Rainbow Municipal Water District

Water and Wastewater Master Plan Update

March 2016

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Water and Wastewater Master Plan Update

Prepared for

RAINBOW MUNICIPAL WATER DISTRICT
Committed to Excellence

Rainbow Municipal Water District
3707 Old Highway 395
Fallbrook, California 92028

Prepared by

ATKINS

3570 Carmel Mountain Road, Suite 300
San Diego, California 92130
Atkins Proj No: 100044880

In Association with
Dudek & Associates
Gillingham Water

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Acronyms

ACP	asbestos cement pipe
ADD	average day demand
AFY	acre feet per year
APN	Assessor Parcel number
cfs	cubic feet per second
CIP	Capital Improvement Program
CRA	Colorado River Aqueduct
d/D	Depth to Diameter
DIP	ductile iron pipe
District or RMWD	Rainbow Municipal Water District
EDU	equivalent dwelling units
ESP	Emergency Storage Project
FCF	flow control facility
FPD	Fire Protection District
fps	feet per second
FPUD	Fallbrook Public Utility District
FY	fiscal year
GIS	Graphical Information System
gpd	gallons per day
gpf	gallons per flush
gpm	gallons per minute
HGL	hydraulic grade line
I&I	inflow and infiltration
I-15	Interstate 15
IID	Imperial Irrigation District
IPR/DPR	Indirect Potable Reuse/Direct Potable Reuse
ISO	Insurance Services Office
Master Plan	2015 Water and Wastewater Facilities Master Plan Update
MC	million gallons
MDD	maximum day demand
MFR	multi-family residential
MGD	million gallons per day
MWDSC	Metropolitan Water District of Southern California
NCDP	North County Distribution Pipeline
PDWF	peak dry weather flow
PRV	pressure reducing valves
PS	pump stations
psi	pounds per square inch
PSV	pressure sustaining valves
PWWF	peak wet weather flow
RUWMP	Regional Urban Water Management Plan
SANDAG	San Diego Association of Governments
SCADA	supervisory control and data acquisition
SDCWA	San Diego County Water Authority

SFR	single family residential
SR	State Route
SWP	State Water Project
SWRCB	State Water Resources Control Board
UWMP	Urban Water Management Plans
WTP	Water Treatment Plant

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Chapter 1
INTRODUCTION

1.1 Purpose

This report presents the findings and recommendations of the 2015 Water and Wastewater Facilities Master Plan Update (Master Plan) for the Rainbow Municipal Water District (District or RMWD). The report provides a comprehensive review of the District's potable and wastewater systems, and identifies a plan of capital improvements necessary for the systems to adapt to future conditions, including major planned land development projects, while providing reliable and economical service to the District's customers.

The primary purpose of the Master Plan is fourfold:

1) **Integrated Facility Planning:** Map out the integrated water delivery, water supply, wastewater conveyance and wastewater treatment approaches that best meet the needs of the service area with special attention on a District controlled water reclamation project.

2) **Review Planning Criteria and the District's Hydraulic System Models:** Review the District's system performance criteria, and update the District's InfoWater and Info Sewer system hydraulic models to account for new facilities and development and to maintain integration with the District's GIS system;

3) **Refine the CIP and Basis for Capacity Fees:** Refine the District's short term (2020) and long-term (2050) Capital Improvement Program (CIP), and document an objective basis for the setting of capacity fees to help fund the CIP; and

4) **Identify Adaptive Responses to Changed Conditions:** Identify how needed facility improvements and CIP items would change should future demand and supply conditions vary from baseline assumptions.

Planning for the Master Plan is based on the latest regional growth forecasts developed by the San Diego Association of Governments (SANDAG), and is consistent with the adopted land use plans of all jurisdictions within the District boundaries. The District coordinates with these jurisdictions through its development of Urban Water Management Plans (UWMP), and through other ongoing coordination to ensure land use plans account for the availability of water supplies and water service infrastructure. A separate update to the UWMP is currently being prepared and will be completed by May 2016.

1.2 District Overview

> **District Mission**
>
> To provide our customers, reliable, high quality water and water reclamation services in a fiscally sustainable manner.

