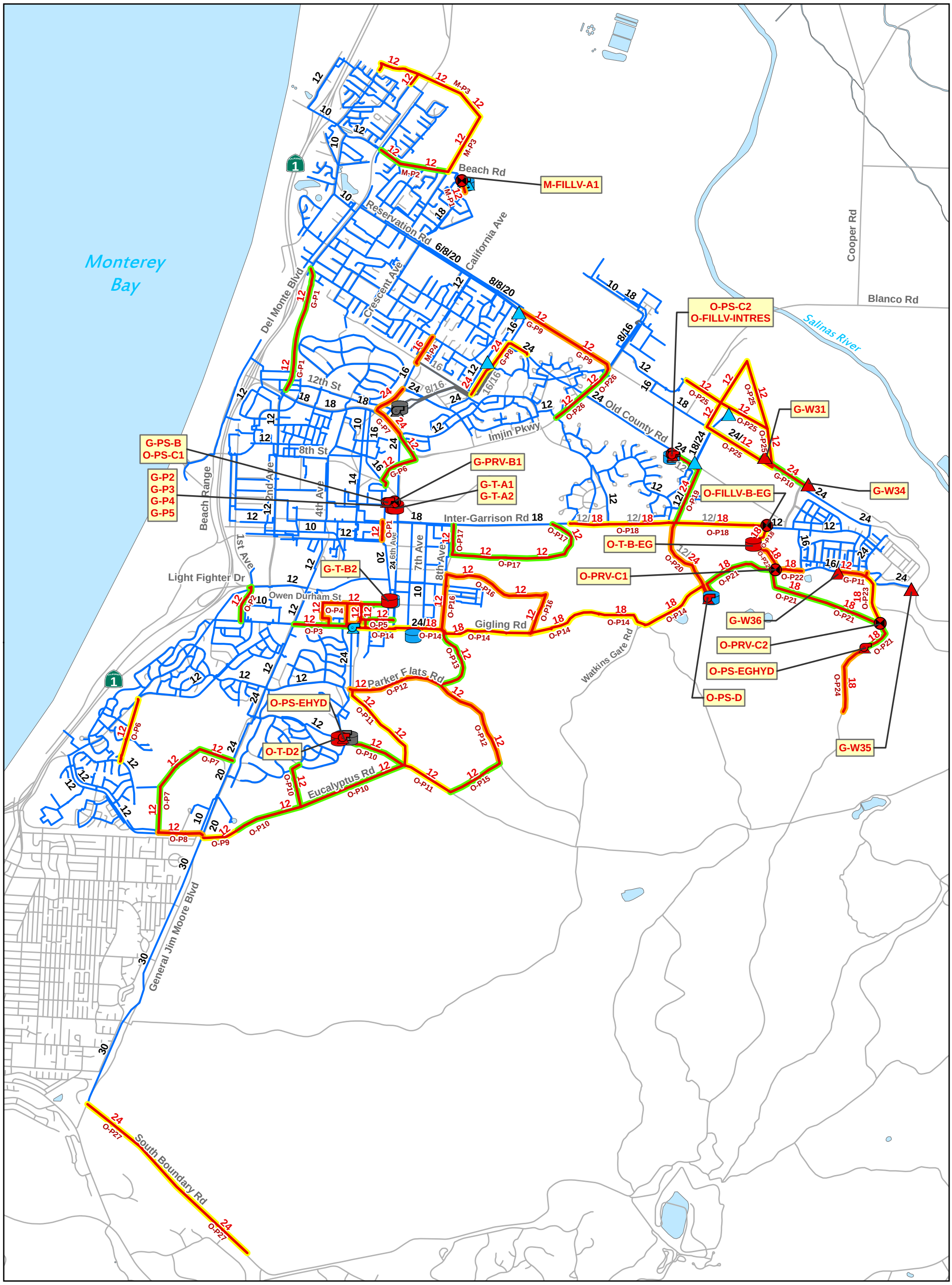
For the purposes of this master plan, and based on District staff input on the potential for buildout development to occur over an extended period of time, the Capital Improvement Program parallels the FORA development limit horizon and evaluates the improvements required in the next 15 years. These improvements and their associated costs are included on **Table 8.3** and shown graphically on **Figure 8.2**, reflect the water system infrastructure necessary to mitigate existing system deficiencies and serve the 15-year development.

It should be noted that some improvements are required for buildout development only and are not included in this Capital Improvement Program. Additionally, the capacities of recommended tanks and pump stations may be reduced based on the limited development within the near-term horizon. District staff may, at their prerogative and based on the approval of the District Engineer, require the construction of the buildout improvement. Thus, capacity sharing for the buildout improvements are documented on **Table 8.2**.

8.3.2 Recommended Cost Allocation Analysis and “In-Tract” Development

Cost allocation analysis is needed to identify improvement funding sources, and to establish a nexus between development impact fees and improvements needed to service growth. In compliance with the provisions of Assembly Bill AB 1600, the analysis differentiates between the project needs of servicing existing users and for those required to service anticipated future developments. The cost responsibility is based on model parameters for existing and future land use, and may change depending on the nature of development. **Table 8.2** and **Table 8.3** list each improvement, and separates the cost by responsibility between existing and future users.

It should be noted that the District adopted an “In-Tract” policy in January 2004, and as related to development, and redevelopment, within the Fort Ord Cost Center. This policy was adopted in an effort to fulfill obligations to the Fort Ord Reuse Authority, as well as avoiding undue cost burden to the existing customers within the Ord community. This policy is a result of inadequate design, age, and aggressive deterioration of the facilities located within the Fort Ord Cost Center. The full


Monterey Bay
Beach Rd
M-FILLV-A1
Reservation Rd
California Ave
Del Monte Blvd
Crescent Ave
Cooper Rd
Blanco Rd
Salinas River
O-PS-C2
O-FILLV-INTRES
G-W31
G-W34
O-FILLV-B-EG
O-T-B-EG
O-PRV-C1
G-W36
O-PRV-C2
O-PS-EGHYD
O-PS-D
G-W35
12th St
8th St
Imjin Pkwy
Old County Rd
Inter-Garrison Rd
Light Fighter Dr
Owen Durham St
Gigling Rd
Parker Flats Rd
Watkins Gate Rd
Eucalyptus Rd
South Boundary Rd
General Jim Moore Blvd
Beach Range
1st Ave
2nd Ave
4th Ave
6th Ave
7th Ave
8th Ave
G-PS-B
O-PS-C1
G-P2
G-P3
G-P4
G-P5
G-PRV-B1
G-T-A1
G-T-A2
G-T-B2
O-PS-EHYD
O-T-D2
M-P1
M-P2
M-P3
G-P1
G-P6
G-P7
G-P8
G-P9
M-P4
O-P1
O-P2
O-P3
O-P4
O-P5
O-P6
O-P7
O-P8
O-P9
O-P10
O-P11
O-P12
O-P13
O-P14
O-P15
O-P16
O-P17
O-P18
O-P19
O-P20
O-P21
O-P22
O-P23
O-P24
O-P25
O-P26
O-P27
G-P10
G-P11
6/8/20
8/8/20
8/16
16/16
24/12
18/24
12/18
24/18
Legend
Future Improvements
Tanks
Wells
Boosters
Valves
Pipes
Future to be Abandoned
Tanks
Boosters
Pipes
Existing Modeled System
Tanks
Wells
Boosters
Pipes
Streets
Rivers/Streams
Waterbodies
PRELIMINARY
Update: March 29, 2019
0 0.25 0.5 1 Mile
N
W GIS E
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AKEL ENGINEERING GROUP, INC.
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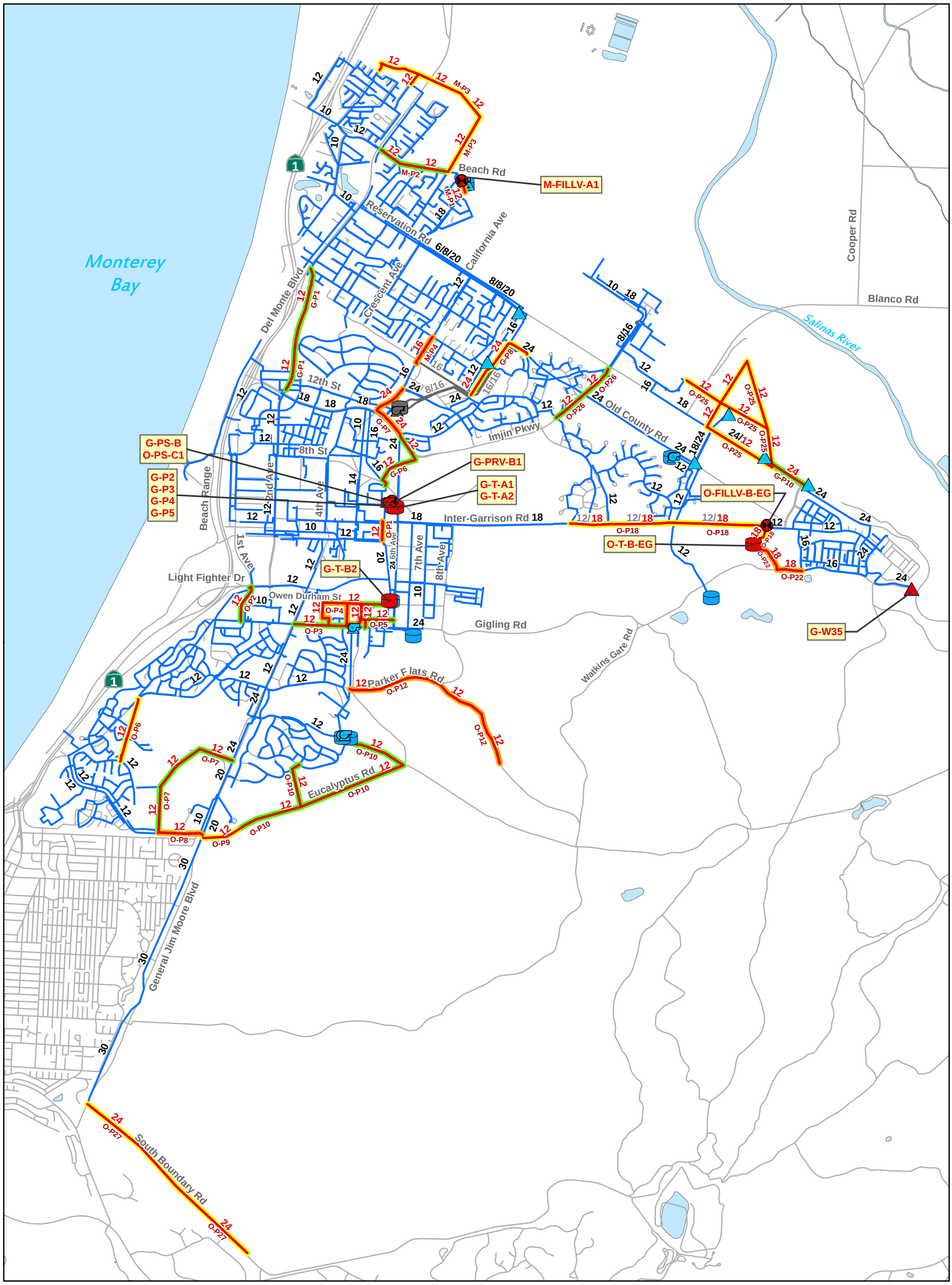
Figure 8.1
Capital Improvement Program Alternative 2
Water Master Plan
Marina Coast Water District
MARINA COAST WATER DISTRICT



Legend

PRELIMINARY

Future Improvements
- Tanks
- Wells
- Boosters
- Valves
- Pipes

Future to be Abandoned
- Tank
- Booster
- Pipes

Existing Modeled System
- Tanks
- Wells
- Boosters
- Pipes

- Streets
- Rivers/Streams
- Waterbodies

0 0.25 0.5 1 Mile

N W GIS E S

Update: June 3, 2019

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Figure 8.2
Near Term Improvements

Water Master Plan
Marina Coast Water District

Table 8.2 Buildout Capital Improvement Program

Water Master Plan

Marina Coast Water District

PRELIMINARY

Improv. No.	Improv. Type	Pressure Zone	Alignment	Limits	Improvement Details				Suggested Cost Allocation		Included in 15-Year CIP
									Existing Users	Future Users	
Central Marina Water System											
Pipeline Improvements					Existing Diameter (in)	New/Parallel /Replace	Diameter (in)	Length (ft)			
M-P1	Reliability	Zone A	ROW	From existing Reservoir 2 Site to Crescent Ave	-	New	12	425	100%	0%	Yes
M-P2	Reliability	Zone A	Beach Rd	From De Forest Rd to Del Monte Blvd	8	Parallel	12	2,725	100%	0%	Yes
M-P3	Development	Zone A	Armstrong Ranch	Future Armstrong Ranch Development	-	New	12	7,575	0%	100%	Yes
M-P4	Capacity	Zone A	California Ave	From approximately 500' n/o 3rd Ave to Reindollar Ave	12	Replace	16	1,225	50%	50%	Yes
Valve Improvements					New/Replace	Size (in)					
M-FILLV-A1	Operational	Zone A	Existing Reservoir 2 Site		New	8			100%	0%	-
M-PRV-B1	Reliability	Zone B	Planned A1/A2 tank site, nw/o the intersection of Inter-Garrison Rd and 6th Avenue		New	8			70%	30%	Yes
Ord Community Water System											
Pipeline Improvements					Existing Diameter (in)	New/Parallel /Replace	Diameter (in)	Length (ft)			
O-P1	Fire Flow	Zone C	5th St	From 3rd Rd to 1st St	8	Replace	12	750	100%	0%	Yes
O-P2	Reliability	Zone B	First Ave	From Lightfighter Dr to Gigling Ave	-	New	12	1,500	50%	50%	Yes
O-P3	Condition	Zone C	Gigling Rd	From General Jim Moore Blvd to Zone D Pump Station	12	Replace	12	2,300	100%	0%	Yes
O-P4	Fire Flow	Zone C	Planned Mixed Use Development	N/o Gigling Ave, between Malmedy Rd and Parker Flats Rd	6, 8	Replace	12	4,775	100%	0%	Yes
O-P5	Fire Flow	Zone D	Planned Mixed Use Development	N/o Gigling Ave, between Parker Flats Rd and 6th Ave	6, 8	Replace	12	3,500	100%	0%	Yes
O-P6	Fire Flow	Zone B	Existing ROW	From Monterey Rd to Leinbach Ave	8	Replace	12	2,425	100%	0%	Yes
O-P7	Development	Zone D	McClure Rd and ROW	From the intersection of General Jim Moore Blvd and McClure Rd to Coe Ave	-	New	12	5,325	0%	100%	Yes
O-P8	Capacity	Zone D	Coe Ave	From General Jim Moore Blvd to approx. 1,700' w/o General Jim Moore Blvd	8	Replace	12	1,725	50%	50%	Yes
O-P9	Development	Zone D	Eucalyptus Rd	From General Jim Moore Blvd to approx. 1,500' e/o General Jim More Blvd	-	New	12	1,350	0%	100%	Yes
O-P10	Development	Zone E	Eucalyptus Rd and Future ROW	Future Commercial Development, along and n/o Eucalyptus Rd	-	New	12	10,900	0%	100%	Yes
O-P11	Development	Zone D	Normandy Rd and Parker Flats Cutoff Rd	From Parker Flats Rd to Future ROW	-	New	12	5,750	0%	100%	-
O-P12	Development	Zone D	Parker Flats Cutoff Rd and Eucalyptus Rd	From Normandy Rd to Future ROW	-	New	12	7,525	0%	100%	Yes
O-P13	Development	Zone D	8th Ave	From Gigling Rd to Parker Flats Cutoff Rd	-	New	12	2,850	0%	100%	-
O-P14	Development	Zone D	Gigling Rd	From 8th Ave to existing C2 reservoir	-	New	18	15,275	0%	100%	-
O-P15	Development	Zone D	Future ROW	From Eucalyptus Rd to Parker Flats Rd	-	New	12	2,175	0%	100%	-
O-P16	Development	Zone D	Future Residential Development	E/o 8th Ave and n/o Gigling Rd	-	New	12	7,875	0%	100%	-
O-P17	Development	Zone C	Future Residential Development	E/o 8th Ave and s/o Inter-Garrison Rd	-	New	12	7,025	0%	100%	-
O-P18	Development	Zone C	Inter-Garrison Rd, Future ROW	From approx. 1,400' w/o Abrams Dr to future Reservoir B-EG (O-T-B-EG)	12	Replace	18	8,600	0%	100%	Yes
O-P19	Development	Zone C	Existing ROW	From existing Intermediate Reservoir to Inter-Garrison Rd	-	New	24	3,300	0%	100%	Yes
O-P20	Development	Zone C	Existing ROW	From Inter-Garrison Rd to existing C2 reservoir	12	Replace	18	3,625	0%	100%	-
O-P21	Development	Zone C	Watkins Gate Rd, Future ROW	From existing C2 Reservoir to future Barloy Canyon Rd	-	New	18	9,625	0%	100%	-
O-P22	Development	Zone B-EG	Watkins Gate Rd	From future B-EG reservoir (O-T-B-EG) to to Watkins Gate Rd	-	New	18	2,375	0%	100%	Yes
O-P23	Development	Zone B-EG/ Zone C	Barloy Canyon Rd	From Watkins Gate Rd to future East Garrison Hydropneumatic Pump Station	-	New	18	2,050	0%	100%	-
O-P24	Development	Zone EG-HYD	Barloy Canyon Rd	From future East Garrison Hydropneumatic Pump Station to approx. 4,700' n/o Eucalyptus Rd	-	New	18	2,800	0%	100%	-
O-P25	Development	Zone B	Planned Mixed Use Development	N/o Reservation Rd and e/o Blanco Rd	-	New	12	13,525	0%	100%	Yes
O-P26	Reliability	Zone B	Imjin Rd, Neeson Rd	From Reservation Rd to approx. 700' ne/o Abrams Dr	-	New	12	2,725	0%	100%	Yes

Table 8.2 Buildout Capital Improvement Program

Water Master Plan

Marina Coast Water District

PRELIMINARY

Improv. No.	Improv. Type	Pressure Zone	Alignment	Limits	Improvement Details				Suggested Cost Allocation		Included in 15-Year CIP
									Existing Users	Future Users	
O-P27	Development	Zone D	South Boundary Rd	From General Jim Blvd to approx. 8,300' se/o South Boundary Rd	-	New	24	8,275	0%	100%	Yes
Tank Improvements					New/Replace	Capacity (MG)					
O-T-B-EG	New Capacity	Zone B-EG	Existing Travel Camp tank site, s/o Inter-Garrison Rd approximately 1,700' w/o Camp St		New	1.00			25%	75%	Modified
O-T-D2	New Capacity	Zone D	Existing D1 tank site		New	1.70			0%	100%	-
O-T-SAND	Demolition	Zone A	Existing Sand Tank Facility						100%	0%	Yes
Pump Station Improvements					New/Upgrade /Replace	Total Capacity (gpm)					
O-PS-C1	New Capacity	Zone C	Planned A1/A2 tank site, nw/o the intersection of Inter-Garrison Rd and 6th Avenue		New	2,000			20%	80%	Modified
O-PS-C2	New Capacity	Zone C	Existing Intermediate Reservoir site		New	6,000			20%	80%	-
O-PS-D	New Capacity	Zone D	Existing C2 reservoir site		New	3,000			15%	85%	-
O-PS-EHYD	Replace Capacity	Zone E	Existing PS-EHYD Pump Station Site		Replace	1,200			20%	80%	-
O-PS-EGHYD	New Capacity	Zone EG-HYD	Barloy Canyon Rd, approximately 1,600' sw/o Crescent Bluff Rd		New	3,600			0%	100%	-
Valve Improvements					New/Replace	Size (in)					
O-FILLV-INTRES	Operational	Zone C	Intermediate Reservoir		New	8			20%	80%	-
O-FILLV-B-EG	Supply Capacity	Zone B-EG	Inter-Garrison Road		New	8			25%	75%	Yes
O-PRV-C1	Reliability	Zone C	Watkins Gate Rd		New	8			30%	70%	-
O-PRV-C2	Reliability	Zone C	Barloy Canyon Rd		New	8			30%	70%	-
Combined Water System (General)											
Pipeline Improvements					Existing Diameter (in)	New/Parallel /Replace	Diameter (in)	Length (ft)			
G-P1	Capacity	Zone A	Future 2nd Ave Extension	From Imjin Rd to Reindollar Ave	-	New	12	4,775	100%	0%	Yes
G-P2	Capacity	Zone B	Planned Zone A Tank Site	From future PS-B to existing Zone B transmission main.	-	New	18	300	50%	50%	Yes
G-P3	Capacity	Zone C	Planned Zone A Tank Site	From future PS-C to existing Zone C transmission main.	-	New	24	300	20%	80%	Yes
G-P4	Capacity	Zone A	Planned Zone A Tank Site	From future Zone A tanks to future Zone A (existing Zone C) transmission main.	-	New	24	300	100%	0%	Yes
G-P5	Capacity	Zone A	Planned Zone A Tank Site	From future Zone A tanks to future Zone A (existing Zone C) transmission main.	-	New	24	300	40%	60%	Yes
G-P6	Reliability	Zone B	Imjin Road and Imjim Parkway	From the 8th St Cut-off to Abrams Dr	-	New	12	2,950	100%	0%	Yes
G-P7	Capacity	Zone A	Imjin Parkway	From Abrams Dr to Marina Heights Dr	-	New	24	2,550	0%	100%	Yes
G-P8	Capacity	Zone A	Marina Heights Development	From California Dr to approximately 600' n/o MacArthur Dr	-	New	24	3,300	0%	100%	Yes
G-P9	Development	Zone B	Reservation Rd	From Imjin Pwy to Salinas Ave	-	New	12	4,050	0%	100%	-
G-P10	Capacity	Zone A	Reservation Rd	From existing Well 34 discharge to existing Well 31 discharge	16	Replace	24	2,000	0%	100%	Yes
G-P11	Capacity	Zone A	Watkins Gate Rd	From future Well 36 to Camp St	-	New	12	1,225	0%	100%	-
Tank Improvements					New/Replace	Capacity (MG)					
G-T-A1	Capacity	Zone A	Nw/o the intersection of Inter-Garrison Rd and 6th Avenue		Replace	1.60			100%	0%	Modified
G-T-A2	Capacity	Zone A	Nw/o the intersection of Inter-Garrison Rd and 6th Avenue		Replace	1.60			40%	60%	Modified
G-T-B2	Capacity	Zone B	Existing B1 Tank site		New	2.50			20%	80%	Modified
Pump Station Improvements					New/Upgrade /Replace	Total Capacity (gpm)					
G-PS-B	Capacity	Zone B	Planned A1/A2 tank site, nw/o the intersection of Inter-Garrison Rd and 6th Avenue		New	4,800			50%	50%	Modified