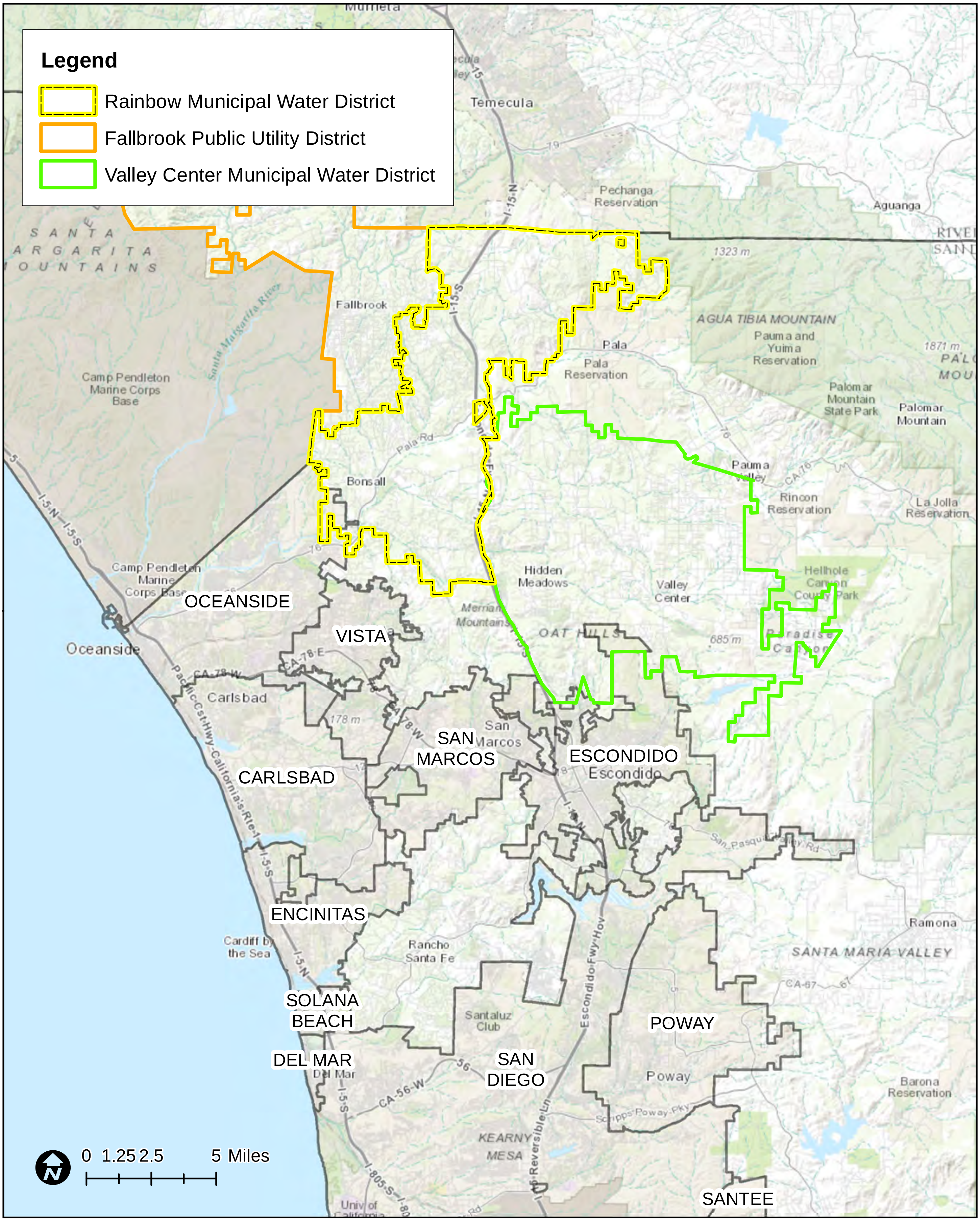
The District is a publicly owned retail water and sewer agency serving approximately 78 square miles (49,800 acres) in northern San Diego County. The District boundaries encompass the unincorporated communities of Rainbow and Bonsall, as well as portions of Pala, Fallbrook and Vista. The District's boundaries and service areas are shown in **Figure 1-1.**

The District's climate is mild, varying from a low mean daytime temperature of 69 degrees in the winter to a high mean daytime temperature of 86 degrees in the summer. The average annual rainfall of approximately 16 inches occurs primarily from December through March. Most of the District consists of hills and valleys with a mix of primarily intermittent streams and some perennial streams and rivers. The topography ranges from 150 to 2,200 feet mean sea level. The San Luis Rey River crosses diagonally through the District and several smaller creeks divide the area, including Gopher Canyon, Moosa Canyon, and Tamarack Creeks.

The District provides water service to almost all of the area within its boundaries, encompassing approximately 7,800 metered accounts. The District currently owns, through contract, capacity to treat 1.5 million gallons of sewage per day at the San Luis Ray Wastewater Treatment Plant in Oceanside. The District's sewer service area includes over 2,150 connections mainly along the SR-76 corridor.

The District was authorized as a California Special District by the State Legislature in 1953, under the provisions of the Municipal Water District Code. A five member elected Board of Directors sets ordinances, policies, taxes, and rates for providing sewer and potable water services within the District service area. The District is revenue neutral: each end user pays their fair share of the District's costs of capital improvements, water acquisition, and the operation and maintenance of its facilities.