Table 8.2 Buildout Capital Improvement Program

Water Master Plan

Marina Coast Water District

PRELIMINARY

Improv. No.	Improv. Type	Pressure Zone	Alignment	Limits	Improvement Details		Suggested Cost Allocation		Included in 15-Year CIP
							Existing Users	Future Users	
Supply Improvements					New/Replace	Total Capacity (gpm)			
G-W31	Capacity	Zone A	Existing Well 31 site		Replace Pump		0%	100%	-
G-W34	Capacity	Zone A	Existing Well 34 site		Replace Pump		0%	100%	-
G-W35	Capacity	Zone A	Existing Well 35 site		Replace Pump		0%	100%	Yes
G-W36	Capacity	Zone A	Watkins Gate Rd approx. 1,000' w/o Camp St		New Well	1,500 gpm	0%	100%	-
G-W1	Water Quality	Zone A	Existing Well 30, 31, 34, 35		Wellhead Treatment		100%	0%	Yes
Miscellaneous Improvements					New/Replace	Total Capacity (gpm)			
G-WD1	Other	-	Corporation Yard Demolition and Rehab				100%	0%	Yes

Table 8.3 Near-Term Capital Improvement Program

Water Master Plan

Marina Coast Water District

PRELIMINARY

Improv. No.	Improv. Type	Pressure Zone	Alignment	Limits	Improvement Details				Infrastructure Costs		Baseline Construction Cost	Estimated Construction Cost[1]	Capital Improvement Cost[2,3,4]	Suggested Cost Allocation		Cost Sharing	
									Unit Cost	Infr. Cost				Existing Users	Future Users	Existing Users	Future Users
									($/unit)	($)	($)	($)	($)			($)	($)
Central Marina Water System																	
Pipeline Improvements					Existing Diameter (in)	New/Parallel /Replace	Diameter (in)	Length (ft)									
M-P1	Reliability	Zone A	ROW	From existing Reservoir 2 Site to Crescent Ave	-	New	12	425	213	90,525	91,000	136,000	170,000	100%	0%	170,000	0
M-P2	Reliability	Zone A	Beach Rd	From De Forest Rd to Del Monte Blvd	8	Parallel	12	2,725	213	580,425	581,000	863,000	1,079,000	100%	0%	1,079,000	0
M-P3	Development	Zone A	Armstrong Ranch	Future Armstrong Ranch Development	-	New	12	7,575	213	1,613,475	1,614,000	2,397,000	2,997,000	0%	100%	0	2,997,000
M-P4	Capacity	Zone A	California Ave	From approximately 500' n/o 3rd Ave to Reindollar Ave	12	Replace	16	1,225	256	313,600	314,000	467,000	584,000	50%	50%	292,000	292,000
					Subtotal - City of Marina Pipeline Improvements					**2,598,025**	**2,600,000**	**3,863,000**	**4,830,000**			**1,541,000**	**3,289,000**
Valve Improvements					New/Replace	Size (in)											
M-FILLV-A1	Operational	Zone A	Existing Reservoir 2 Site		New	8				73,000	73,000	109,000	137,000	100%	0%	137,000	0
					Subtotal - City of Marina Valve Improvements					**73,000**	**73,000**	**109,000**	**137,000**			**137,000**	**0**
Total Central Marina Improvement Costs																	
									Pipeline Improvements	**2,598,025**	**2,600,000**	**3,863,000**	**4,830,000**			**1,541,000**	**3,289,000**
									Valve Improvements	**73,000**	**73,000**	**109,000**	**137,000**			**137,000**	**0**
									Total - Central Marina Improvements	**2,671,025**	**2,673,000**	**3,972,000**	**4,967,000**			**1,678,000**	**3,289,000**
Ord Community Water System																	
Pipeline Improvements					Existing Diameter (in)	New/Parallel /Replace	Diameter (in)	Length (ft)									
O-P1	Fire Flow	Zone C	5th St	From 3rd Rd to 1st St	8	Replace	12	750	213	159,750	160,000	238,000	298,000	100%	0%	298,000	0
O-P2	Reliability	Zone B	First Ave	From Lightfighter Dr to Gigling Ave	-	New	12	1,500	213	319,500	320,000	476,000	595,000	50%	50%	297,500	297,500
O-P3	Condition	Zone C	Gigling Rd	From General Jim Moore Blvd to Zone D Pump Station	12	Replace	12	2,300	213	489,900	490,000	728,000	910,000	100%	0%	910,000	0
O-P4	Fire Flow	Zone C	Planned Mixed Use Development	N/o Gigling Ave, between Malmedy Rd and Parker Flats Rd	6, 8	Replace	12	4,775	213	1,017,075	1,018,000	1,512,000	1,890,000	100%	0%	1,890,000	0
O-P5	Fire Flow	Zone D	Planned Mixed Use Development	N/o Gigling Ave, between Parker Flats Rd and 6th Ave	6, 8	Replace	12	3,500	213	745,500	746,000	1,108,000	1,385,000	100%	0%	1,385,000	0
O-P6	Fire Flow	Zone B	Existing ROW	From Monterey Rd to Leinbach Ave	8	Replace	12	2,425	213	516,525	517,000	768,000	960,000	100%	0%	960,000	0
O-P7	Development	Zone D	McClure Rd and ROW	From the intersection of General Jim Moore Blvd and McClure Rd to Coe Ave	-	New	12	5,325	213	1,134,225	1,135,000	1,686,000	2,108,000	0%	100%	0	2,108,000

Table 8.3 Near-Term Capital Improvement Program

Water Master Plan

Marina Coast Water District

PRELIMINARY

Improv. No.	Improv. Type	Pressure Zone	Alignment	Limits	Improvement Details				Infrastructure Costs		Baseline Construction Cost	Estimated Construction Cost[1]	Capital Improvement Cost[2,3,4]	Suggested Cost Allocation		Cost Sharing	
									Unit Cost	Infr. Cost				Existing Users	Future Users	Existing Users	Future Users
									($/unit)	($)	($)	($)	($)			($)	($)
O-P8	Capacity	Zone D	Coe Ave	From General Jim Moore Blvd to approx. 1,700' w/o General Jim Moore Blvd	8	Replace	12	1,725	213	367,425	368,000	547,000	684,000	50%	50%	342,000	342,000
O-P9	Development	Zone D	Eucalyptus Rd	From General Jim Moore Blvd to approx. 1,500' e/o General Jim More Blvd	-	New	12	1,350	213	287,550	288,000	428,000	535,000	0%	100%	0	535,000
O-P10	Development	Zone E	Eucalyptus Rd and Future ROW	Future Commercial Development, along and n/o Eucalyptus Rd	-	New	12	10,900	213	2,321,700	2,322,000	3,449,000	4,312,000	0%	100%	0	4,312,000
O-P12	Development	Zone D	Parker Flats Cutoff Rd and Eucalyptus Rd	From Normandy Rd to Future ROW	-	New	12	7,525	213	1,602,825	1,603,000	2,381,000	2,977,000	0%	100%	0	2,977,000
O-P18	Development	Zone C	Inter-Garrison Rd, Future ROW	From approx. 1,400' w/o Abrams Dr to future Reservoir B-EG (O-T-B-EG)	12	Replace	18	8,600	276	2,373,600	2,374,000	3,526,000	4,408,000	0%	100%	0	4,408,000
O-P22	Development	Zone B-EG	Watkins Gate Rd	From future B-EG reservoir (O-T-B-EG) to to Watkins Gate Rd	-	New	18	2,375	276	655,500	656,000	975,000	1,219,000	0%	100%	0	1,219,000
O-P25	Development	Zone B	Planned Mixed Use Development	N/o Reservation Rd and e/o Blanco Rd	-	New	12	13,525	213	2,880,825	2,881,000	4,279,000	5,349,000	0%	100%	0	5,349,000
O-P26	Reliability	Zone B	Imjin Rd, Neeson Rd	From Reservation Rd to approx. 700' ne/o Abrams Dr	-	New	12	2,725	213	580,425	581,000	863,000	1,079,000	0%	100%	0	1,079,000
O-P27	Development	Zone D	South Boundary Rd	From General Jim Blvd to approx. 8,300' se/o South Boundary Rd	-	New	24	8,275	346	2,863,150	2,864,000	4,254,000	5,318,000	0%	100%	0	5,318,000
					Subtotal - Fort Ord Pipeline Improvements					**18,315,475**	**18,323,000**	**27,218,000**	**34,027,000**			**6,082,500**	**27,944,500**
Tank Improvements					**New/Replace**	**Capacity (MG)**											
O-T-B-EG	New Capacity	Zone B-EG	Existing Travel Camp tank site, s/o Inter-Garrison Rd approximately 1,700' w/o Camp St		New	0.80		2.92	2,336,000		2,336,000	3,469,000	4,337,000	20%	80%	867,400	3,469,600
O-T-SAND	Demolition	Zone A	Existing Sand Tank Facility						-		-	-	552,000	100%	0%	552,000	0
					Subtotal - Fort Ord Tank Improvements					**2,336,000**	**2,336,000**	**3,469,000**	**4,889,000**			**1,419,400**	**3,469,600**
Pump Station Improvements					**New/Upgrade /Replace**	**Total Capacity (gpm)**											
O-PS-C1	New Capacity	Zone C	Planned A1/A2 tank site, nw/o the intersection of Inter-Garrison Rd and 6th Avenue		New	2,250		153	344,933		345,000	513,000	642,000	60%	40%	385,200	256,800
					Subtotal - Fort Ord Pump Station Improvements					**344,933**	**345,000**	**513,000**	**642,000**			**385,200**	**256,800**
Valve Improvements					**New/Replace**	**Size (in)**											
O-FILLV-B-EG	Supply Capacity	Zone B-EG	Inter-Garrison Road		New	8			73,000		73,000	109,000	137,000	20%	80%	27,400	109,600
					Subtotal - Fort Ord Valve Improvements					**73,000**	**73,000**	**109,000**	**137,000**			**27,400**	**109,600**

Table 8.3 Near-Term Capital Improvement Program

Water Master Plan

Marina Coast Water District

PRELIMINARY

Improv. No.	Improv. Type	Pressure Zone	Alignment	Limits	Improvement Details				Infrastructure Costs		Baseline Construction Cost	Estimated Construction Cost[1]	Capital Improvement Cost[2,3,4]	Suggested Cost Allocation		Cost Sharing	
									Unit Cost ($/unit)	Infr. Cost ($)	($)	($)	($)	Existing Users	Future Users	Existing Users ($)	Future Users ($)
Total Ord Community Improvement Costs																	
								Pipeline Improvements		**18,315,475**	**18,323,000**	**27,218,000**	**34,027,000**			**6,082,500**	**27,944,500**
								Tank Improvements		**2,336,000**	**2,336,000**	**3,469,000**	**4,889,000**			**1,419,400**	**3,469,600**
								Pump Station Improvements		**344,933**	**345,000**	**513,000**	**642,000**			**385,200**	**256,800**
								Valve Improvements		**73,000**	**73,000**	**109,000**	**137,000**			**27,400**	**109,600**
								Total - Fort Ord Improvements		**21,069,408**	**21,077,000**	**31,309,000**	**39,695,000**			**7,914,500**	**31,780,500**
Combined Water System (General)																	
Pipeline Improvements					Existing Diameter (in)	New/Parallel /Replace	Diameter (in)	Length (ft)									
G-P1	Capacity	Zone A	Future 2nd Ave Extension	From Imjin Rd to Reindollar Ave	-	New	12	4,775	213	1,017,075	1,018,000	1,512,000	1,890,000	100%	0%	1,890,000	0
G-P2	Capacity	Zone B	Planned Zone A Tank Site	From future PS-B to existing Zone B transmission main.	-	New	18	300	276	82,800	83,000	124,000	155,000	75%	25%	116,250	38,750
G-P3	Capacity	Zone C	Planned Zone A Tank Site	From future PS-C to existing Zone C transmission main.	-	New	24	300	346	103,800	104,000	155,000	194,000	60%	40%	116,400	77,600
G-P4	Capacity	Zone A	Planned Zone A Tank Site	From future Zone A tanks to future Zone A (existing Zone C) transmission main.	-	New	24	300	346	103,800	104,000	155,000	194,000	100%	0%	194,000	0
G-P5	Capacity	Zone A	Planned Zone A Tank Site	From future Zone A tanks to future Zone A (existing Zone C) transmission main.	-	New	24	300	346	103,800	104,000	155,000	194,000	75%	25%	145,500	48,500
G-P6	Reliability	Zone B	Imjin Road and Imjim Parkway	From the 8th St Cut-off to Abrams Dr	-	New	12	2,950	213	628,350	629,000	935,000	1,169,000	100%	0%	1,169,000	0
G-P7	Capacity	Zone A	Imjin Parkway	From Abrams Dr to Marina Heights Dr	-	New	24	2,550	346	882,300	883,000	1,312,000	1,640,000	0%	100%	0	1,640,000
G-P8	Capacity	Zone A	Marina Heights Development	From California Dr to approximately 600' n/o MacArthur Dr	-	New	24	3,300	346	1,141,800	1,142,000	1,696,000	2,120,000	0%	100%	0	2,120,000
G-P10	Capacity	Zone A	Reservation Rd	From existing Well 34 discharge to existing Well 31 discharge	16	Replace	24	2,000	346	692,000	692,000	1,028,000	1,285,000	0%	100%	0	1,285,000
								Subtotal - Combined Pipeline Improvements		**4,755,725**	**4,759,000**	**7,072,000**	**8,841,000**			**3,631,150**	**5,209,850**
Tank Improvements					New/Replace	Capacity (MG)											
G-T-A1	Capacity	Zone A	Nw/o the intersection of Inter-Garrison Rd and 6th Avenue		Replace	1.25			2.33	2,912,500	2,913,000	4,326,000	5,841,000	100%	0%	5,841,000	0
G-T-A2	Capacity	Zone A	Nw/o the intersection of Inter-Garrison Rd and 6th Avenue		Replace	1.25			2.33	2,912,500	2,913,000	4,326,000	5,841,000	75%	25%	4,380,750	1,460,250
G-T-B2	Capacity	Zone B	Existing B1 Tank site		New	0.90			2.33	2,097,000	2,097,000	3,115,000	3,894,000	50%	50%	1,947,000	1,947,000
								Subtotal - Combined Tank Improvements		**7,922,000**	**7,923,000**	**11,767,000**	**15,576,000**			**12,168,750**	**3,407,250**
Pump Station Improvements					New/Upgrade /Replace	Total Capacity (gpm)											
G-PS-B	Capacity	Zone B	Planned A1/A2 tank site, nw/o the intersection of Inter-Garrison Rd and 6th Avenue		New	2,700			147	395,706	396,000	589,000	737,000	75%	25%	552,750	184,250
								Subtotal - Combined Pump Station Improvements		**395,706**	**396,000**	**589,000**	**737,000**			**552,750**	**184,250**

Table 8.3 Near-Term Capital Improvement Program

Water Master Plan

Marina Coast Water District

PRELIMINARY

Improv. No.	Improv. Type	Pressure Zone	Alignment	Limits	Improvement Details		Infrastructure Costs		Baseline Construction Cost	Estimated Construction Cost[1]	Capital Improvement Cost[2,3,4]	Suggested Cost Allocation		Cost Sharing	
							Unit Cost	Infr. Cost				Existing Users	Future Users	Existing Users	Future Users
							($/unit)	($)	($)	($)	($)			($)	($)
Supply Improvements					New/Replace	Total Capacity (gpm)									
G-W35	Capacity	Zone A	Existing Well 35 site		Replace Pump		55,000	55,000	55,000	82,000	103,000	0%	100%	0	103,000
G-W1	Water Quality	Zone A	Existing Well 30, 31, 34, 35		Wellhead Treatment		-	-	-	-	2,801,000	100%	0%	2,801,000	0
					Subtotal - Combined Supply Improvements			**55,000**	**55,000**	**82,000**	**2,904,000**			**2,801,000**	**103,000**
Valve Improvements					New/Replace	Size (in)									
G-PRV-B1	Reliability	Zone B	Planned A1/A2 tank site, nw/o the intersection of Inter-Garrison Rd and 6th Avenue		New	8		73,000	73,000	109,000	137,000	75%	25%	102,750	34,250
					Subtotal - City of Marina Valve Improvements			**73,000**	**73,000**	**109,000**	**137,000**			**102,750**	**34,250**
Miscellaneous Improvements															
G-WD1	Other	-	Corporation Yard Demolition and Rehab				-	-	-	-	465,000	100%	0%	465,000	0
					Subtotal - Combined Miscellaneous Improvements			**0**	**0**	**0**	**465,000**			**465,000**	**0**
Total Combined Improvement Costs															
					Pipeline Improvements			**4,755,725**	**4,759,000**	**7,072,000**	**8,841,000**			**3,631,150**	**5,209,850**
					Tank Improvements			**7,922,000**	**7,923,000**	**11,767,000**	**15,576,000**			**12,168,750**	**3,407,250**
					Pump Station Improvements			**395,706**	**396,000**	**589,000**	**737,000**			**552,750**	**184,250**
					Supply Improvements			**55,000**	**55,000**	**82,000**	**2,904,000**			**2,801,000**	**103,000**
					Valve Improvements			**73,000**	**73,000**	**109,000**	**137,000**			**102,750**	**34,250**
					Miscellaneous Improvements			**0**	**0**	**0**	**465,000**			**465,000**	**0**
					Total - Combined Improvements			**13,201,431**	**13,206,000**	**19,619,000**	**28,660,000**			**19,721,400**	**8,938,600**
Total Water System Improvement Costs															
					Pipeline Improvements			**25,669,225**	**25,682,000**	**38,153,000**	**47,698,000**			**11,254,650**	**36,443,350**
					Supply Improvements			**55,000**	**55,000**	**82,000**	**2,904,000**			**2,801,000**	**103,000**
					Tank Improvements			**10,258,000**	**10,259,000**	**15,236,000**	**20,465,000**			**13,588,150**	**6,876,850**
					Valve Improvements			**146,000**	**146,000**	**218,000**	**411,000**			**267,150**	**143,850**
					Pump Station Improvements			**740,639**	**741,000**	**1,102,000**	**1,379,000**			**937,950**	**441,050**
					Miscellaneous Improvements			**0**	**0**	**0**	**465,000**			**465,000**	**0**
					Total - Combined Improvements			**36,868,864**	**36,883,000**	**54,791,000**	**73,322,000**			**29,313,900**	**44,008,100**

AKEL ENGINEERING GROUP, INC.

6/3/2019

Notes:

1. Estimated Construction costs include 48.5 percent of baseline construction costs to account for unforeseen events and unknown field conditions, and for Contractor's overhead and profit, general conditions, and sales tax, consistent with 2007 Water Master Plan.
2. Capital Improvement Costs also include an additional 25 percent of the estimated construction costs to account for administration, construction management, and legal costs.
3. The Capital Improvement Costs for storage tank improvements G-T-A1 and G-T-A2 also include an additional 10 percent of the estimated construction cost to account for California State University Architectural Requirements.
4. Projects only including a Capital Improvement Cost are based on capital improvement information received from District staff and are assumed to include planning contingencies.

"In-Tract" policy is included in **Appendix C**. The following is directly from the District's "In-Tract" policy:

For all proposed redevelopment projects in areas served by existing water and wastewater collection infrastructure, the developer will be required to implement one of the following procedures:

1. *Where redevelopment will raze the existing buildings and streets:*
   - *Developer completes a subdivision water and sewer master plan per the District standards.*
   - *Developer replaces all existing water and wastewater collection pipelines and components within the project area to District standards, and replaces all existing water and wastewater collection pipelines and components adjacent to the project area to District standards, as project impacts necessitate.*
   - *Developer provides meter boxes for all structures and landscaping.*
   - *Developer provides for District's installation of remote read meters.*
2. *Where redevelopment will use existing buildings and infrastructure or will raze or remodel a portion or all of the existing buildings but streets and existing infrastructure will remain:*
   - *Developer completes a subdivision water and sewer master plan per the District standards. This subdivision master plan would include a physical and design standard condition assessment of the systems per District standards. The subdivision master plan must be approved by the District prior to receiving water and sewer service.*
   - *From the subdivision master plan, the Developer replaces components as required by the District.*
   - *Developer relocates the District's backbone water/sewer infrastructure (infrastructure that serves other upstream and downstream users) onto roadway right of way, as necessary.*
   - *When the Developer is planning to construct improvements, including, but not limited to, structures, landscape areas, walkways, parking facilities, etc., over existing water and sewer infrastructure, then the Developer is responsible to relocate existing water/sewer infrastructure away from under proposed improvements.*
   - *The developer will enter into a separate utility agreement with the District to provide for anticipated higher maintenance costs of the remaining older systems that will be left in place.*
   - *The separate utility agreement will include an annual water and wastewater collection inspection report to be completed by the Developer or its successor in accordance with District standards. That agreement will require the developer to provide an annual wastewater collection system, water system inspection report in accordance with District standards and to provide master meters for the project. The water inspection report will include a water audit.*
   - *Developer provides meter boxes for all structures and landscaping.*
   - *Developer provides for District's installation of remote read meters.*

8.3.3 Construction Triggers

As a part of this Master Planning process, construction triggers were developed in an effort to orderly plan the expansion of the water system. These construction triggers are based on equivalent dwelling units (EDU), which are defined as *insert information from Bartle Wells.* It should be noted that Bartle Wells and Associates prepared an updated analysis of EDUs for the District, and based on industry standards and approved by District staff. This analysis is included in **Appendix D**, and summarized as follows:

Summarize EDU Analysis from Bartle Wells

To be finalized pending MCWD staff approval

APPENDICES

APPENDIX A

Water System Planning and Design Criteria
- Prepared by GHD

Water System
Planning and Design Criteria

Marina Coast Water District

GHD | 2235 Mercury Way, Suite 150, Santa Rosa, California

11140005 | November 6, 2017

Marina Coast Water District

Water System Planning and Design Criteria

Project No. 11140005

Prepared for:

AKEL ENGINEERING GROUP, INC.
7433 N. First Street, #103
Fresno, CA 93720

Prepared by:

Luke Philbert
Project Engineer

Reviewed by:

Matt Winkelman, P.E.
Principal

2235 Mercury Way, Suite 150
Santa Rosa, CA 95407
(707) 523-1010

November 6, 2017

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1. Water System Planning & Design Criteria

The following section provides planning and design criteria for surface water quality, groundwater quality and contamination, and saltwater intrusion. Criteria were evaluated from Marina Coast Water District (MCWD) and similar agencies and provide a basis for decision making for the master plan.

1.1 Surface Water Quality

Currently, MCWD receives all of its source water solely from groundwater, and plans to diversify its water supply portfolio in upcoming years. MCWD does not currently have surface water quality criteria. Groundwater quality and contamination monitoring programs are discussed in Section 1.2. Saltwater intrusion is discussed at length in Section 1.3. MCWD maintains active monitoring of intrusion and contamination status and participates in the analytical and management efforts undertaken by the Monterey County Water Resources Agency (MCWRA) with respect to seawater intrusion remediation actions and by the U. S. Army Corps of Engineers relative to groundwater cleanup on the former Fort Ord.

1.2 Groundwater Quality and Contamination

Groundwater quality and contamination problems are well monitored and mitigated in the MCWD service area to meet state and federal standards. Groundwater supply is provided from eight wells (See Figure 1) and delivered through a distribution system network of seven storage tanks and nearly 250 miles of pipeline. Three deep supply wells (10, 11, and 12) located in Central Marina draw groundwater from the 900-foot aquifer of the Salinas Valley Groundwater Basin. The groundwater is treated at each well site for disinfection and to remove naturally occurring hydrogen sulfide that can cause odor.

Five supply wells (29, 30, 31, 34 and “Watkins Gate” 35) located in the Ord Community, draw groundwater from the Salinas Valley Groundwater Basin 900-foot, 400-foot, and lower 180-foot Aquifers. Groundwater from these supply wells is disinfected in the Ord Community chlorination treatment plant.

In 2005, the Central Marina and Ord Community water systems were connected to allow water to flow between the systems to meet peak demands and improve overall service.

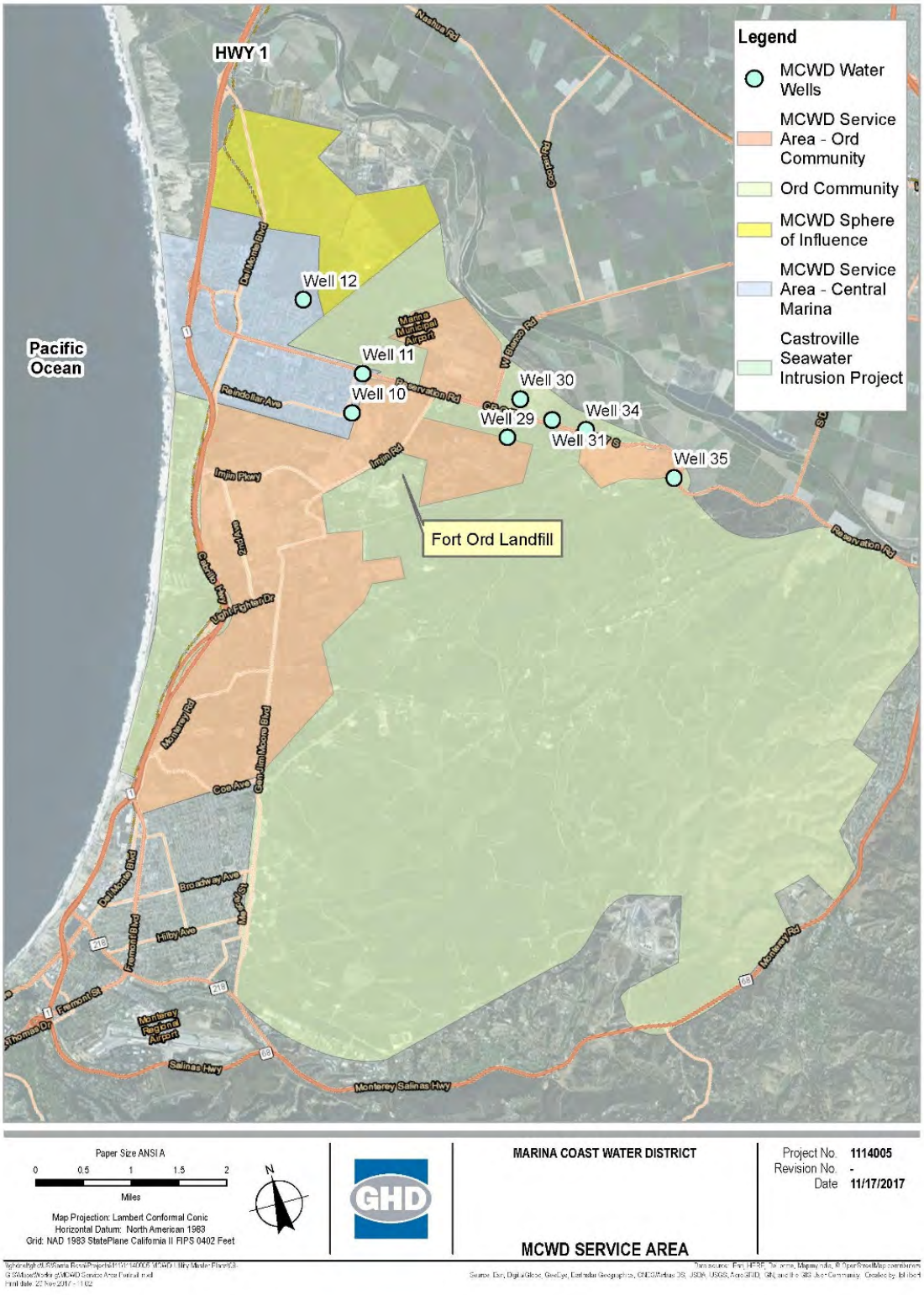


Figure 1 - MCWD Service Area

1.2.1 GeoTracker Water Quality Assessment

GHD reviewed GeoTracker data to identify hazardous materials sites within a 0.25-mile radius of each supply well. Results are summarized in Table 1.1. GeoTracker is the State Water Resources Control Board's (SWRCB) data management system for sites that impact, or have the potential to impact, water quality in California, with emphasis on groundwater. GeoTracker contains records for sites that require cleanup, such as Leaking Underground Storage Tank (LUST) Sites, Department of Defense Sites, and Cleanup Program Sites. GeoTracker also contains records for various unregulated projects as well as permitted facilities including: Irrigated Lands, Oil and Gas production, operating Permitted USTs, and Land Disposal Sites.

Table 1.1 - Open Cleanup Sites within 0.25 mile radius of wells

Well ID	1/4 Mile GeoTracker Open Cases	Comments	Links
Well 10	0	3/4 mile from Fort Ord Landfill.	http://geotracker.waterboards.ca.gov/profile_report.asp?global_id=L10006198832
Well 11	1	Open case, Fort Ord.	http://geotracker.waterboards.ca.gov/profile_report.asp?global_id=DOD100196800
Well 12	1	Open case, Fort Ord - offsite plume 0.2 miles southeast.	http://geotracker.waterboards.ca.gov/profile_report.asp?global_id=DOD100220600
Well 12	1	Dry cleaning solvents plume in soil and GW 0.6 miles to the southwest, open case.	http://geotracker.waterboards.ca.gov/profile_report.asp?global_id=SLT3S2061339
Well 29	0	Closed case, water district LUST site. Also, 1 mile from Fort Ord Landfill.	
Well 30	0	Irrigation lands to the east are part of Irrigated Lands Regulatory Program.	
Well 31	0	Irrigation lands to the east are part of Irrigated Lands Regulatory Program.	
Well 34	0	Fort Ord Superfund site closed March 2017 for Lead in soil 0.7 miles east. Irrigation lands to the east are part of Irrigated Lands Regulatory Program.	http://www.envirostor.dtsc.ca.gov/public/profile_report.asp?global_id=80001196
Well 35	0	Fort Ord Superfund site closed March 2017 for Lead in soil 0.25 miles west. Irrigation lands to the east are part of Irrigated Lands Regulatory Program.	http://www.envirostor.dtsc.ca.gov/public/profile_report.asp?global_id=80001196

1.2.2 State and Federal Standards

Water quality monitoring and lab analysis is performed by MCWD lab staff and under contract with state certified laboratories. Water samples from wells, water treatment plants, and point-of-use locations are collected and tested to assure water delivered to customers meets both state and federal standards.

Results from water quality testing are published annually in MCWD's annual Consumer Confidence Report, with the latest from 2016.[1] Currently the District has water quality reporting through October 2017.[2] The following is an analysis based on this publicly available data.

State drinking water quality regulations include drinking water standards at maximum contaminant levels (MCLs). MCLs are found in Title 22 of the California Code of Regulations. Specific constituents mentioned in this section are summarized in Table 1.2. Reported levels of contaminants are included in MCWD's annual Consumer Confidence Report[1,] with the latest year at 2016.

Table 1.2 - MCWD Constituent Limits under Title 22

Constituent	Maximum Contaminant Level	Recommended Level	Upper Level	Short Term Level	Units	Section Number
arsenic	0.01				mg/L	64431
chloride		250	500	600	mg/L	64449
chromium	0.05				mg/L	64431
color	15				units	64449
copper	1				mg/L	64449
fluoride	2				mg/L	64431
nitrate	10					64431
haloacetic acids	0.06				mg/L	64533
magnesium		10			mg/L	64536
odor - threshold	3				units	64449
specific conductance		900	1,600	2,200	uS/cm	64449
sulfate		250	500	600	mg/L	64449
total dissolved solids		500	1000	1500	mg/L	64449
total trihalomethanes	0.08				mg/L	64533
trichloroethylene	0.005				mg/L	64444
turbidity	5				units	64449

Federal drinking water quality regulations are maintained under the Safe Drinking Water Act (SDWA). The Environmental Protection Agency (EPA) sets standards for drinking water quality, and with its partners implements various technical and financial programs to ensure a safe drinking water supply.

In addition, the California Department of Public Health (CDPH) implemented the Federal Groundwater Rule (GWR); compliance started on December 1, 2009. The purpose of the GWR is to reduce the risk of illness caused by microbial contamination in public groundwater systems. MCWD reported that

[1] http://www.mcwd.org/gsa_ccr.html

[2] http://www.mcwd.org/gsa_water_quality.html

coliforms were not detected in all but four of the required 532 distribution system samples collected in Central Marina and Ord Community[1].

The Regional Water Quality Control Boards (RWQCBs) located throughout California are responsible for assessing the water quality of all water bodies in their regions. This information is compiled into a statewide Water Quality Assessment, a database that lists water bodies alphabetically by water type (lakes, streams, wetlands, groundwater, etc.) and assesses each water body as having "good," "intermediate," "impaired," or "unknown" water quality. Formally, an impaired water body is one that does not meet water quality standards even after technology based discharge limits on point sources are implemented (i.e., water quality standards are not attainable even with Best Available Treatment/Best Control Technology).

Section 303(d) of the federal Clean Water Act requires each State to maintain a list of impaired water bodies and to develop total maximum day loads (TMDLs) for all impaired water bodies. A TMDL estimates the maximum amount of a pollutant that a water body can receive and still meet water quality standards. A TMDL must be developed for each stressor or pollutant for each water body threatened or impaired. Establishing a TMDL includes gathering data about the sources of the pollutant, including both point and nonpoint sources, and allocating the pollutant loads from the various identified sources. Once a TMDL is established, an implementation plan must be developed to describe how that water body will meet water quality standards.

The Central Coast RWQCB is the State agency responsible for identifying impaired water bodies within the Central Coast region. On August 4, 2010, the SWRCB approved the 2010 Integrated Report, which California's 2008-2010 Section 303(d) list of impaired waters requiring TMDLs and 305(b) report on the quality of the State's waters, and on November 12, 2010 the Integrated Report was approved by the US EPA.

Within the Greater Monterey County Integrated Regional Water Management (IRWM) region, 29 water bodies have been determined by the RWQCB to be impaired under Section 303(d) of the Clean Water Act. These water bodies are shown in the Greater Monterey Integrated Regional Water Management Plan (IRWMP)[3]. The 2010 California 303(d) List of Water Quality Limited Segments for water bodies within the Greater Monterey County IRWM region is also included as Appendix G of the IRWMP report, with the identified pollutants.[4]

The entire Salinas Valley Groundwater Basin, which includes four sub-basins, is listed as impaired and as only partially supporting beneficial uses due to nitrate contamination and seawater intrusion[5]. The water bodies in the lower Salinas Valley have some of the worst pollutant impairments on the Central Coast. The Lower Salinas River (from the estuary to Gonzales Road) has the most pollutant impairments identified on the 303(d) list of any other water body on the Central Coast, with 19 impairments. Second

[3] Integrated Regional Water Management Plan for the Greater Monterey County Region. Regional Water Management Group. Adopted April 2013.

[4] To see the Section 303(d) List of water bodies for all of California, go to the RWQCB's website: http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml

[5] California Regional Water Quality Control Board, Central Coast Region (RWQCB). 2002. Watershed Management Initiative Chapter (January 2002). Prepared by Alison Jones.

is Orcutt Creek in Santa Maria (Santa Barbara County) with 15 impairments, but tied for third are the Salinas Reclamation Ditch and Tembladero Slough, each with 14 pollutant impairments. In addition, the Old Salinas River Channel and Quail Creek are both listed for 11 impairments.[6] More important than the number of pollutant impairments identified are the magnitude of the problems. Each of these water segments is impaired for toxicity and high levels of pesticides, nutrients and indicator bacteria. Moss Landing Harbor, which lies at the bottom of the Salinas Reclamation Ditch (Gabilan) watershed, is listed for 10 pollutant impairments, including pesticides, toxicity, pathogens, and sediment.

1.2.3 Efforts to Improve Water Quality in the Greater Monterey Area

Both regulatory and voluntary approaches are being employed in the effort to improve water quality from agricultural sources in the region.

Regulatory

In July 2004, the Central Coast RWQCB adopted an order known as the "Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands (Irrigated Agricultural Order R3-2010-0040)." The Central Coast RWQCB extended the 2004 Agricultural Order multiple times, and on March 15, 2012 voted to adopt an updated Irrigated Lands Order (Order No. R3-2012-0011), replacing the order that was approved in 2004.[7] The 2012 Irrigated Lands Agricultural Order prioritizes conditions to control pollutant loading in area where water quality impairment is documented in the 2010 Clean Water Act section 303(d) List of Impaired Waterbodies, and specifically addresses the growing problem of nitrate contamination in the region's drinking water. The Agricultural Order mandates all growers within the RWQCB's jurisdiction who discharge runoff from irrigated agricultural lands to comply with the conditions of the Order. Dischargers are required to implement, and where appropriate update or improve, management practices, which may include local or regional control or treatment practices and changes in farming practices to effectively control discharges, meet water quality standards, and achieve compliance with the Order. Dischargers must also comply with other conditions of the Agricultural Order, including monitoring and reporting requirements. For farms that pose the greatest risk to water quality, growers are required to develop certified Irrigation and Nutrient Management Plans, Water Quality Buffer Plans if they are adjacent to the most critical creeks, and monitor their individual discharge.

The SWRCB adopted a Recycled Water Policy in February 2009, which requires local stakeholders, such as local water and wastewater entities, and members of the public to develop salt and nutrient management plans for groundwater basins. The Policy mandated completion of the salt and nutrient management plans by May 14, 2014, although it allows the Central Coast RWQCB to permit a two-year extension (until May 14, 2016) if the stakeholders demonstrate substantial progress toward completion of the plan. As of the April 2013 adoption of the IRWMP Plan, no entity has as of yet initiated the salt and nutrient management planning process within the Greater Monterey County IRWM planning region.

[6] To see the fact sheets for each of these water segments, go to the following link: http://www.waterboards.ca.gov/water_issues/programs/tmdl/2010state_ir_reports/category5_report.shtml

[7] The 2012 Irrigated Lands Agricultural Order can be viewed at: http://www.waterboards.ca.gov/centralcoast/water_issues/programs/ag_waivers/ag_order.shtml

According to a Spring 2015 publication by the Monterey County Farm Bureau[8] only 3 agencies in the Central Coast RWQCB met the May 14, 2014 date (Llagas (Southern Santa Clara), San Benito and Seaside). For the Salinas Basin, the MCWRA had not begun this plan.

The Central Coast RWQCB has included the following in the City of Salinas Stormwater Permit (RWQCB 2012d, pp. 86-87):

> b) Salt and Nutrient Management
>
> i) Within 2 years of adoption of this Order, the Permittee shall coordinate with local water and wastewater entities, together with local salt/nutrient contributing stakeholders, to fund locally driven and controlled, collaborative processes open to all stakeholders that will prepare salt and nutrient management plans for groundwater basins underlying the Permit coverage area, per State Water Board Recycled Water Policy (State Water Board Resolution No. 2009-0011).
>
> ii) Within 4 years of adoption of this Order, the Permittee shall evaluate opportunities to include a significant stormwater use and recharge component within the salt/nutrient management plan(s). At a minimum, the Permittee shall coordinate with other stakeholders to include stormwater recharge/use goals and objectives in salt and nutrient management plan(s).

When the salt and nutrient management planning effort for the Salinas Valley Groundwater Basin is initiated, either by the City of Salinas or some other entity, the Regional Water Management Group (RWMG) will be sure to coordinate that planning effort with the IRWM Plan.

Voluntary

According to the Greater Monterey IRWMP, the Agriculture and Rural Lands Action Plan (Ag Plan), developed with input from agriculture industry groups, resource agencies, and environmental groups, offers voluntary strategies for protecting water quality and the productivity of Central Coast agricultural lands through a stewardship approach. These strategies fall into six general categories: 1) identification and adoption of more effective management practices through development of industry networks; 2) expansion and coordination of technical assistance/outreach; 3) public education and public relations; 4) regulatory coordination/permit streamlining for conservation measures; 5) improved funding mechanisms and tax incentives; and 6) strategies for public lands and rural roads.

The Agriculture Water Quality Alliance (AWQA) was initiated in 1999 to carry out the strategies of the Ag Plan.[9] AWQA is a unique regional partnership that brings together farmers, ranchers, resource conservation agencies, researchers, and agricultural and environmental organizations. Since 1999, AWQA partners have worked together to reduce the runoff of sediments, nutrients, and pesticides from agricultural and rural lands through education and outreach, technical and financial assistance, research and monitoring, permit streamlining, and watershed coordination. AWQA's regional approach focuses on industry-led initiatives and voluntary, collaborative solutions to tackling water quality problems, and as such offers an important non-regulatory approach to improving water quality in the region. AWQA

[8] Monterey County Farm Bureau. Farm Focus. Spring 2015

[9] See AWQA website at: http://www.awqa.org/index.html

partners meet monthly to discuss emerging issues and coordinate projects. The process has led to improved coordination and collaboration of agencies, researchers, non-profits, and industry groups.