The District is a member agency of the San Diego County Water Authority (SDCWA, Water Authority). SDCWA is responsible for transmission of the imported water supply within San Diego County to all its member agencies. SDCWA is a member of the Metropolitan Water District of Southern California (MWDSC). The District receives imported potable water from the aqueduct systems owned and operated by SDCWA and MWDSC. The District continues to be active in reducing demands through conservation measures, and in pursuing new local and innovative sources of supply to increase system reliability, flexibility, and economy.



Vicinity Map

FIGURE 1-1

1.3 Planning Context / Baseline Conditions / Key Issues

This 2015 Master Plan builds on the District's previous comprehensive 2006 Water Master Plan (Dudek) and 2006 Wastewater Master Plan (Dudek), as well as other water supply planning studies completed over the past several years.

Baseline Conditions

Based on information from RMWD and based on the results of the Wastewater Treatment/Reclamation Alternatives Study (**Appendix E**), the Master Plan assumes the water supply and wastewater treatment conditions listed in **Table 1-1** will be in effect, and defines these as baseline planning assumptions over the next several years. The primary CIP recommendations of the Master Plan are based on these assumptions. However, the Master Plan also identifies how needed facility improvements and CIP items would change should future demand and supply conditions vary from the listed baseline assumptions, most significantly those surrounding the details of a District-owned water reclamation plant. It is important to note that the District has undertaken additional study to determine the feasibility and best option for a District-owned water reclamation plant and no final determination for the size, location, or other details concerning a plant and recycled water system have been made.

Table 1-1 presents one new local supply option to provide recycled water and wastewater disposal.

Table 1-1 Baseline and Optional Conditions

Conditions	Description
Baseline Conditions	
1) Continued availability of water supply from San Diego County Water Authority	The District currently purchases water from the SDCWA. The Master Plan baseline condition assumes that water will continue to be available to supply the District throughout the plan's horizon year.
2) Water Reclamation Plant	The District constructs an 0.9 MGD water recycling plant and recycled water distribution system.(1)
3) Wastewater treatment available through the San Luis Rey Wastewater Treatment Plant	The District currently has an agreement for treatment of 1.5 million gallons per day of sewage at the San Luis Rey Wastewater Treatment Plant. Based on the sizing and location of the water reclamation plant sewer flow will still be conveyed to Oceanside.
Optional Conditions	
4) Groundwater Supply	District participates with Oceanside on a groundwater recovery project.

(1) The Wastewater Treatment/Reclamation Alternatives study identified this option as the most economically feasible. The District has made no determination on its preferred alternative and the available options are being studied further and refined to assist with that determination.

The Master Plan presents order of magnitude costs to develop each option.

Key Issues

Key issues affecting the development and recommendations of the 2015 Master Plan are listed in **Table 1-2.** These include consideration of changed conditions relative to the District's 2006 Master Plan, including a marked decline in per capita water use, revisions to the District's assumed future supply portfolio, and other changes.

Table 1-2 Key Planning Issues

Issue	Description	Implications to WFMP / Discussion
1) Decline in per capita water use	■ FY2013-14 potable use per account has declined almost 20 percent in comparison to 2005-06 conditions. ■ Projected 2050 demands in this Master Plan are approximately 45 percent less than those in the District's previous (2006) Master Plan.	■ Reduces the need for capacity expansion and treated water storage projects; reduces CIP ■ Projected per capita demand levels indicate the District will remain in compliance with SB x7-7 (the "20% by 2020" legislation)
2) Wastewater Treatment and Reclamation Options	■ Provide a District-controlled water reclamation plant. ■ Release and minimize the District's dependence upon treatment in the City of Oceanside.	■ Reduces treatment costs to Oceanside and reduces ocean disposal. ■ Develop reliable source of local water supply and future plan for Indirect Potable Reuse/Direct Potable Reuse (IPR/DPR). ■ Provides drought-proof supply for major agricultural users and nurseries. ■ Serves as a water supply offset mitigation plan
3) Water Supply Option for Reliability and Economy	■ Groundwater desalter to develop local San Luis Rey River groundwater resources for District use. ■ Oceanside's Weese Water Treatment Plant (WTP) access to related water from City of Oceanside	■ Potential yield of 2,000 acre feet per year (AFY) of local supply ■ Additional supply to District during 10-day shutdowns.
4) CIP as a basis for capacity fees	■ District needs updated CIP to update fees.	■ Provide sound basis and defensibility
5) Forecast sensitivity / Plan adaptability	■ The Master Plan needs to be adaptable to future demand, supply, and other conditions should they vary from the Master Plan's baseline assumptions.	■ The Master Plan presents a baseline assumption as to future demand, supply, and other conditions, and identifies a corresponding set of CIP components and recommendations which includes developing a local recycling project and an option to continue treatment of wastewater through the San Luis Rey Wastewater Treatment Plant. ■ The Master Plan also flags key variables that could alter the CIP, and identifies how the CIP could adjust to should future conditions vary from the Master Plan's baseline assumptions.