With a mix of federal, state, and private funding, AWQA partners have made great strides towards implementing the Ag Plan. Some examples include:

- *Watershed Working Groups*: Through AWQA, farmers and ranchers throughout the region have been establishing management practices on their properties to reduce runoff in the form of sediments, nutrients and pesticides. The Central Coast Agricultural Water Quality Coalition, which represents six County Farm Bureaus whose watersheds drain to the Sanctuary, has been organizing Watershed Working Groups comprised of agricultural landowners and managers along local streams and rivers. These groups work together to identify local water quality issues and implement conservation projects.
- *Irrigation and Nutrient Management Program*: AWQA and a broad suite of partners developed the Central Coast Irrigation and Nutrient Management Program to help farmers implement irrigation and nutrient management practices to address water quantity and water quality concerns in the region. Led by the Central Coast Resource Conservation & Development Council, AWQA has secured millions of dollars in federal financial cost-share assistance under the National Resource Conservation Service (NRCS) Agricultural Water Enhancement Program (AWEP) to support implementation of irrigation and nutrient management practices in Central Coast watersheds. These practices include irrigation system and nutrient management evaluations, improved sprinkler systems, conversion to microirrigation, and installation of flow meters, among many others. AWEP is a non-regulatory program; participation is voluntary and confidential.
- *Permit Coordination Programs*: The time, cost, and complexity of navigating the permit process with a host of regulatory agencies can be daunting for landowners seeking to implement conservation projects on their properties. To help farmers, ranchers and other rural landowners overcome these barriers and to encourage implementation of conservation and restoration projects across Sanctuary watersheds, AWQA partners have worked to develop permit coordination programs. Led by Sustainable Conservation, Resource Conservation Districts, and the Natural Resource Conservation Service, the Partners in Restoration Permit Coordination Programs help landowners to quickly and effectively obtain permits from multiple agencies, and provides technical and cost-share assistance for the installation of certain conservation practices.
- *Education and Outreach*: AWQA developed a Farm Water Quality Planning Short Course through which 70 percent of growers in the region have developed farm water quality management plans for their properties.
- *Confidential Technical and Financial Assistance*: Over the past 10 years the NRCS has assisted growers in the region to voluntarily implement conservation practices through $18M in Farm Bill support dollars, matched by $15M of farmer investment in these same practices.

1.2.4 Pajaro Valley Water Management Agency Groundwater Management Projects

The Pajaro Valley Water Management Agency (PVWMAGMP) is a neighboring water agency that deals with similar issues with groundwater contamination as MCWD. The agency must meet similar requirements as MCWD as mentioned in Section 1.2.2. Key constituents of concern for water quality in the Pajaro Valley include nitrates, salinity, sodium, toxicity from chloride and sodium, and crop pathogens, primarily phytophthora. The following projects are addressed to halt groundwater contamination and seawater intrusion, as reported in the Agency's February 2014 Basin Management Plan (BMP) update[10]

- Watsonville Recycled Water Treatment Facility.
  - Completed in 2008, this facility was designed to deliver 4,000 acre feet per year (AFY) of recycled water during the irrigation season. That amount has not been fully utilized due to insufficient supply during peak demand times (daytime summer irrigation).
  - Two million gallons of additional storage is estimated to allow an additional 750 AFY of recycled water to be supplied to meet daytime demand.
- Harkins Slough Recharge Facilities Upgrades
  - The Harkins Slough Recharge Facilities were constructed in 2002 and seasonally store wet weather flows from Harkins Slough in the shallow aquifers near the coast. The average annual yield from the extraction wells to the Coastal Distribution System[11] (CDS) was estimated to be 1,100 AFY at the time the project was constructed.
  - The goal of upgrades is to increase the project's yield of recovered water by approximately 1,000 AFY on average, in addition to the current recovered water yield of approximately 200 AFY.
- Watsonville Slough with Recharge Basins
  - The Watsonville Slough with Recharge Basins Project is planned to divert Watsonville Slough water during winter high flows from December to May. The water would be stored in the surficial groundwater aquifer at the proposed North Dunes Recharge Basin and/or at alternative locations near the existing Harkins Slough Recharge Basin (the Southeast Recharge Basin and the Monitoring Well #7 Recharge Basin).
  - The proposed project would yield approximately 1,200 AFY. The yield is lower than the maximum diversion of 2,000 AFY due to years when the maximum diversion is not possible because of water quality and flows.

[10] Pajaro Valley Water Management Agency. Basin Management Plan Update. Carollo Engineers. February 2014.

[11] The Coastal Distribution System (CDS) is the pipeline that delivers supplies from the Harkins Slough Project, Recycled Water Facility (RWF), supplemental wells for the City of Watsonville. Cost of these combined projects is over $60 million with State and federal grants paying for a majority of the project costs.

- College Lake with Inland Pipeline to the Coastal Distribution System
    - The project would increase the capacity of College Lake and send water during the summer through a new pipeline either to the Recycled Water Facility (RWF) storage tank to supply the Coastal Distribution System (CDS), or directly to the CDS, with provisions to supply inland users along the new water main pipeline.
    - The proposed project would provide a yield of approximately 2,100 to 2,400 AFY. The estimated yield includes the volume of the lake of 1,700 acre feet, plus an estimated inflow of 700 to 1,000 acre feet during the irrigation season, minus an estimated outflow of 300 acre feet to satisfy minimum flow requirements downstream for steelhead habitat.
- Murphy Crossing with Recharge Basins
    - The Murphy Crossing with Recharge Basins Project would divert water from the Pajaro River between December and May. The project includes the construction of an infiltration gallery, pump station, monitoring wells, recharge basins, and a connector pipeline from pump station to recharge basins.
    - The proposed Murphy Crossing Project would provide approximately 500 AFY.

1.2.5 MCWD Criteria for Addressing Groundwater Contamination

Water Quality Monitoring and Mitigation

MCWD's state-certified laboratory performs extensive water quality monitoring of the Marina and Ord drinking water supply. Regulations require weekly monitoring for coliform bacteria in the distribution system, which has been reported in the latest 2017 Water Quality Data. The presence of coliform bacteria may indicate the presence of disease-causing organisms. One water sample from each of five sampling sites in Marina and from each of five in Ord is collected and analyzed each week. A different set of five is analyzed each week in a month for each water system. There are a total of 20 different sample sites in Marina and 20 different sample sites in the Ord Community from which water samples are collected. Bacteriological Quality Monitoring methods are found in the Title 22, Section 64212 of the California Water Code.[12]

Chapter 14 – Water Permits
§64212. Bacteriological Quality Monitoring.

(a) A water supplier operating a state small water system shall collect a minimum of one routine sample from the distribution system at least once every three months. The sample shall be analyzed for the presence of total coliform bacteria by a laboratory certified by the State Board for bacteriological analyses pursuant to Article 3, commencing with section 100825, of Chapter 4 of Part 1 of Division 101, Health and Safety Code. The results of the analyses shall be reported to the local health officer no later than the 10th day of the month following receipt of the results by the state small water system.

(b) If any routine sample is total coliform-positive, the water supplier shall collect a repeat sample from the same location within 48 hours of being notified of the positive result. If the repeat sample is also total coliform-positive, the sample shall also be analyzed for the presence of fecal coliforms or Escherichia coli (E. coli). The water supplier shall notify the local health officer within 48 hours from

the time the results are received and shall take corrective actions as directed by the local health officer to eliminate the cause of the positive samples.

(c) A local health office may require a state small water system to sample the distribution system each month, in lieu of the requirements of subsection (a), if the system has bacteriological contamination problems indicated by more than one total-coliform positive sample during the most recent 24 months of operation. The monthly sample shall be analyzed for the presence of total coliform bacteria by a laboratory certified by the State Board for bacteriological analyses pursuant to Article 3, commencing with section 100825, of Chapter 4 of Part 1 of Division 101, Health and Safety Code. The results of the analyses shall be reported to the local health officer no later than the 10th day of the month following receipt of the results by the state small water system.

To make sure that water quality is maintained from source to delivery, MCWD's laboratory also performs weekly monitoring of general physical and chemical parameters. Each week five water samples are collected from the Marina and Ord coliform sampling sites, from the Marina and Ord source wells and from the water reservoir in Marina. The water samples are tested for color, odor, turbidity, temperature, pH, conductivity, free chlorine residual and sulfides. This is provided per Title 22 of the California Code of Regulations.[12]

Article 2 - General Requirements

§64415. Laboratory and Personnel

(b) Sample collection, and field tests including color, odor, turbidity, pH, temperature, and disinfectant residual shall be performed by personnel trained to perform such sample collections and/or tests by:

(1) The State Board;

(2) A laboratory certified pursuant to subsection (a); or

(3) An operator, certified by the State Board pursuant to section 106875(a) or (b) of the Health and Safety Code and trained by an entity in paragraph (1) or (2) to perform such sample collections and/or tests.

In addition, the Marina and Ord source wells are also tested for chloride, fluoride, nitrate, bromide and sulfate. The purpose of this monitoring is to detect any abnormal concentrations that might indicate problems within the system.

According to the Greater Monterey Integrated Regional Water Management Plan[19], the two major water quality problems affecting the Salinas Valley Groundwater Basin are nitrate contamination and seawater intrusion. Nitrate contamination in the Salinas Valley is due primarily to use of nitrogen-based synthetic fertilizers for irrigated agriculture, and commonly occurs in the unconfined and semi-confined aquifers that underlie areas of intense agricultural activity. There are many wells in the Salinas Valley that have tested high above the MCL requirement of 10 mg/L, but according to the 2016 MCWD Annual Consumer Confidence Report[1], MCWD's low to high range was between non detect and 5.8 mg/L. It is worth noting that nitrate contamination can also be caused from septic system failures, from wastewater treatment ponds located in floodplains that convey sewage during flood events, and from livestock waste.

[12] California Regulations Related to Drinking Water. TITLES 17 AND 22 of the California Code of Regulations. Last updated September 23, 2016.

When in operation, the State requires MCWD to monitor water quality at different stages of the Marina Desalination Plant treatment processes. Water samples are collected from the ocean (Monterey Bay), at the plant's seawater intake well and from its finished product water on a daily, weekly, monthly and quarterly schedule. Water samples are tested for coliform organisms, free chlorine residual, pH, turbidity, conductivity, total dissolved solids, temperature, chloride, sulfate, alkalinity, hardness and corrosive index. This monitoring program ensures that the desalination plant is operating properly and is producing water that meets or exceeds state and federal standards. As mentioned in Section 1.3, this plant is not currently in operation.

MCWD monitors for compliance of over 110 constituents in drinking water in varying schedules. Many of these constituents are naturally occurring substances. The Marina and Ord source wells, Marina's reservoir and the desalination plant are tested for general minerals such as calcium, magnesium, hardness; inorganic chemicals such as arsenic, chromium and other metals; organic chemicals such as solvents, pesticides and herbicides; radioactivity including radon; asbestos and other chemicals that are still not regulated and have no state or federal standards. Regulations also require that MCWD test for disinfection (chlorination) by-products such as total trihalomethanes and haloacetic acids in the distribution system. Lead and copper are tested from indoor water samples to check if materials used in home or building plumbing contribute to levels of lead and copper.

Fort Ord Mitigation for Groundwater Contamination

The former Fort Ord was identified by the U.S. Environmental Protection Agency (EPA) as a National Priority List federal Superfund site on the basis of groundwater contamination discovered on the installation in 1990. The facility was listed "fenceline to fenceline," covering all 28,000 acres. Initial investigations pinpointed 39 sites of concern in addition to two Operable Units (the Fritzsche Army Airfield Fire Drill Pit and the Fort Ord landfill) which had been investigated during the 1980s. The sites of concern included motor pools, vehicle maintenance areas, dry cleaners, sewage treatment plants, firing ranges, hazardous waste storage areas, and unregulated disposal areas. An additional two sites were added during the investigation process: one, a defueling area located at Fritzsche Army Airfield; the other, a fire drill burn pit in East Garrison. In all, 43 sites were investigated.[13]

MCWD continues to monitor the affected well, and all other wells, for TCE and other contaminants on a regular basis. Any changes in contaminant plume migration due to increased MCWD pumping will be monitored and appropriate actions taken. MCWD maintains close coordination with the U.S. Army Corps of Engineers, who manages groundwater cleanup efforts on the former Fort Ord. The Corps of Engineers recently published an update to their mitigation program in February 2017, which provides a current and historical extent of the groundwater contamination, depicted in Figure 2.

[13] www.fortordcleanup.com

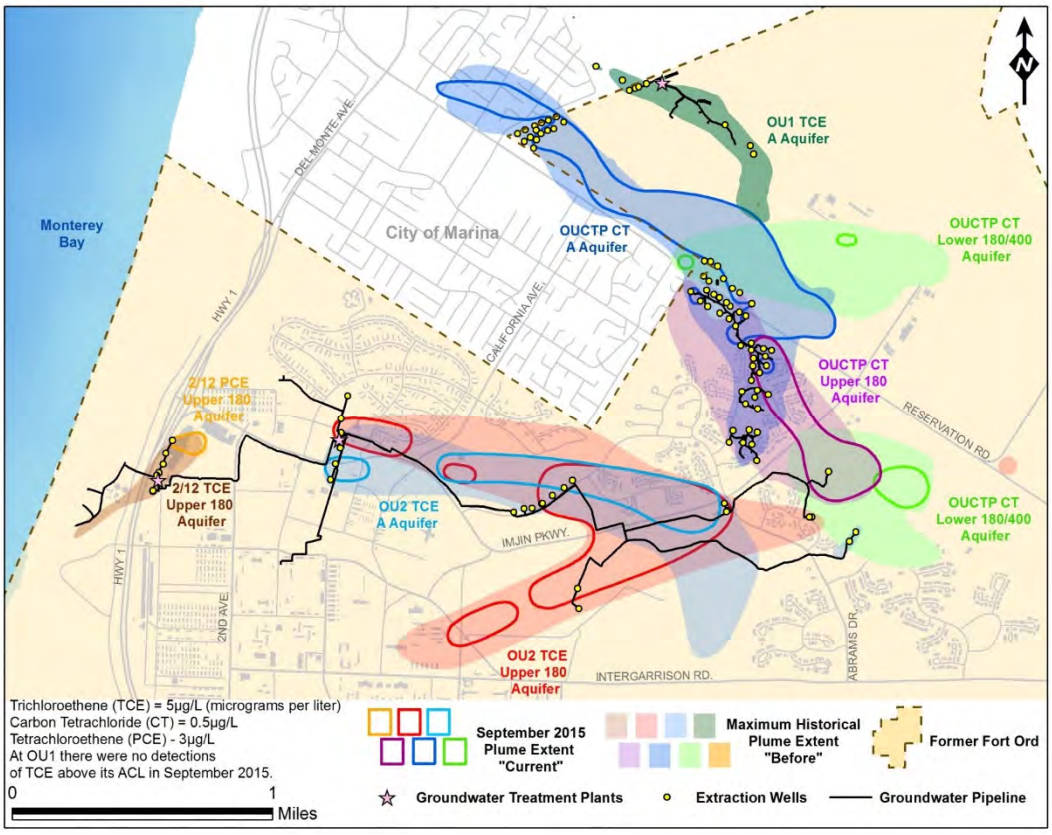


Figure 2 – Groundwater Contamination Plume[14]

The following groundwater plume contamination sites depicted in Figure 2 are described below.

- **OU1 -** Groundwater at this site was contaminated by former fire-fighting training in an area near the Marina Municipal Airport. Training ceased in 1985. The primary chemical of concern was Trichloroethyene (TCE), an industrial solvent used for degreasing, dry cleaning, and cleaning of mechanical parts. Contaminated soil was removed in 1988, and as of September 2014, all sampling results from monitoring wells have been below the Aquifer Cleanup Level (the cleanup goal for a COC in groundwater identified in a Record of Decision, typically the same as the MCL or lower). Groundwater treatment has ceased. Evaluation for site closeout is in progress.
- **OU2** - A landfill southwest of the intersection of Imjin Parkway and Abrams Road caused groundwater contamination. An impermeable cover placed over the landfill now prevents rainwater from draining through the buried materials. A gas extraction and treatment system removes methane gas and chemicals of concern. Groundwater extraction for TCE, the main chemical of concern, from the A-Aquifer and the Upper 180-Foot Aquifer and treatment with Granular Activated Carbon began in 1995. The plume has shrunk significantly, and to optimize cleanup, the treatment

[14] Source: Community Involvement Workshop Information – Fort Ord Groundwater. February 2017

plant will be relocated nearer to the center of the plume. Relocation construction activities are in progress.

- **Sites 2/12** – A former maintenance facility in the current location of "The Dunes on Monterey Bay" shopping center (south of Imjin Parkway and east of Highway 1) caused groundwater contamination from improperly disposed solvents. Contaminated soil was removed in the 1990s. Tetra Chloroethene (PCE) and TCE are primary chemicals of concern. Groundwater extraction and treatment with Granular Activated Carbon began in 1999 and is ongoing. The army also used a cleanup method called in-situ biodegradation. Treatment by soil vapor extraction has been added to enhance groundwater remediation and shorten cleanup time.
- **OUCTP** - Groundwater located north of Imjin Parkway and Abrams Road and along Reservation Road was contaminated by improperly disposed solvents. Carbon Tetrachloride (CT) is the primary chemical of concern and cleanup includes enhanced *in situ* bio-remediation (A-Aquifer), groundwater extraction and treatment with Granular Actived Carbon (Upper 180-Foot Aquifer), and monitored natural attenuation (with well-head treatment as a contingency measure) (Lower 180-Foot Aquifer). Remediation began in 2009 for the A-Aquifer and in 2011 for the Upper and Lower 180-Foot Aquifers. Additional enhanced *in situ* bioremediation is currently underway.

State and federal safe drinking water MCL standards for TCE are set at 5.0 parts per billion, or approximately ten times higher than detected. Detection of TCE, even at the low concentration levels, was reported by MCWD, as required by law, to the California Department of Public Health (DPH). No additional action was deemed necessary by DPH because the concentration levels are well below the MCL of 5.0 parts per billion. Both MCWD and the Army regularly monitor the former Fort Ord wells to assess concentration changes. The 2015 TCE detections in the Ord Community wells ranged from non-detect to 1.8 parts per billion[15]. TCE detections have been intermittent since the initial detection in 2001.

The Defense Department is required by law to clean up contamination to below allowable contaminant levels set by the State Department of Public Health as a public health protection measure. Groundwater samples are taken quarterly and compiled in annual status reports. Additionally, all data is summarized in documents known as five-year reviews.

The Army will continue to treat known contaminated groundwater sites until the chemicals of concern are at or below the accepted contamination levels. Due to the amount of water that must be pumped and treated, the concentrations of contaminants decline slowly over time. As of February 2017, OU1 has met its ACLs and Site 2/12 is expected to meet the Accepted Contaminant Level in the next few years. Removal of sufficient contamination to meet Accepted Contaminant Levels at OUCTP could take up to 20 years and at OU2 it could take up to 30 years. Additional information on groundwater cleanup and other base contamination remediation actions can be found at www.fortordcleanup.com.

Because Fort Ord is on the National Priority List, section 9604(i) of the federal Superfund law (Comprehensive Environmental Response Compensation and Liability Act, or "CERCLA") requires the federal Agency for Toxic Substances and Disease Registry ("ATSDR") to complete an assessment of whether any hazardous substances at the site pose a threat to human health. ATSDR analyzed whether

[15] EPA test method 524.2 is accurate to +/- 20%.

hazardous substances released at Fort Ord might threaten human health by contaminating drinking water wells serving Marina and Ord Community. ATSDR's final health assessment[16] concludes as follows:

- There are no detections of groundwater contaminants at levels of health concern in the presently "active" drinking water wells on Ord Community. The water at Ord Community is safe to drink. Because the drinking water wells currently in use in the Ord Community are located far from sources of contamination, drilled to deep aquifers that are not likely to be contaminated, and monitored regularly, the Ord Community's drinking water supply should be safe to drink in the future.
- Because the concentration of groundwater contamination detected in the past in the Ord Community and Marina drinking water wells was low and the duration of exposure was short, adverse health effects will not likely result.
- The water supplied by drinking water wells presently used by Marina is safe to drink. Further, because Marina's drinking water wells are drilled to deep aquifers and the quality of the water is monitored regularly, Marina's drinking water should be safe to drink in the future.
- Additional Mitigation for Groundwater Contamination
- Groundwater from the Marina and Ord water supply wells is disinfected with chlorine as a safeguard against microorganisms. In Marina, chlorine is also used to treat the naturally occurring sulfides at Well 12 (See Figure 1) that can cause odors.

In July 2001, the California Department of Public Health (CDPH) completed a source water assessment of each groundwater supply well in Central Marina, which concluded they are most vulnerable to historic waste dumps, landfill activities and military installations.

For the Ord Community, in February 2002, a source water assessment was completed for each groundwater supply well. The assessment determined that the wells are most vulnerable to known volatile organic contaminant plumes from the closed landfill on the former Fort Ord, as well as to saltwater intrusion, sewer collection system, above ground storage tanks, irrigated crops, transportation corridors, farm machinery repairs and septic systems. In November 2012, a completed source assessment for Watkins Gate well (Well 35) determined the well to be most vulnerable to groundwater contamination from Military Installations. In February 2014, a completed assessment for Well 34 determined the well most vulnerable to Military installations (former Fort Ord), agricultural drainage, salt water intrusion, and sewer collection systems.

1.3 Saltwater Intrusion

While sufficient production capacity (versus water availability) can be provided to meet the projected ultimate demand within MCWD's service areas, there is concern that seawater intrusion may eventually

[16] See ATSDR Public Health Assessment, Fort Ord, Marina, Monterey County, California (Community Health Concerns and Potential Pathways of Exposure).

degrade water quality in the Marina Area Subbasin where MCWD's wells are located and render all or a number of them unfit for domestic water supplies without further treatment, such as desalination.

1.3.1 Current and Predicted Conditions

It is estimated that the Salinas Valley Groundwater Basin has an average annual non-drought overdraft of approximately 50,000 acre feet (AF)[17], though during the last drought the annual overdraft was estimated at 150,000–300,000 acre-feet/year (AFY)[18]. As a result of this consistent overdraft, groundwater levels in the Salinas Valley Groundwater Basin have dropped below sea level, allowing seawater to intrude from Monterey Bay into aquifers located 180 and 400 feet below ground surface. The East Side and Pressure Subareas of the Salinas Valley Groundwater Basin are most impacted by overdraft (MCWRA 1997). The East Side and Pressure Subareas of the Salinas Valley Groundwater Basin are the most impacted by lack of recharge.

Seawater intrusion into 180-Foot and 400-Foot aquifers was identified along the coast over 50-years ago. The areas of seawater intrusion may be tracked using chloride concentration. A chloride concentration of 500 milligrams per liter (mg/L) is the upper California Department of Public Health Secondary Drinking Water Standard for chloride (250 mg/L is recommended) and is used as a measure of impairment of drinking water (water above 500 mg/L may still be suitable for non-potable uses). The line of chloride concentration (isohaline) of 500 mg/L water is used as the basis for determining the seawater intrusion front as shown on Figure 3 and Figure 4. Wells within the intruded areas were progressively moved further inland or into deeper aquifers. Note that these maps trace the timing and location of the "intrusion front" and do not reflect the current condition of groundwater behind the intrusion front.

The Greater Monterey Integrated Regional Water Management Plan identifies that while basin overdraft conditions are expected to improve by the year 2030, recent groundwater modeling (from the Salinas Valley Integrated Ground and Surface Water Model, or SVIGSM) predicts seawater intrusion to continue to worsen, though at a decreased rate. The SVIGSM modeling did not take into account, however, expected sea level rise due to climate change.[19]

Sea level rose approximately seven inches (18 cm) over the past century (1900–2005) along most of the California coast[20]. Currently, the State of California is using estimates of global sea level rise produced by Rahmstorf (2007)[21] and Cayan et al. (2008)[20] for coastal adaptation planning purposes. These projections suggest possible sea level rise of approximately 14 inches (36 cm) by 2050 and up

[17] California Water Service Company (Cal Water). 2010 Urban Water Management Plan, King City District. Adopted June 2011.

[18] California Water Service Company (Cal Water). 2010 Urban Water Management Plan, Salinas District. Adopted June 2011.

[19] Integrated Regional Water Management Plan for the Greater Monterey County Region. Regional Water Management Group. Adopted April 2013.

[20] Cayan, D., P. Bromirski, K. Hayhoe, M. Tyree, M. Dettinger, and R. Flick. 2008. Climate change projections of sea level extremes along the California coast. Climatic Change, 87(0), 57-73.

[21] Rahmsotrf, S. 2001. A semi-empirical approach to projecting future sea-level rise. Science, 315(5810), 368-370.

to approximately 55 inches (140 cm) by 2100. Sea level rise will significantly increase the pressure of saltwater on the coastal Salinas Valley Groundwater Basin aquifers, causing increased seawater intrusion in critical groundwater supplies.

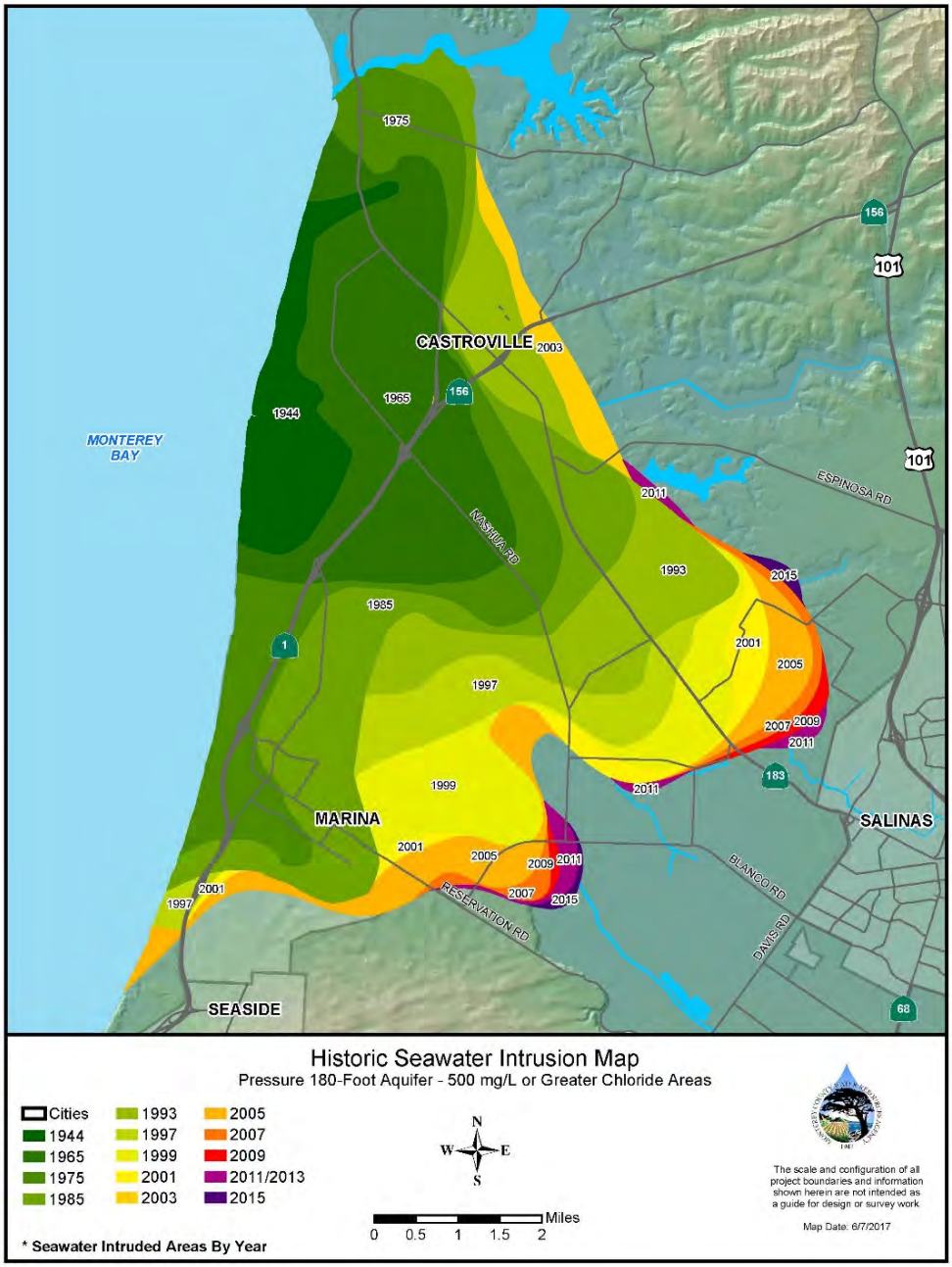


Figure 3 - Historic Seawater Intrusion in the 180-ft Aquifer[22]

[22] Source: MCWRA website

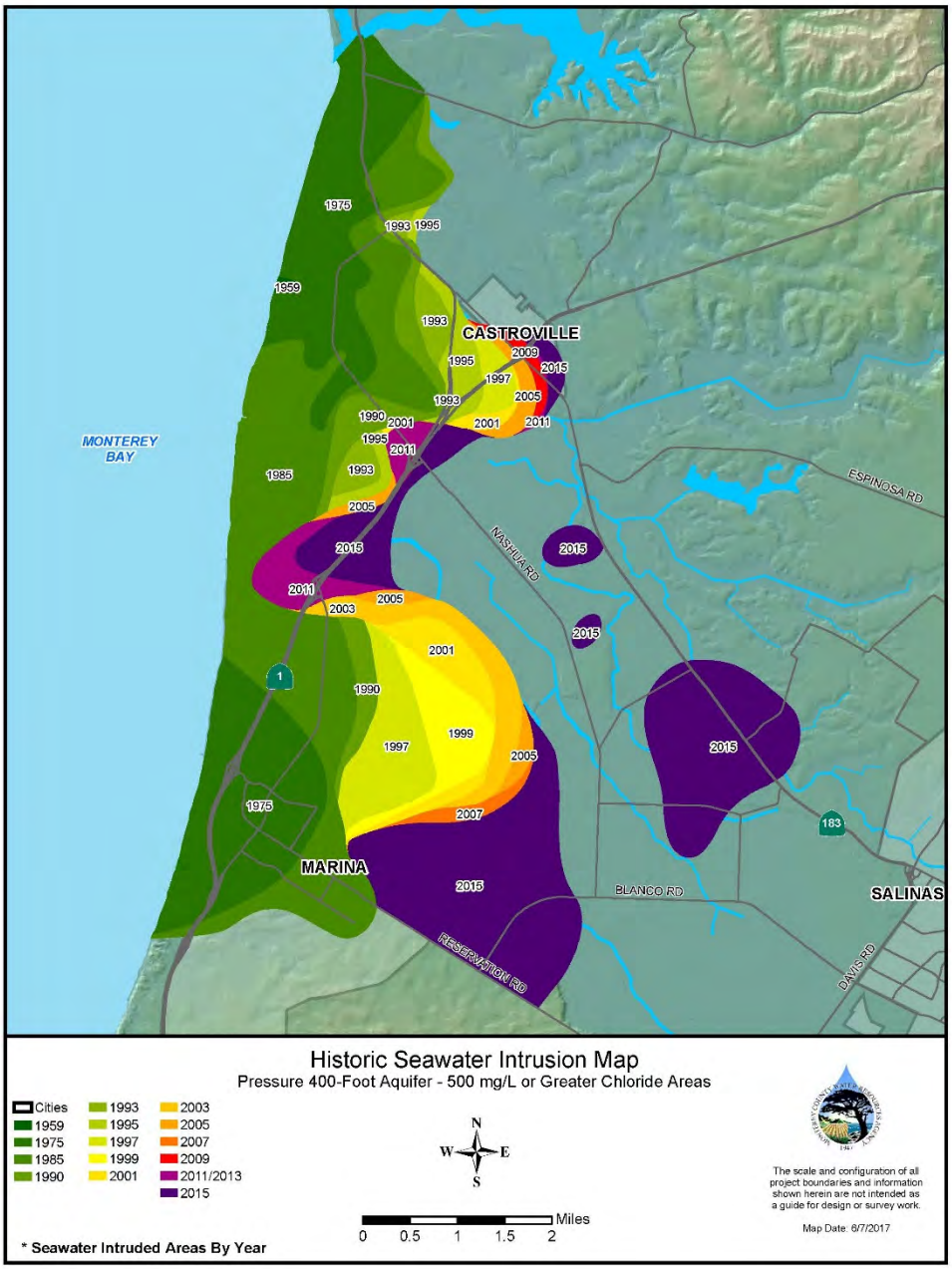


Figure 4 - Historic Seawater Intrusion in the 400-ft Aquifer[23]

Historically, MCWD supplied its Marina service area with water from 11 wells (MCWD-1 through MCWD-9, and two replacement wells) screened in the 180-Foot and 400-Foot aquifers. According to September 2017 groundwater trends[24], the Pressure 180-Foot Aquifer depth to water was 58 ft, up 11 ft since the

[23] Source: MCWRA Website

[24] Monterey County Water Resource Agency. Quarterly Salinas Valley Water Conditions. September 2017.

previous year and down 6 ft from 1985. At the Pressure 400-Foot Aquifer, the depth to water was 49 ft, up 8 ft since the previous year and up 7 ft since 1985. Between 1960 and 1992, some of those wells indicated varying degrees of seawater intrusion and were replaced, first moving from the 180-Foot aquifer to the 400-Foot aquifer, and later moving to the Deep Aquifer, a 900 foot aquifer that MCWD has used to replace groundwater in the shallower aquifers. The District currently has three Central Marina wells in the Deep Aquifer, MCWD-10, MCWD-11 and MCWD-12, constructed in 1983, 1986 and 1989 respectively. These wells are depicted in Figure 1.

The U.S. Army's original wells serving the former Fort Ord were located in the Main Garrison area near Marina. When wells indicated varying degrees of seawater intrusion, the Army in 1985 installed four wells further inland. Located near the intersection of Reservation and Blanco Roads in Marina (Figure 1), the wells draw from the 180-Foot and 400-Foot Aquifers (well numbers FO-29, FO-30, FO-31 and FO-32). Well FO-32 suffered a screen failure and was shut down in the late 1990s. The District added Wells 34 (in the Deep Aquifer) and Well 35 (in the 400-ft Aquifer) in 2011.

Ongoing monitoring by MCWRA indicates that the seawater intrusion front continues to migrate inland, particularly in the 180-Foot Aquifer, but groundwater conditions behind the front appear to be improving in some areas south of the Salinas River. Based upon the information available at the time, MCWD's 2007 Water System Master Plan[25] identified the need for a phased replacement of wells in the threatened area. Additional data on the migration and extent of seawater contamination can be found in the Final Report Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina, Salinas Valley California, April 2001.[26]

Recent investigations being conducted in and around the North Marina Area as part of the Monterey Peninsula Water Supply Project[27] The Monterey Peninsula Water Supply Project (MPWSP) would include a 9.6 million gallon per day (mgd) desalination plant and facility improvements to the existing Seaside Groundwater Basin ASR system to secure water supplies for the approximately 40,000 customers in CalAm's Monterey District service area. The project has identified an occurrence of freshwater within the shallow dune sand aquifer and the underlying 180-Foot aquifer within the area delineated as first experiencing seawater intrusion between 1975 and 1985. Water level data from wells in the shallow dune sand aquifer appear to show protective water levels that are sufficiently above sea level to prevent seawater intrusion in the shallower sediments. This condition, combined with the reduction in pumping in the 180-Foot aquifer in the North Marina Area, appears to have slowed seawater intrusion in this portion of the coastline. Water quality test results for chloride concentrations in the Dune Sand (A-Aquifer) and the 180-Foot Aquifer zones is shown in Figure 5.

[25] Carollo Engineers, Marina Water Systems Master Plan, February 2007.

[26] Final Report, Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina, Salinas Valley, California, prepared by Harding ESE, April 2001

[27] State of California Public Utilities Commission. Monterey Peninsula Water Supply Project Description. http://www.cpuc.ca.gov/Environment/info/esa/mpwsp/PD.html 1/12/2017

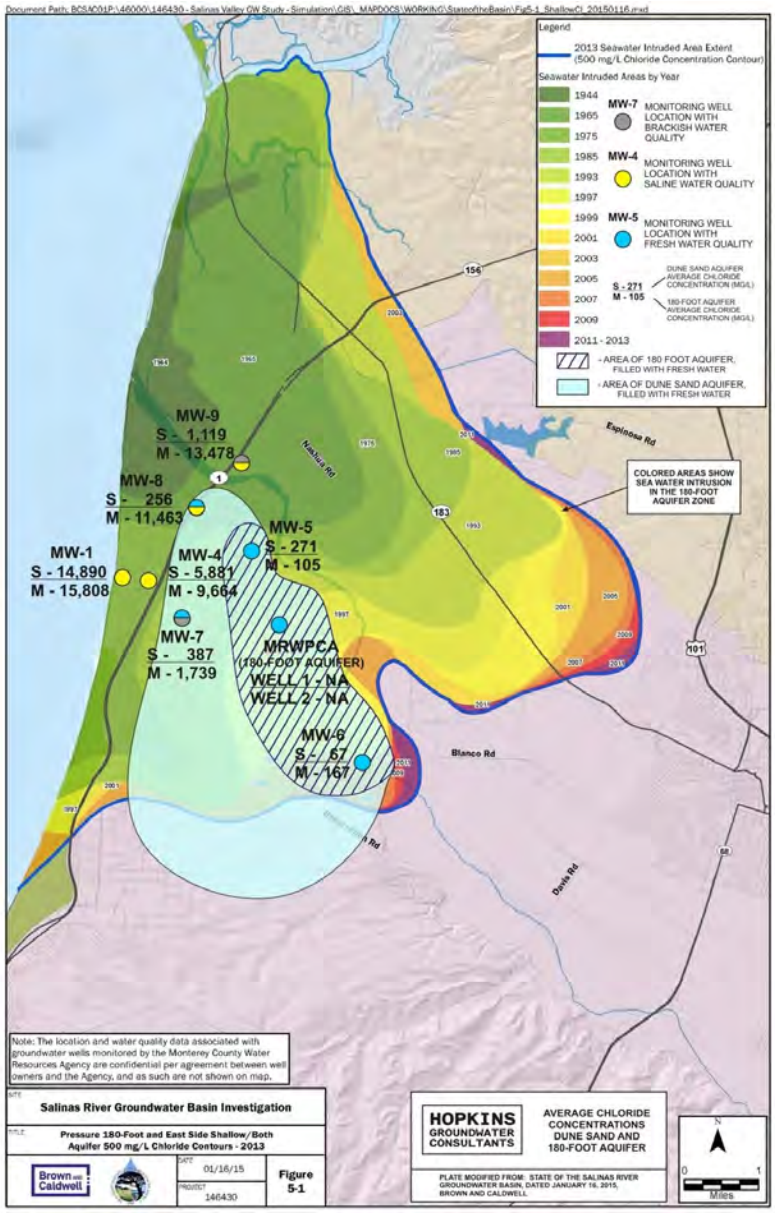


Figure 5 –Dune Sand Aquifer and 180-Foot Aquifer Chloride Concentration Data[28]

This recent data may suggest a change of groundwater conditions in this coastal section of the 180-Foot Aquifer or they may just reveal the groundwater conditions in an area previously lacking in data. While the freshwater in this area contains salts and nutrients that are derived from overlying land uses that include agriculture, landfill, and wastewater treatment plant and composting facilities, the chemical character is not sodium chloride, which is indicative of seawater. Instead, the chemical character of groundwater in these new wells is calcium chloride and calcium bicarbonate[28]. Future use of this area for a potable groundwater supply may be unlikely; however, these conditions do show a retardation of

[28] Hopkins Groundwater Consultants. North Marina Area Groundwater Data and Conditions. May 26, 2016

seawater intrusion in these shallower aquifer zones in this coastal portion of the Salinas Valley Groundwater Basin, which provides some protection for inland uses of the 180-Foot Aquifer.

There is some concern that the Deep Aquifer may become affected by seawater intrusion. MCWD operates a monitoring well installed between the Monterey Bay and the Marina production wells. That monitoring well serves as an early warning system to identify any seawater intrusion that might later affect MCWD's production wells, located further inland. Once identified, MCWD can install or begin operating one or more back-up wells to replace any potential future loss of production capacity.

It should be noted that water from the deep wells contains acceptable levels of chloride and total dissolved solids, which should not be misinterpreted as a sign of seawater intrusion. This natural salinity does not prevent the use of this water for municipal demands. The levels of chloride (average 99 mg/L) and total dissolved solids (average 386 mg/L) have not increased in the 25 years MCWD has operated the deep wells.

Another concern is that the Deep Aquifer may be connected to, and affect seawater intrusion in, the upper aquifers. Preliminary findings regarding the Deep Aquifer in the Ord Community area indicate that there is some vertical connectivity between the Deep Aquifer and the overlying aquifers. According to the Deep Aquifer Investigative Study, WRIME, May 2003, increased pumping of the Deep Aquifer would be expected to increase the rate of seawater intrusion in the middle and upper aquifers, but to a lesser extent than if the increased pumping occurred in the middle or upper aquifers. In that report, WRIME modeled the effect of increasing groundwater pumping from the Deep Aquifer by two to five times the baseline rate of 4,800 AFY. The model predicted that, in the absence of other actions to control seawater intrusion, the landward flow of groundwater would increase as a result.

1.3.2 MCWRA Recommendations to Minimize Seawater Intrusion

In October 2017, MCWRA released a special report of recommendations to prevent Seawater Intrusion in the Salinas Valley Groundwater Basin.[29] In this report, staff made six recommendations with the aim to slow or halt seawater intrusion in the Salinas Valley Groundwater Basin. In no particular order of priority, the following recommendations were:

1) An immediate moratorium on groundwater extractions from new wells in the Pressure 400-Foot Aquifer within an identified Area of Impact (See Figure 6), except for the following use categories:

    a. Wells operating under the auspices of the Castroville Seawater Intrusion Project (CSIP).

    b. Monitoring wells owned and maintained by the Agency or other water management agencies.