1.4 Report Outline and Synopsis

The Master Plan report is organized into eight chapters as follows:

Chapter	Contents	Synopsis
1) Introduction	▪ Purpose ▪ District overview ▪ Key Issues ▪ Report outline	The Master Plan identifies the facilities and capital funding the District will need to continue providing reliable water and recycled water service to its customers through 2035. Supply and demand conditions have changed significantly over the past decade; the 2015 Master Plan addresses these changed conditions.
2) System Criteria	▪ Water and wastewater system planning and design criteria	The District's water and wastewater planning criteria define the minimum levels of flow capacity, storage capacity, operational reliability, and treatment capacity required for the District to provide excellent service to its customers. Because water service is a life-line requirement, these criteria and service standards are necessarily and appropriately high.
3) Water Demands and Wastewater Flows	▪ Historical, current, and projected water demands and wastewater flows	Water demands and sewer flows have declined significantly in recent years due to conservation, water price increases, economic recession, and the mandatory use restrictions in effect during 2009-10 and at present, beginning in the summer of 2014. The Master Plan projects potable demands will increase in response to population and employment growth, but at a slower pace than that growth, with future demands significantly below the levels projected in previous master plans. Wastewater flows are also developed for the sewer service area.
4) Water Supplies	▪ Existing and planned future water supplies ▪ Review of District's water supply reliability	The District currently relies on the eight connections from the Metropolitan Water District of Southern California and the San Diego County Water Authority. Options for other sources can provide redundancy and ease dependence for a single source.
5) Potable Water System	▪ Review of existing system and needed improvements	The Master Plan identifies needed capital improvements addressing the following categories: a) system expansion to serve new development; b) improved water distribution and quality c) replace aging infrastructure; and d) improve system redundancy, reliability, and flexibility.
6) Wastewater System	▪ Review of existing system and needed improvements	The Master Plan identifies needed capital improvements addressing the following categories: a) system expansion to serve new development; b) reduce infiltration in the sewer system c) provide alternatives to provide additional treatment capacity

Chapter	Contents	Synopsis
7) Capital Improvement Program Recommendations	■ Summary of long-term capital spending recommendations ■ Summary of recommended water and wastewater	■ 5-Year (2020) Capital Spending: Potable: $9.7 million Wastewater: $60.4 million ■ Additional Long-Term Capital Spending (2020 to 2035): Potable: $6.5 million Wastewater: $3.3 million Recommendation of CIP projects which are implementable to address future demands in the potable water system, and wastewater treatment and recycling facilities, which may be operated by the District

1.5 Authorization

The Rainbow Municipal Water District retained Atkins to provide engineering services necessary to analyze and evaluate existing and future requirements for continued reliable water and wastewater service. The scope of work was approved by the Board of Directors in January 2015, and the notice to proceed was provided in March 2015.

1.6 References

The following reports and references have been incorporated, where indicated, into the findings and conclusions of this report.

Rainbow Municipal Water District, Groundwater Study, prepared by West Yost Associates, 2016

Rainbow Municipal Water District, Water and Sewer Analysis for the Meadowood Project, prepared by Atkins, February 2016

Rainbow Municipal Water District, PDR for Wastewater Outfall Replacement, prepared by Tetra Tech, October 2013

Rainbow Municipal Water District, 2009 Sewer Flow Monitoring, prepared by Infrastructure Engineering Corporation, March 2010

Rainbow Municipal Water District, Urban Water Management Plan, 2010

Rainbow Municipal Water District, PDR for Lift Station #2, prepared by RBF Consulting, October 2008

Rainbow Municipal Water District, PDR for Vallecitos Pump Station Rehabilitation, prepared by J.C. Heden and Associates, Inc., November 2007

Rainbow Municipal Water District, Wastewater Master Plan Update, prepared by Dudek & Associates, May 2006

Rainbow Municipal Water District, Water Master Plan Update, prepared by Dudek & Associates, 2006

San Diego Association of Governments (SANDAG), Series 13 Regional Growth Forecast Projections, August 2013

San Luis Rey Municipal Water District, Master Plan for Water and Wastewater Services, October 2003

Chapter 2
SYSTEM PLANNING CRITERIA

The level of service that is provided to a community is the result of the implementation of improvements that are designed in accordance with accepted criteria. This chapter describes the planning criteria and operating criteria used in the evaluation of the potable water and sewer distribution system relative to 2015 conditions.

Since the last Master Plan Update in 2006 (Dudek), there have been a few changes in the systems including water storage projects, sewer interceptors and a lift station upgrade. Development within the District has generally been slow in the region, but changes in operational characteristics, aging facilities, and the most recent potential for providing service to both large developments within and outside the current District boundary has led to the need for a master plan update. In the event of a potential service area boundary expansion, both economic and hydraulic viability must be evaluated to provide the District with the information to make the best decisions.

In summary, the Master Plan includes tasks to document and analyze existing facilities, develop unit water and wastewater demands and peaking factors, project ultimate water and wastewater flows, and recommend facility and operational improvements based on hydraulic analyses results. To analyze the wastewater collection system, the *InfoSewer* computer modeling software was used to perform a hydraulic analysis on the existing and ultimate wastewater systems. To analyze the water distribution system, the *InfoWater* computer modeling software was used to perform a hydraulic analysis on the existing and ultimate wastewater systems. The outcome of the analyses is a recommended long-term capital improvement program (CIP) that will provide a water and wastewater system capable of providing reliable service to the RMWD customers at build-out conditions.

2.1 Potable Water System and Operating Criteria

The planning criteria for the design and evaluation of potable water facilities in RMWD are based on existing system performance characteristics, past criteria used by the District, and current industry and area standards. Planning criteria include standards for demand peaking factors, system pressures, distribution pipelines, storage reservoirs, and booster pump stations. A summary of criteria that impact the design and performance of water facilities is provided in **Table 2-1**. These criteria are the basis for evaluating water system performance and determining facilities required to serve future development.

2.1.1 Demand Peaking Factors

The demand peaking factors are based on an analysis of current and historical RMWD peak flows, as described in detail in the **Chapter 3**. The minimum and maximum month peaking factors of 0.21 and 1.68, respectively, are documented in this report. The maximum day peaking factor used in the analysis of the existing and ultimate system is 1.9, and a peak hour factor of 2.7 is applied to domestic demands. It is noted that these peaking factors are applicable for the analysis of the system as a whole, based on existing land use, and are considered conservative for the ultimate system, since peaking factors will generally decrease with increasing demands. Higher peaking factors may be used when evaluating smaller portions of the distribution system with a single land use type.

Table 2-1 RMWD Planning and Performance Criteria Summary

Water Demand Peaking Factors	1.6 x ADD – Maximum month demand 1.9 x ADD – Maximum day demand 2.7 x ADD – Peak hour demand
System Pressures	*Static Pressures (based on the reservoir high water line):* 60 psi – minimum desired 150 psi – maximum desired distribution pressure 300 psi – maximum desired transmission pressure *Dynamic Pressures (with reservoir levels half full):* 40 psi – minimum desired pressure during peak hour demands 20 psi – minimum allowable pressure for fire flows
Pipelines	8 fps – maximum desirable velocity at peak hour flow 5 feet per 1,000 feet of pipe – maximum desirable head loss at peak flow Minimum 8-inch pipe size for all new pipes serving a fire hydrant
Daily Storage	Operational – 15% of maximum day demand Emergency – 100% of the maximum day demand Fire Flow – Maximum required fire flow within the zone for the required fire duration
Reserve Storage	10 days of storage based on the average day demand for planned shutdowns of the SDCWA aqueducts
Pump Stations	Capacity equivalent to the maximum day demand with the largest pumping unit out-of-service.

ADD = average day demand
psi = pounds per square inch
fps = feet per second

2.1.2 System Pressures

The range of water pressures experienced at any location is a function of the hydraulic grade and the service elevation. Within a specific pressure zone, the hydraulic grade is affected by the reservoir or tank water level and/or pressure reducing valve settings, friction losses in the distribution system, and the flow delivered through aqueduct connections, if applicable. The maximum static pressure within a pressure zone is based on the high-water level of the reservoir or highest pressure reducing valve setting and the elevation at any specific point in the zone. The maximum desired pressure within the distribution system is 150 pounds per square inch (psi) and the maximum pressure should be no greater than 200 psi. It is noted however that, due to the hilly terrain and dominance of agricultural customers, there are currently many areas of the RMWD distribution system where pressures exceed 200 psi. The maximum desired pressure within the transmission system is 300 psi. It is much more difficult to control the pressure in transmission pipelines as they must maintain the gradeline of the zone and are typically less flexible in terms of installation locations. Despite the District’s terrain, the vast majority of the District transmission system is within the desired maximum pressure.