[29] MCWRA. Recommendations to Address the Expansion of Seawater Intrusion in the Salinas Valley Groundwater Basin. October 2017. Special Report Series 17-01.

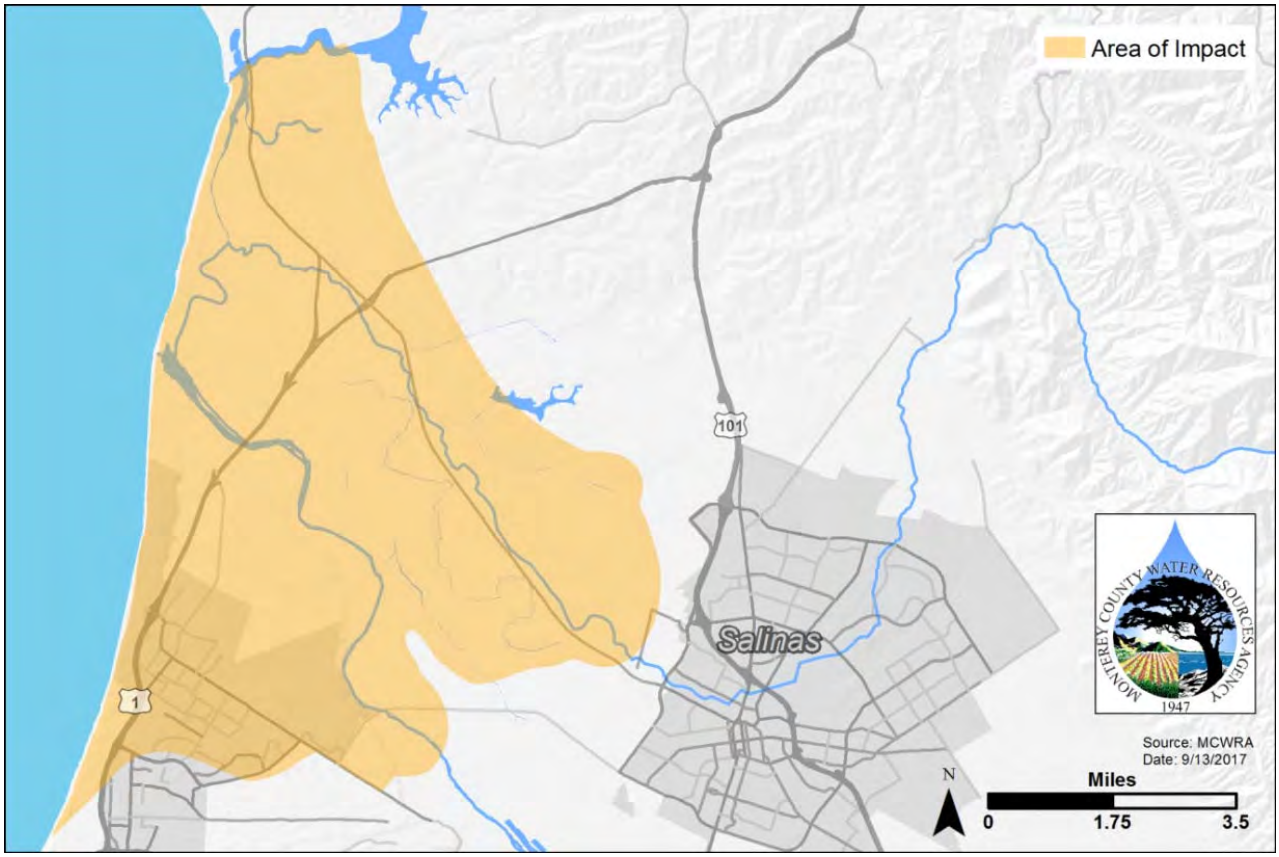


Figure 6 –Saltwater Intrusion Area of Impact[29]

2) Enhancement and expansion of the CSIP Service Area. The expansion should include, at a minimum, lands served by wells currently extracting groundwater within the Area of Impact.

3) Following expansion of the CSIP Service Area, termination of all pumping from existing wells Pressure 180-Foot or Pressure 400-Foot Aquifer wells within the Area of Impact, except for the following use categories:

   a. Municipal water supply wells;

   b. Wells operating under the auspices of the Castroville Seawater Intrusion Project;

   c. Monitoring wells owned and maintained by MCWRA or other water management agencies.

4) Initiate and diligently proceed with destruction of wells in Agency Zone 2B, in accordance with MCWRA Ordinance No. 3790, to protect the Salinas Valley Groundwater Basin against further seawater intrusion.

Figure 7 gives a map of wells prioritized for termination in the CSIP area.

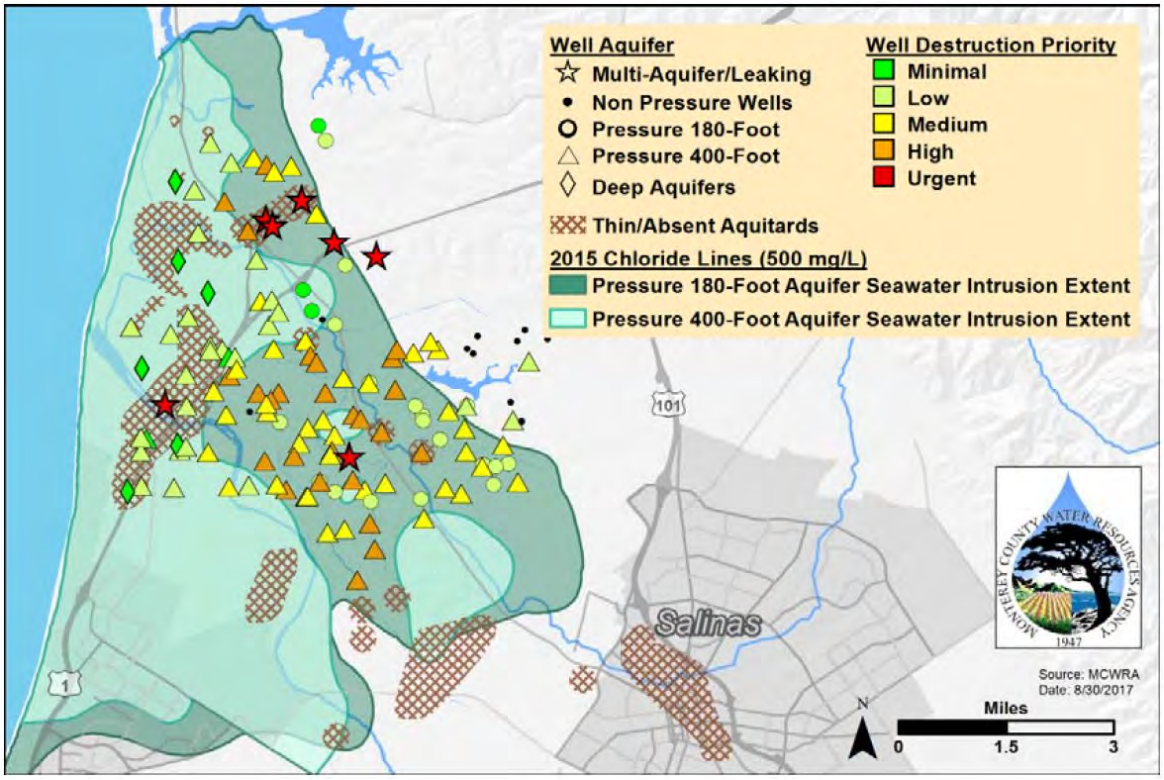


Figure 7 – Map of Wells Prioritized for Destruction in the Castroville Seawater Intrusion Project Service Area[29]

5) An immediate moratorium on groundwater extractions from new wells within the entirety of the Deep Aquifers below the 180/400 Foot Aquifer and Monterey Subbasins until such time as an investigation of the Deep Aquifers is completed and data pertaining to the hydraulic properties and long-term viability of the Deep Aquifers are available for knowledge-based water resource planning and decision making.

   a. Monitoring wells, public agency wells, municipal water supply wells, wells for which a construction permit has already been issued, and well repairs should be considered for exemption from this recommendation.

   b. The moratorium should include a prohibition of:

      i. Replacement wells, unless it can be demonstrated that the installation of such a well will not result in further expansion of the seawater intrusion front.

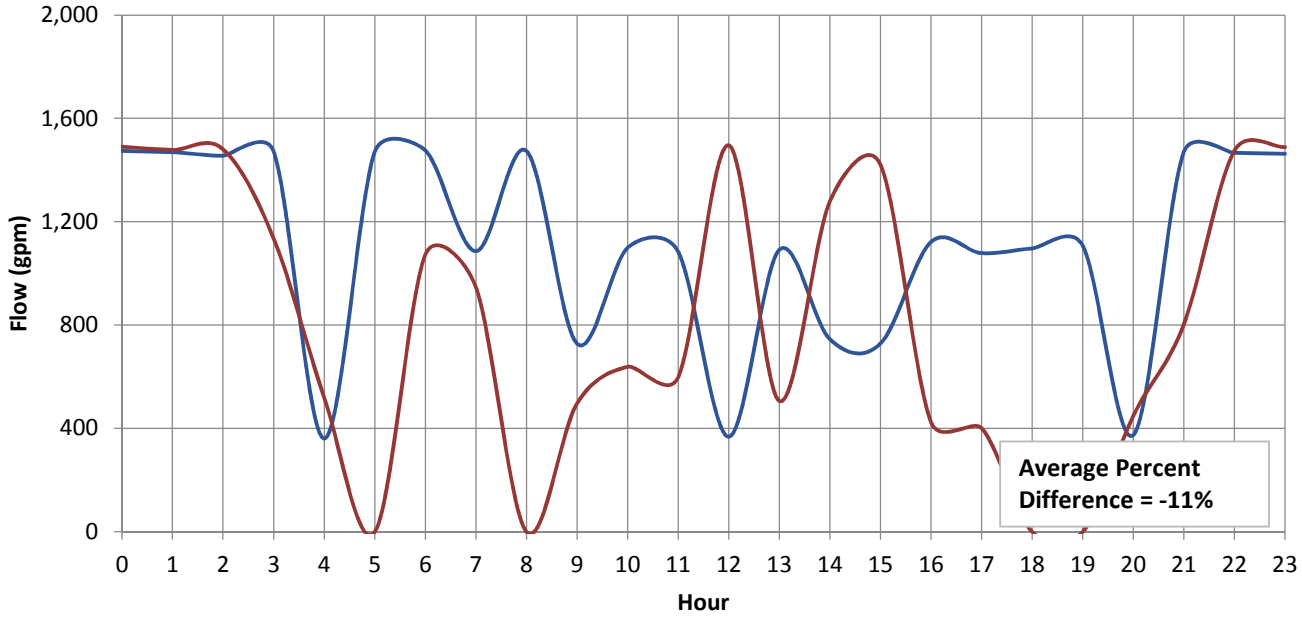
      ii. Deepening of wells from overlying aquifers into the Deep Aquifers, deepening of wells within the Deep Aquifers, and other activities that would expand the length, depth, or capacity of an existing well.

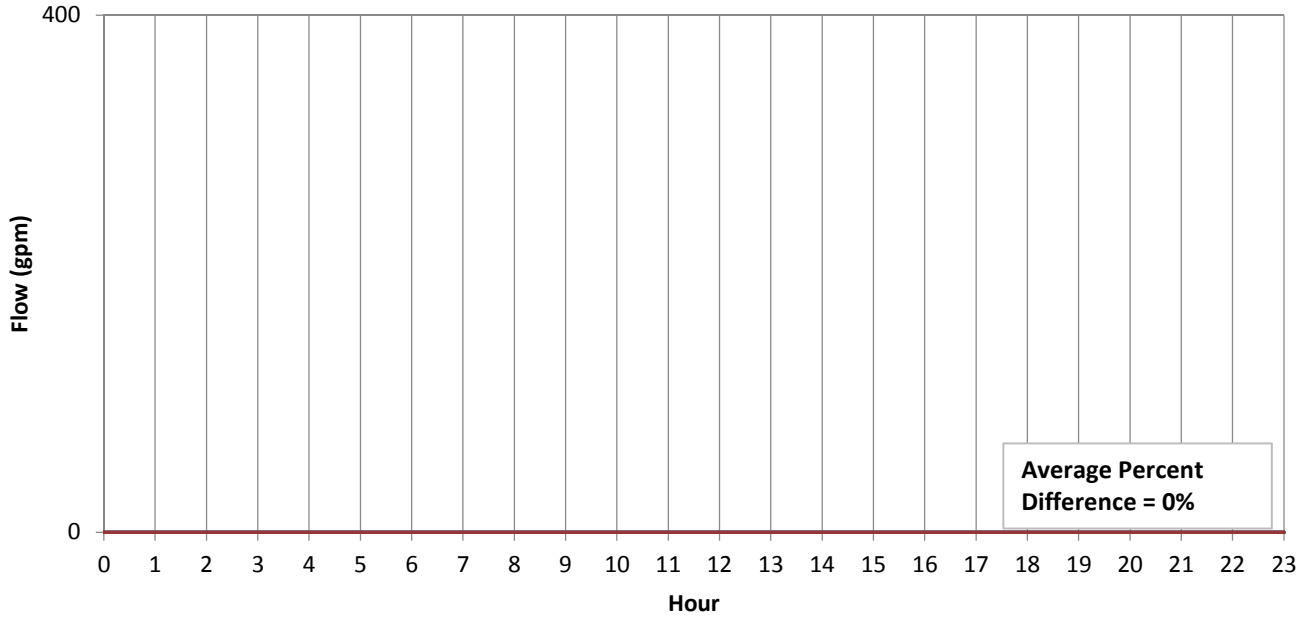
6) Initiate and diligently proceed with an investigation to determine the hydraulic properties and long-term viability of the Deep Aquifers.

7) MCWD is fully cooperating with the MCWRA's program to actively manage and protect the long-term availability of the Salinas Valley groundwater resource. Existing management efforts, reviewed above, include the successful implementation of the CSIP and implementation of the annexation agreements that limit groundwater pumping and provide assessment revenue supporting MCWRA's activities to augment basin water supplies. Those activities include ongoing operation of Nacimiento and San Antonio reservoirs to maximize groundwater recharge through dry-season storage releases that percolate through the Salinas River's streambed. As described in more detail in Section 2.1.4 (references separate deliverable Water Supply and Storage Evaluation) those activities also include the MCWRA's development, approval and implementation of the Salinas Valley Water Project. Implementation of the Sustainable Groundwater Management Act (SGMA) will also better focus groundwater management activities in the Marina Area Subbasin and the adjoining North Marina Area of the 180/400 Foot Aquifer Subbasin.

APPENDIX B

Hydraulic Model Calibration





LEGEND

SCADA

Hydraulic Model

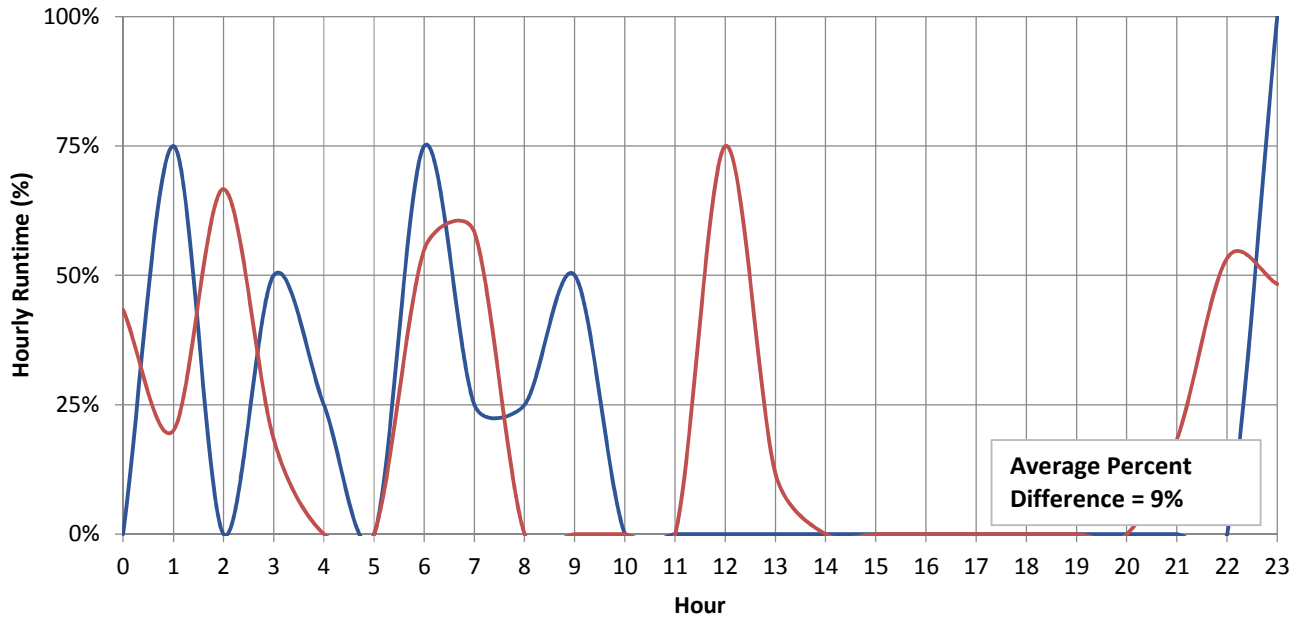
PRELIMINARY

December 5, 2017

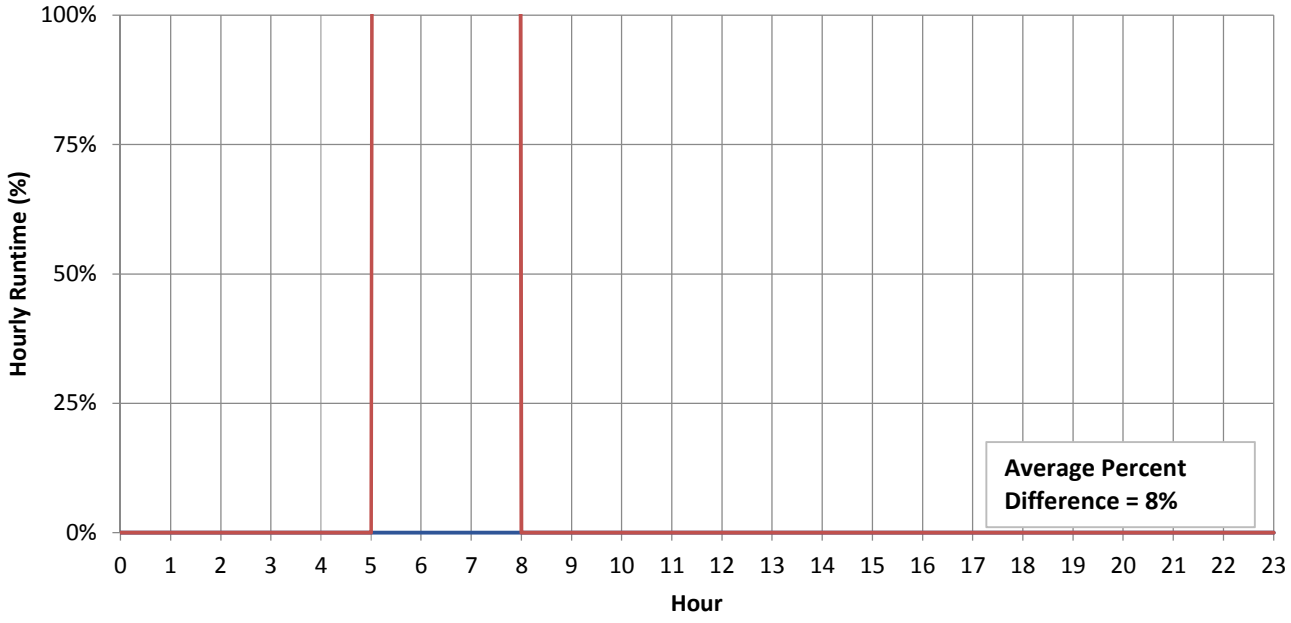
Figure 1
Well Calibration
Water System Master Plan
Marina Coast Water District

AKEL ENGINEERING GROUP, INC.