The minimum static pressure is used as a general guideline for initial design efforts, as the operating or dynamic pressures will generally be lower. The minimum allowable pressure is 40 psi under peak hour flow conditions and 20 psi at a fire flow location during a fire occurring under maximum day demand (MDD) conditions. Under certain circumstances, RMWD will approve the installation of private booster pumps for areas that receive less than the minimum 40 psi operating pressure. The minimum pressure in the distribution system for these areas must be 20 psi based on the Health Department guidelines and the ability to provide adequate pressures for fire flows.

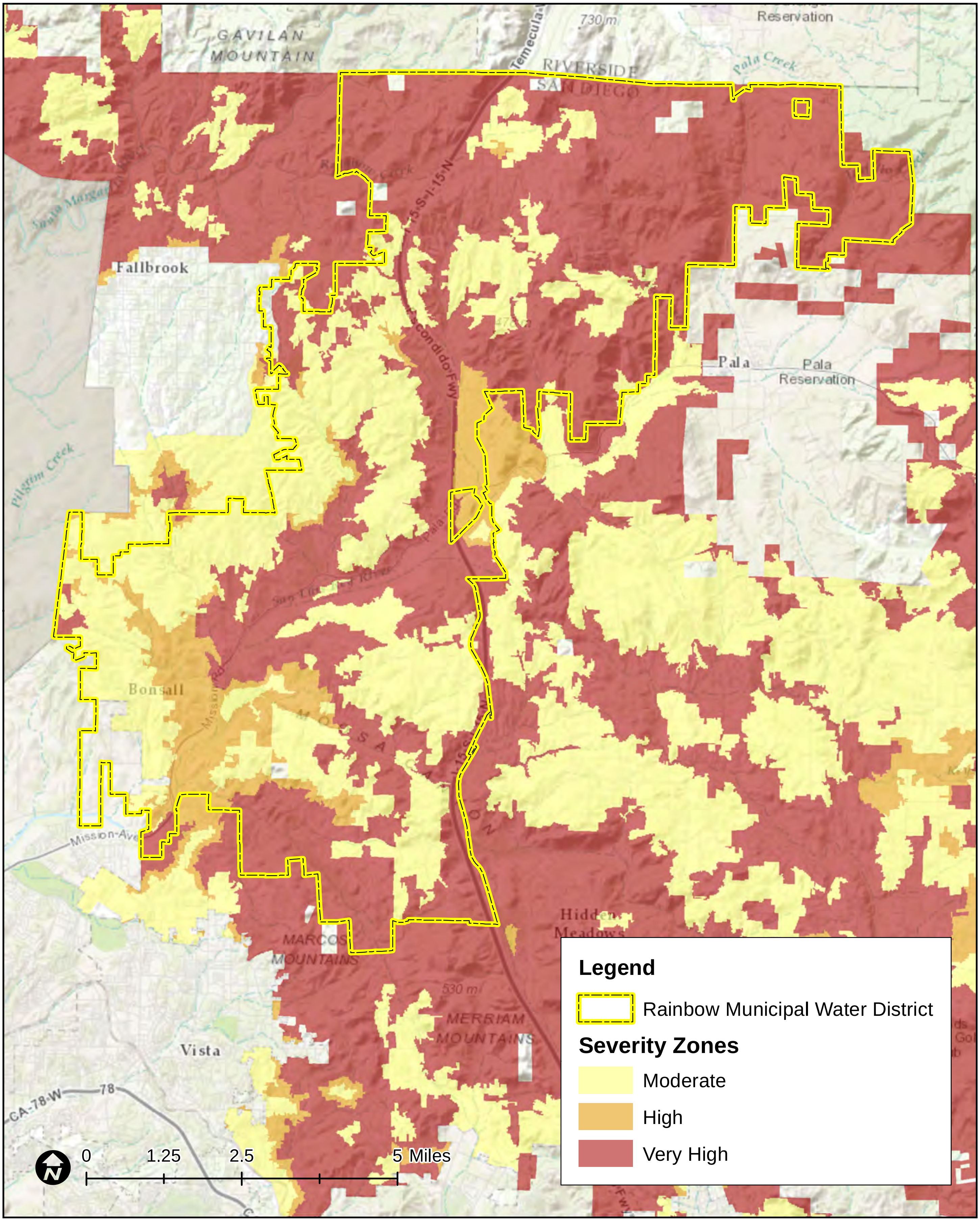
2.1.3 Pipelines

Criteria for pipeline sizing are based upon keeping velocities low to minimize wear on valves and scouring of interior coatings, and limit head loss in the distribution system. Water distribution mains should be sized to supply peak flows at velocities below 8 feet per second (fps), and the corresponding head loss should not exceed five feet per 1,000 feet. These criteria may be exceeded during fire flow situations or in areas where there is a large safety factor in meeting pressure criteria. Generally, transmission mains are designed based upon peak flows and reservoir filling conditions, while distribution piping is sized for fire flows. For zones with long transmission mains, the pipeline friction loss will typically need to be less than 3 to 5 feet per 1,000 feet to maintain adequate pressures and minimize pressure swings. Looping is highly desirable in a distribution system and long, dead-ended pipelines should be avoided where possible to increase reliability and manage water quality.

2.1.4 Fire Flow Requirements

Water must be available not only for domestic and agricultural use, but also for emergency firefighting situations. This type of water use is called a fire flow, and the fire flow must be sustainable for a specific duration at a minimum pressure of 20 psi at the hydrant. General standards establishing the amount of water for fire protection purposes are set by the Insurance Services Office (ISO), and these general standards are applied by local jurisdictions. RMWD is served by several fire protection agencies. The majority of the service area is within the North County Fire Protection District (FPD), while the northeast area is covered by the County of San Diego, the southern part is in within the Vista FPD, the southeast portion of the District is serviced by the Deer Springs FPD, and the Southwest is covered by Oceanside.

Considerations such as type of occupancy, type of construction and construction materials, distance from other structures, and other factors are considered when assigning fire flow requirements. In lieu of calculating specific fire flows for individual structures, minimum fire flows for general building categories were previously reviewed from the 2006 Master Plan Update and supplemented with the 2013 California Fire Code Update. The required fire flows are listed in **Table 2-2**. A minimum fire flow of 1,500 gallons per minute (gpm) is required for single-family and duplex residential units. A 2,500 gpm fire flow applies to residential multi-family buildings consisting of four or more residential dwelling units, schools, and commercial, industrial, office and institutional buildings. A 2,500 gpm fire flow also applies to new development in the wild land areas, which is designated as the High Severity Zone on **Figure 2-1.** It is noted that for any new buildings constructed within the District, the applicable fire protection agency will specify the minimum required fire flow. Higher fire flows than those shown in **Table 2-2** may be required under certain circumstances, such as developments adjacent to open space areas susceptible to wild fires or buildings with floor areas in excess of 300,000 square feet. The 2013 Fire Code requires all residential buildings to be sprinklered.



Fire Severity Zones

FIGURE 2-1

1/29/2016 gool4566 \\sdofs01\Data\Clients\Rainbow MWD\100044880 2015 MP Update\GIS\mxd\Figure 2-1 Fire Severity Zones.mxd

Table 2-2 Fire Flow Criteria

Land Use	Minimum Required Fire Flow @ 20 psi	Required Duration	Required Storage
Residential - single family	1,500 gpm	2 hours	0.18 MG
Residential – multi-family	2,500 gpm	2 hours	0.30 MG
Commercial, Industrial & Office	2,500 gpm	2 hours	0.30 MG
Schools	2,500 gpm	2 hours	0.30 MG
Residential High Severity Zone	2,500 gpm	2 hours	0.30 MG

2.1.5 Storage Criteria

Water storage is used to supply peak hourly fluctuations, make up the difference between the amount of water ordered and consumed, provide fire flows, and supply the service area in the event of an emergency situation or planned shutdown of the SDCWA aqueducts. Storage tanks or reservoirs should be provided separately in each zone or, if necessary, in a higher pressure zone. The amount of storage that should be located within each zone is based on the "daily" storage requirements. Emergency reserve storage is required for long-term supply disruptions, and is typically located in one or more large reservoirs.

Operational Storage

Operational storage is defined as the storage required under normal operating conditions to balance the difference between water supply and daily variations in demand. Water is supplied to the RMWD distribution system from the SDCWA at a constant supply rate, which is the projected water use for the following 24-hour period. Peak hour demands in excess of the 24-hour average demand must be satisfied by drawing on water stored in the RMWD water storage tanks and reservoirs. Providing operational storage within each zone also allows transmission mains to be sized for MDD, rather than higher peak hour flows.

The required operational storage is usually defined as the volume of water required during peak demand periods above the maximum day average flow rate. An operational storage requirement equal to 15 percent of the MDD is typical, and was used for the RMWD analysis. It is noted, however, that while the operational storage requirement as defined pertains to the water system as a whole, it may not be applicable for some of the pumped zones. The RMWD pumped zones typically have pumps with significantly higher flow capacities than the zone demand requirements (refer to **Chapter 5**). Additional storage is also required to operate pumps only during off-peak energy periods at night. For the pumped zones, the storage that is required for daily operations would be more accurately based on the storage required for current pumping operations. As the zone demands increase, however, the pumps will operate for longer periods, and the required storage will more closely approximate the 15 percent of MDD requirement.