Well 29 - On/Off



Well 30 - On/Off



LEGEND

SCADA

Hydraulic Model

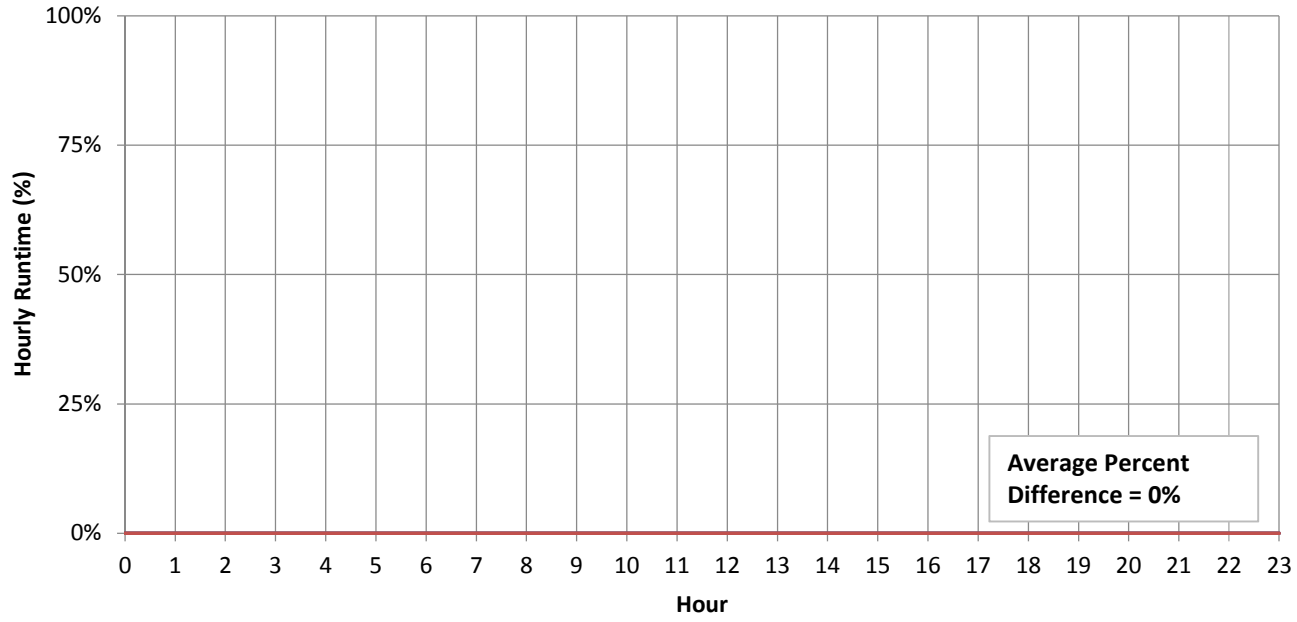
PRELIMINARY

December 5, 2017

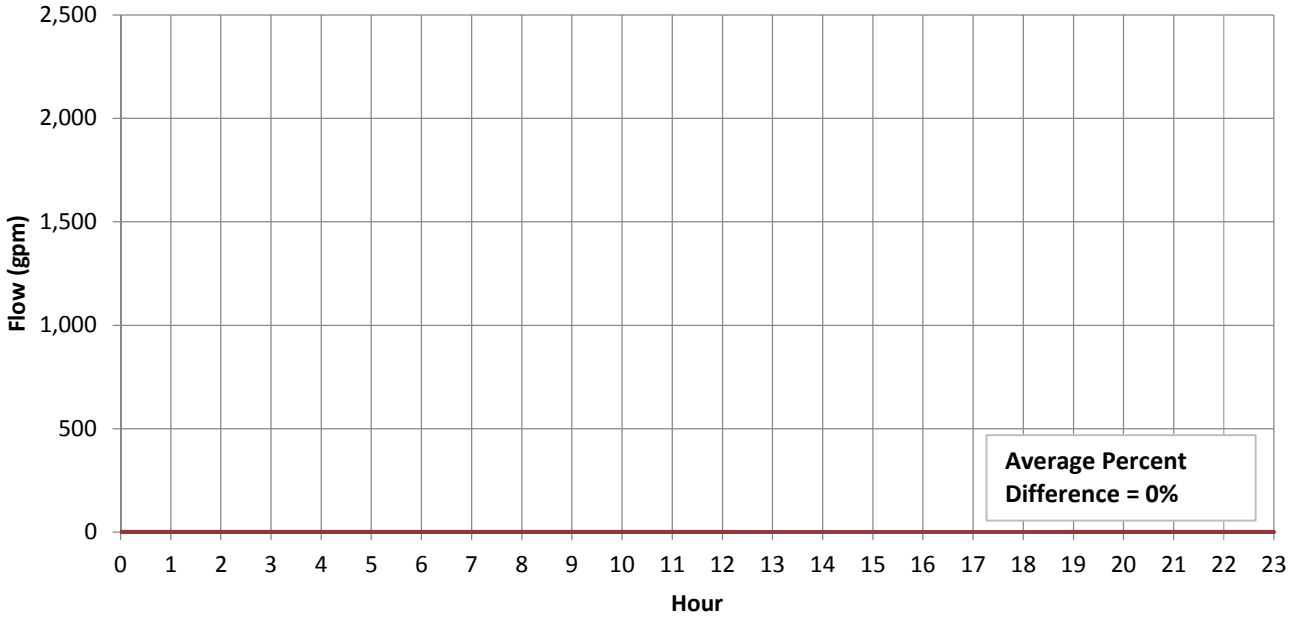
Figure 2
Well Calibration
Water System Master Plan
Marina Coast Water District

AKEL ENGINEERING GROUP, INC.

Well 31 - On/Off



Well 34 - Flow



LEGEND

SCADA

Hydraulic Model

PRELIMINARY

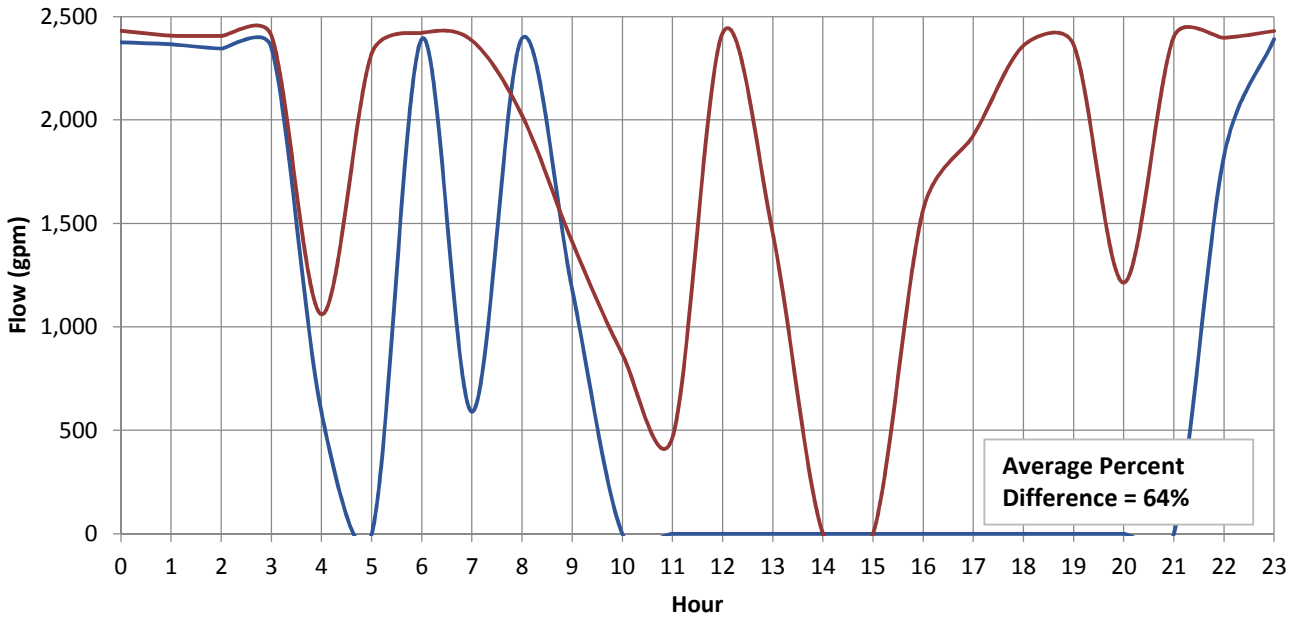
December 5, 2017

Figure 3
Well Calibration

Water System Master Plan

Marina Coast Water District

AKEL ENGINEERING GROUP, INC.



LEGEND

SCADA

Hydraulic Model

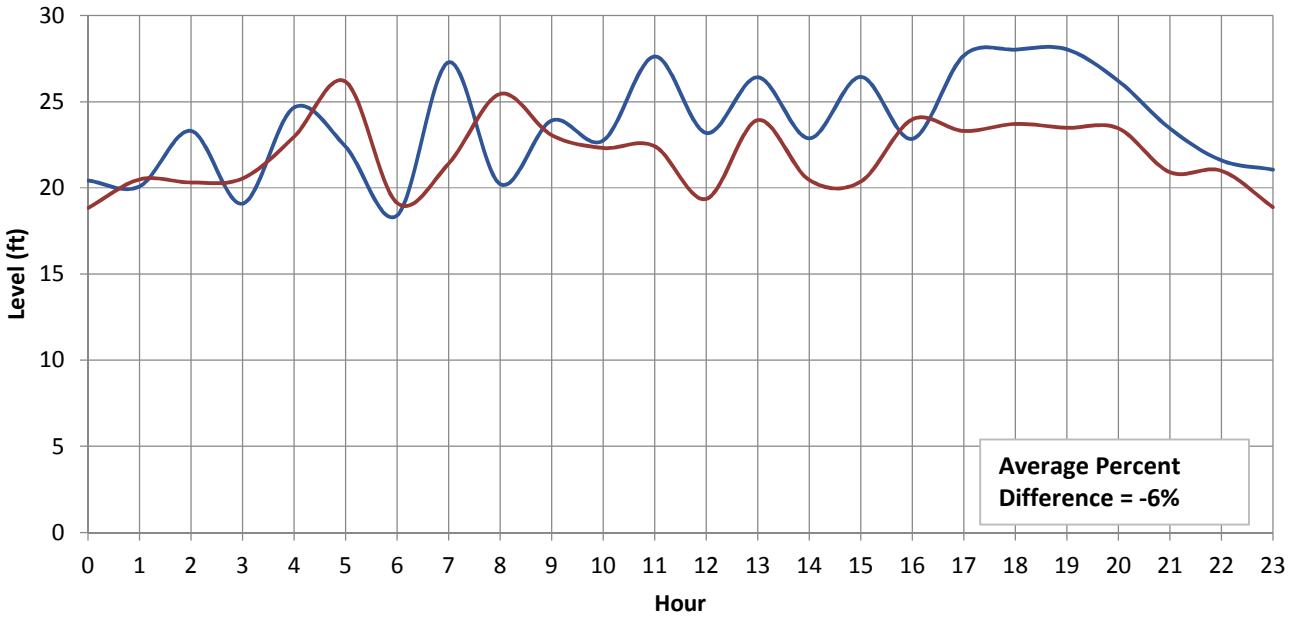
PRELIMINARY

December 5, 2017

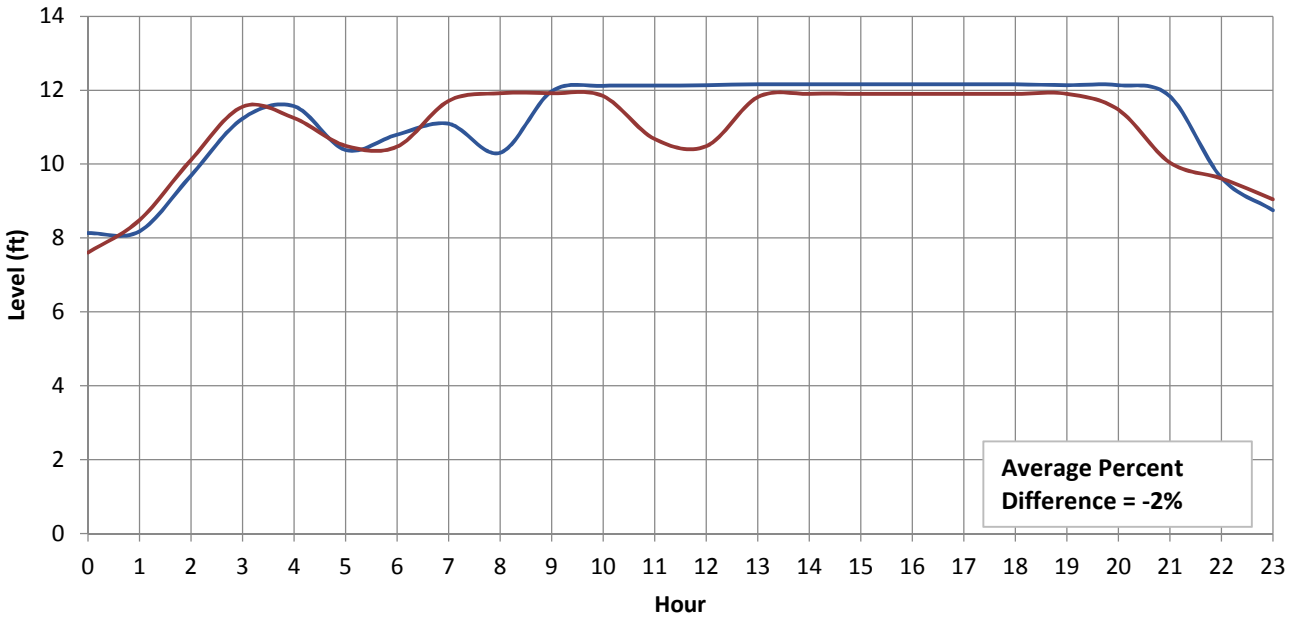
Figure 4
Well Calibration
Water System Master Plan
Marina Coast Water District

AKEL ENGINEERING GROUP, INC.

Intermediate Reservoir - Level



Sand Tank - Level



LEGEND

SCADA

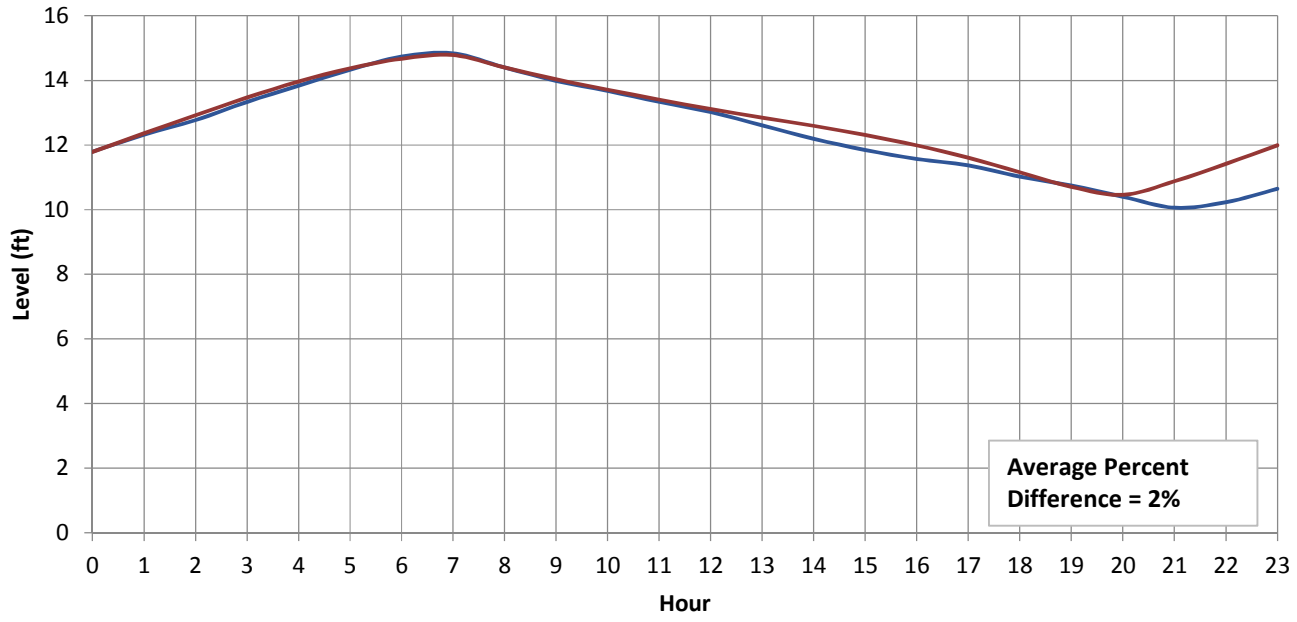
Hydraulic Model

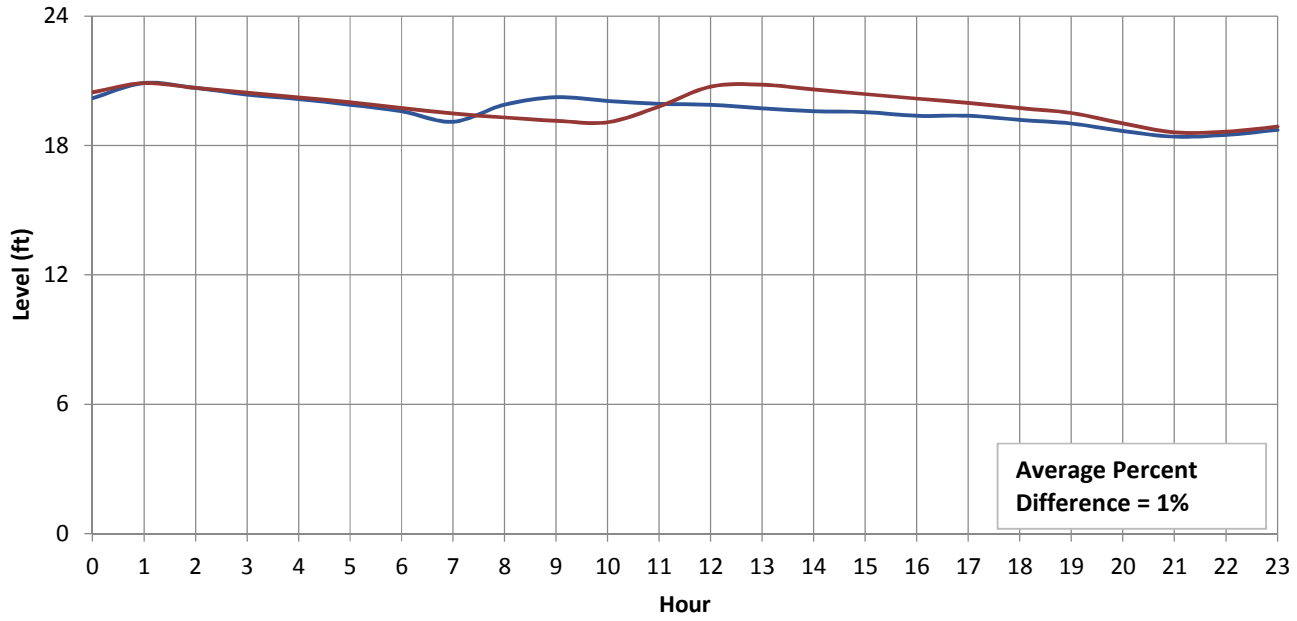
PRELIMINARY

December 5, 2017

Figure 5
Tank Calibration
Water System Master Plan
Marina Coast Water District

AKEL ENGINEERING GROUP, INC.





LEGEND

SCADA

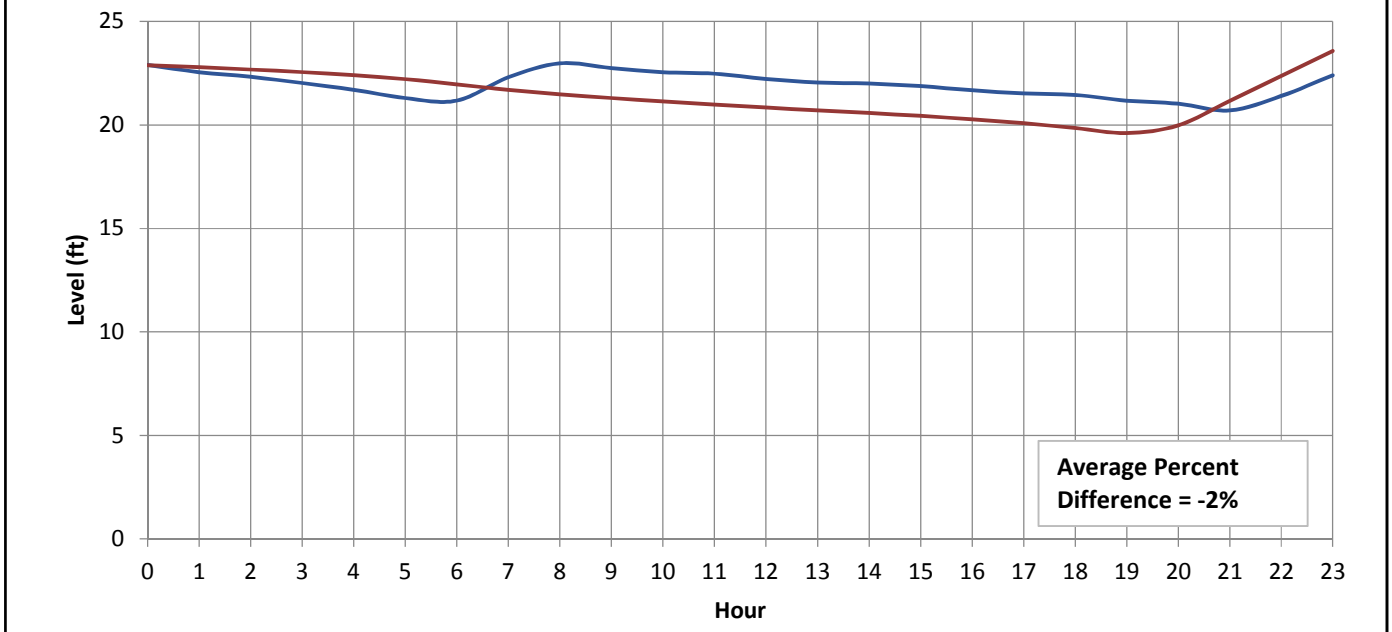
Hydraulic Model

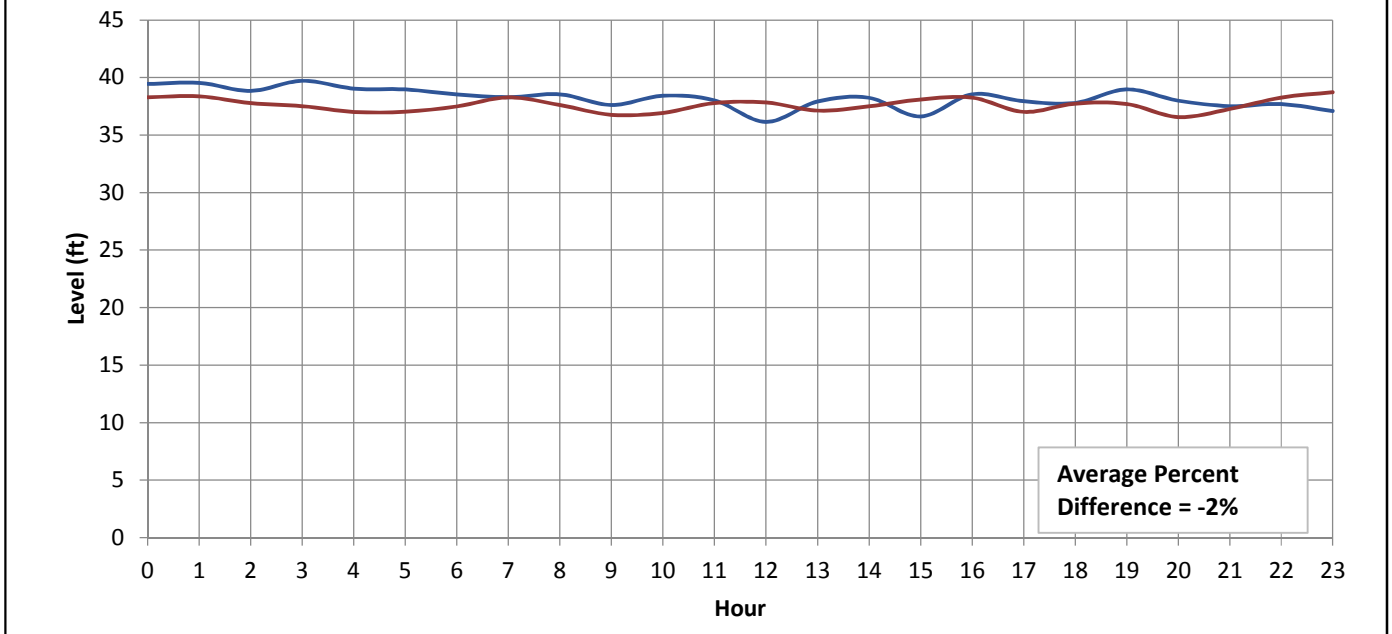
PRELIMINARY

December 5, 2017

Figure 6
Tank Calibration
Water System Master Plan
Marina Coast Water District

AKEL ENGINEERING GROUP, INC.





LEGEND

SCADA

Hydraulic Model

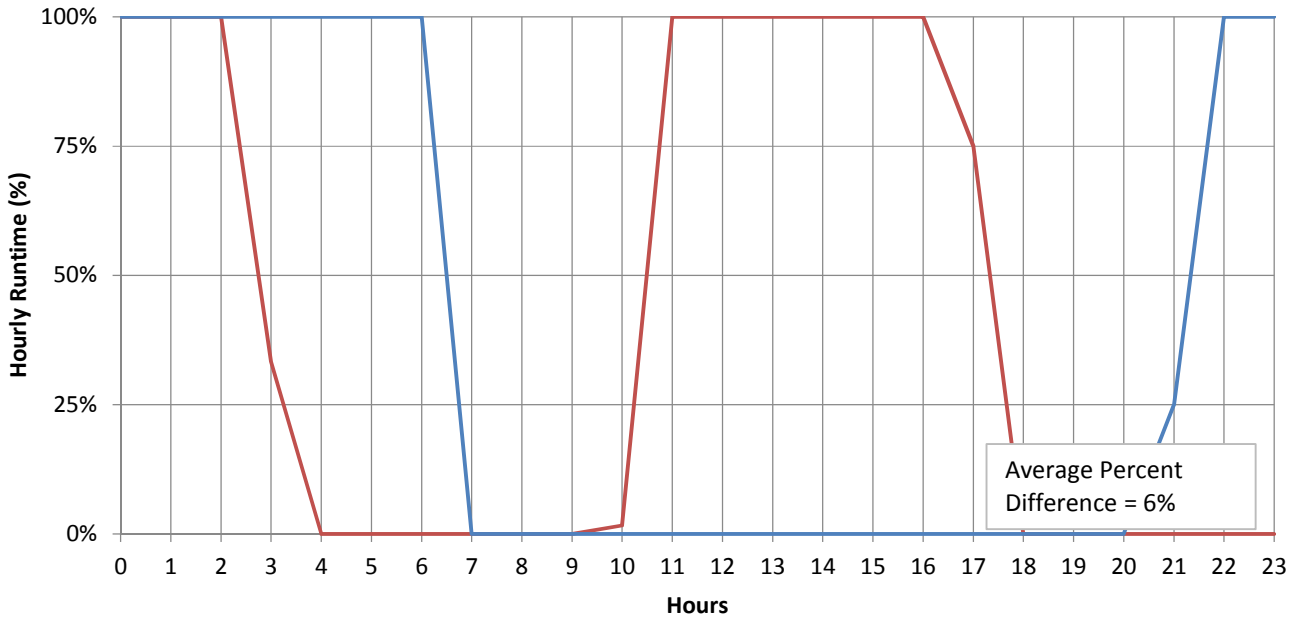
PRELIMINARY

December 5, 2017

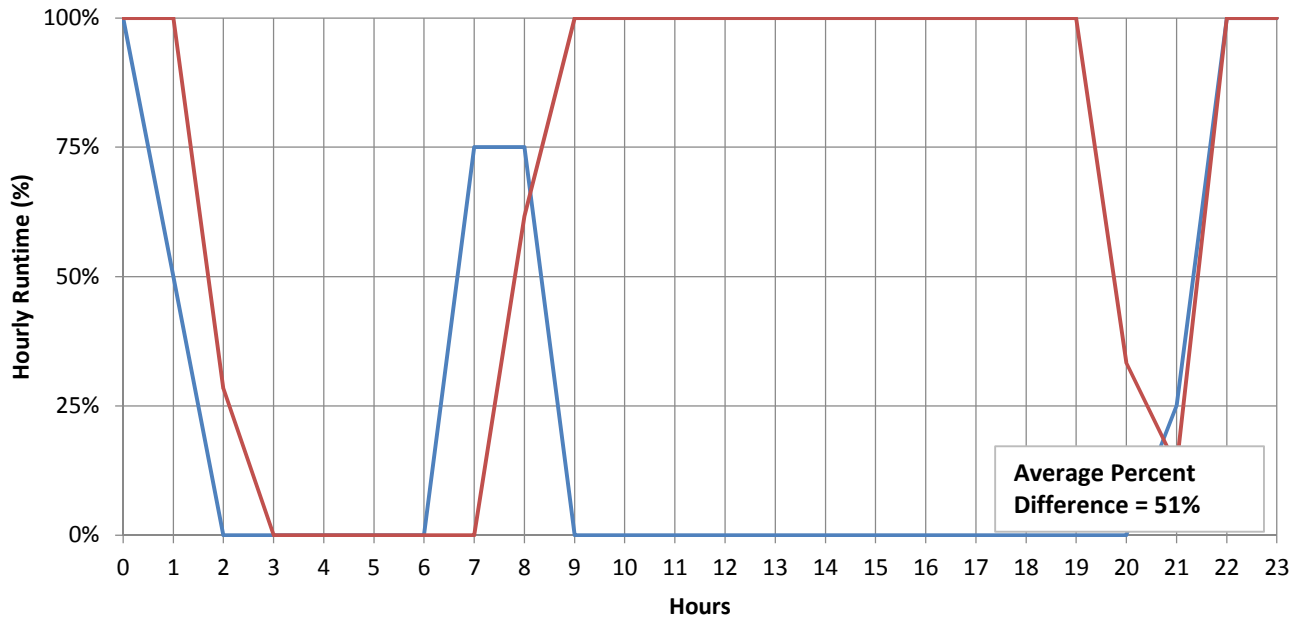
Figure 7
Tank Calibration
Water System Master Plan
Marina Coast Water District

AKEL ENGINEERING GROUP, INC.

B Booster On/Off



C Booster On/Off



LEGEND

SCADA

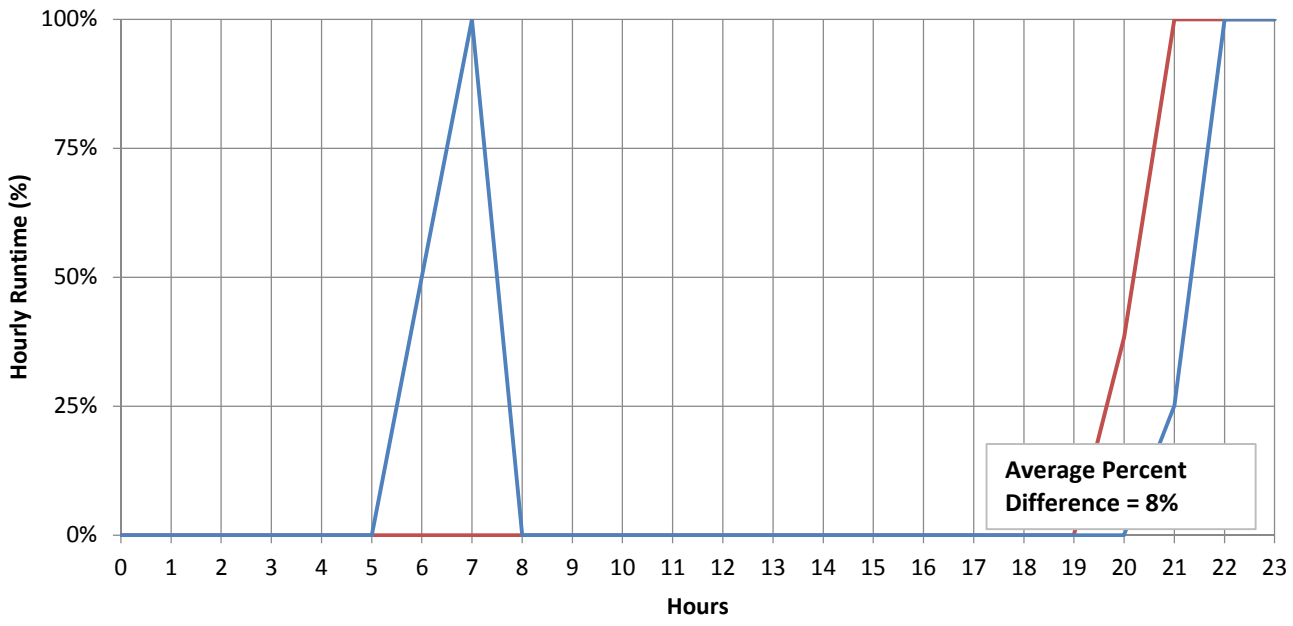
Hydraulic Model

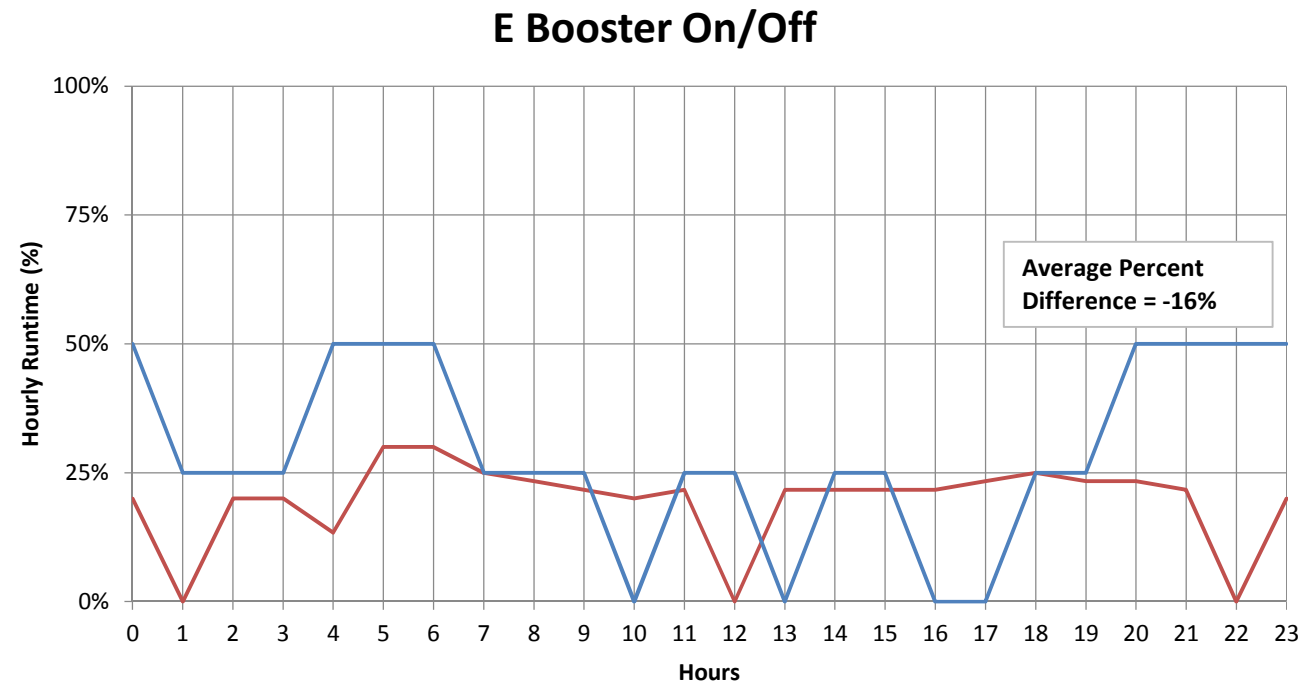
PRELIMINARY

December 5, 2017

Figure 8
Booster Station Calibration
Water System Master Plan
Marina Coast Water District

AKEL ENGINEERING GROUP, INC.





LEGEND

SCADA

Hydraulic Model

PRELIMINARY

December 5, 2017

Figure 9
Booster Station Calibration
Water System Master Plan
Marina Coast Water District

AKEL ENGINEERING GROUP, INC.

APPENDIX C

In-Tract Infrastructure Policy

Marina Coast Water District Water/Wastewater Systems

In-Tract Water and Wastewater Collection System Infrastructure Policy

By
Marina Coast Water District

January 2004

Marina Coast Water District
In-Tract Water and Wastewater Collection System Infrastructure Policy

Summary

During the last 10 to 15 years, an increasing number of studies nationwide have confirmed that water and sewer infrastructure replacement costs are soaring. Water pipe replacement costs alone are estimated to be $1.7 billion per year nationwide, and numerous other studies add to the sense of urgency to improve the nation's underground infrastructure. The infrastructure found on the former Fort Ord is no exception. Much of the water and wastewater collection systems infrastructure is estimated to be 50 years old and integrity and performance issues have already been documented.

Under the Water/Wastewater Facilities Agreement between the District and the FORA, the District is responsible for the successful operation and maintenance of the water and wastewater collection systems on the former Fort Ord, as well as improvements to the systems as FORA reasonably determines are necessary. In an effort to assure the successful redevelopment of the former Fort Ord, the District may cause to be planned, designed, and constructed any other facilities as the District reasonably determines may be needed to carry out the goals as established by FORA.

Systems Age

The former Fort Ord water and wastewater collection systems are on average estimated to be 40 to 50 years old and are nearing the end of their useful life. From this point forward, the systems will continue to deteriorate at an unpredictable pace. A majority of all valves are experiencing failure. Many of the service taps (laterals connecting to mains) have been found to be leaking due to poor construction. Pipelines will increasingly become more brittle over time.

The District implemented a preventative maintenance program to enable a systematic approach to pipeline maintenance. However, when operation and maintenance crews continue to repair or replace components of a system that continues to fail unpredictably, the success of a prudent preventative maintenance program cannot be realized.

Water Infrastructure System

FORA and the District depend on the ability to extract and deliver up to 6,600 afy of groundwater from the Salinas River groundwater basin in accordance with a FORA-approved water allocation plan for land use jurisdictions.

The majority of water use in the Ord Community service area is estimated because meters have not yet been installed on residences. Within the overall water allocation for all jurisdictions, 532 afy (or 8 percent of 6,600 afy) is presently estimated and assigned as water loss. (Industry standards for water loss range from 6% to 15% and include water lost due to water line breaks, fire hydrant use, construction water, etc.) The District accepts its responsibility as the steward of the significantly important water resources in support of FORA's redevelopment plan, and will work to minimize water loss. The District has established a water loss goal of 5 percent from

water leaks. To achieve this goal, water use will need to be accurately measured and distributed through a watertight system

Wastewater Collection System

The District is responsible for maintaining a system free from sewage overflows. Much of the collection system was not constructed to current design standards and is showing signs of aging. It is difficult to determine the failure rate of an aging system as pipelines loose integrity over time. Sewage spills (overflows) is one of the symptoms of system failure. During 2002, the District experienced 15 sewage spills. Many of the spills occurred within redevelopment areas.

The District completed its Wastewater Master Plan for the Ord Community service area in 2001 which included visually inspecting (via video) many of the collection lines and connections. The Plan describes a system that requires an aggressive and costly collection pipe replacement program.

As the collection system continues to experience problems, the District is subject to increasingly tighter regulatory control that will not tolerate sewage spills. Per recent sewer system maintenance regulations promulgated by the California Regional Water Quality Control Board, the District is required to minimize sewage overflows. Given that the sewage system is not constructed to today's design standards, overflows are expected to continue to occur at an accelerated pace. By replacing components of the aging wastewater collection system, the District will be able to keep its permits in good standing and improve upon overall maintenance costs to customers.

Capital Improvement Program

The District is making every effort to keep rates affordable for our customers. With monthly water and wastewater collection rates already on the high end for this region, additional District-funded (in-tract) capital improvements would cause the rates to escalate further, adding to the burden on potentially low to middle income customers in an area where low-income housing is strongly encouraged. Requiring developers to be responsible for in-tract capital improvements to the water system and wastewater collection system would help contain District rates while ensuring the systems are progressively brought up to standard.

Pipelines Relocated from Planned Lots of Record and Planned Improvements

Upon conveyance, the District agreed to accept the systems "as-is" and "where-is". To address right of way issues to decrease District exposure to liabilities due to systems maintenance and/or repair, we must assure that new pipelines planned in redevelopment areas are not constructed to conflict with planned lots of record or planned improvements. Examples of planned improvements include structures, roads, landscape areas, walkways, parking facilities, etc. The District will work to relocate all systems within public easements, e.g. roadway easements. Better access to systems infrastructure will result in more cost effective repairs and reduced liability to the District.

In conclusion, an in-tract water and wastewater collection system infrastructure policy that clearly establishes requirements for developers to bring systems components to industry standards during redevelopment projects is supportive of District responsibilities to FORA and to our customers.

In-Tract Infrastructure Policy

For all proposed redevelopment projects in areas served by existing water and wastewater collection infrastructure, the developer will be required to implement one of the following procedures:

1. Where redevelopment will raze the existing buildings and streets:

    - Developer completes a subdivision water and sewer master plan per the District standards.
    - Developer replaces all existing water and wastewater collection pipelines and components within the project area to District standards, and replaces all existing water and wastewater collection pipelines and components adjacent to the project area to District standards, as project impacts necessitate.
    - Developer provides meter boxes for all structures and landscaping.
    - Developer provides for District's installation of remote read meters.

2. Where redevelopment will use existing buildings and infrastructure or will raze or remodel a portion or all of the existing buildings but streets and existing infrastructure will remain:

    - Developer completes a subdivision water and sewer master plan per the District standards. This subdivision master plan would include a physical and design standard condition assessment of the systems per District standards. The subdivision master plan must be approved by the District prior to receiving water and sewer service.
    - From the subdivision master plan, the Developer replaces components as required by the District.
    - Developer relocates the District's backbone water/sewer infrastructure (infrastructure that serves other upstream and downstream users) onto roadway right of way, as necessary.
    - When the Developer is planning to construct improvements, including, but not limited to, structures, landscape areas, walkways, parking facilities, etc., over existing water and sewer infrastructure, then the Developer is responsible to relocate existing water/sewer infrastructure away from under proposed improvements.
    - The developer will enter into a separate utility agreement with the District to provide for anticipated higher maintenance costs of the remaining older systems that will be left in place.
    - The separate utility agreement will include an annual water and wastewater collection inspection report to be completed by the Developer or its successor in accordance with District standards. That agreement will require the developer to provide an annual wastewater collection system, water system inspection report in accordance

with District standards and to provide master meters for the project. The water inspection report will include a water audit.

- Developer provides meter boxes for all structures and landscaping.
- Developer provides for District's installation of remote read meters.

APPENDIX D

Equivalent Dwelling Unit Analysis

APPENDIX E

Water System Capacity Fees
(Pending Finalization)