Emergency Storage

Emergency storage provides water during incidents such as pipeline failures, pumping or equipment failures, and electrical power failures. These in-District emergencies would typically be repaired or mitigated in a short period of time. An emergency storage requirement of 100 percent of the MDD has been allocated for these purposes.

Fire Flow Storage

Each reservoir serving the RMWD must contain an available supply of water to be used in the event of a fire within its service area. Fire flow storage is equal to the volume of water required for the largest fire flow requirement within the reservoir service area, as determined by the land use (refer to **Chapter 5**). For zones with multiple storage reservoirs, the required fire flow storage may be divided between the reservoirs. In addition, when one reservoir supplies a very large service area or more than one major pressure zone, the fire flow storage for that reservoir may be increased based on the probability of simultaneous fires within the service area.

Reserve Storage

In the event of a loss of supply from the SDCWA or MWD, RMWD would be primarily dependent on stored water to meet supply requirements. The SDCWA performs annual maintenance and repairs on the treated water aqueduct supply system each winter, requiring a shutdown of their supply connections. The wholesale agencies recommend that each of its member agencies have 10 days of storage to meet demand requirements until supply facilities are repaired or returned to service. The storage allocated for this purpose is termed reserve storage. Reserve storage is in addition to the daily storage requirements. For the RMWD, reserve storage is located primarily in the Morro and Northside Reservoirs. Temporary pumps are required to supply water to certain zones, depending on which SDCWA aqueduct pipeline is out of service or water use trends during the shut-down period. The District also has accessed water from the City of Oceanside during a SDCWA shutdown.

2.1.6 Pump Station Criteria

Pump Stations should include one redundant pump of the largest pump in the station and are sized based upon the MDD with the largest pumping unit out of service. As stated above, reservoir storage provides for flow differences between MDD and fire-flow or peak hour flows. It is noted that additional pumping capacity is required for pump stations to operate only during off-peak energy periods.

2.2 Sewer System Design and Operation Criteria

Design criteria provide the standards against which the existing system is evaluated. These criteria are also the basis for planning of new facilities to improve existing service or to handle future wastewater flows. The design criteria presented in this Master Plan Update conforms to existing RMWD design standards and planning criteria. Peaking factors used in the hydraulic analysis are based on historical dry and wet weather peak flows observed from metering data, as presented in **Chapter 3**.

2.2.1 Gravity Pipelines

Evaluation of gravity pipelines makes use of Manning's Equation for computation of a pipeline's capacity. The capacity of each gravity sewer is based on the relative depth of flow within the respective pipeline reach. Sewer systems are not typically designed to flow full, as unoccupied space at the top of the pipe is required for conveyance of sewage gasses and to provide contingent capacity for wet weather inflow and infiltration (I&I).

The parameter Depth to Diameter (d/D) is the ratio between the depth of flow and the available diameter of the conveyance pipe. In general, a depth to diameter ratio of between 0.5 (1/2 full pipe) and 0.75 (3/4 full pipe) define the design capacity of the pipe for average dry weather flow. District standards are based on the pipeline flowing 75 percent full at the peak dry weather flow (PDWF) if the pipe is larger than 12-inches in diameter (D/d = 0.75). Sewers 12 inches in diameter and smaller are sized to flow 50 percent full. Wet weather flow design depths typically range from a depth to diameter ratio of 0.75 to 0.85. It is generally undesirable to operate the system at a depth greater than 85 percent, as exceeding these conditions causes pressurized flow and the associated risks of overflow and exfiltration. **Table 2-3** summarizes the d/D criteria.

Table 2-3 RMWD Sewer System Design Criteria

Item	Recommended Gravity Main Criteria
Gravity Pipeline Minimum Pipe Diameter	8 inch
Gravity Pipeline Minimum Velocity	2 fps at peak dry weather flows
Manning's Roughness Coefficient	0.013
Maximum Peak d/D Ratio for 12-inch and Smaller	0.50 for peak dry weather
Maximum Peak d/D Ratio for 12-inch and Larger	0.75 for peak dry weather
Maximum Peak d/D All Sewer	0.85 for peak wet weather
Lift Station Capacity	Provide firm pumping capacity for 130% of ultimate peak flows
Lift Station Backup Power	Require a secondary or emergency power source
Wet Well Volume	Minimum of 6 hours of peak wet weather flow for all stations
Forcemain Velocity Criteria	Minimum velocity of 2.5 fps Maximum velocity of 6 fps

fps = feet per second

Evaluation of existing collection system pipelines makes use of Manning's Equation for computation of a pipeline's capacity. Friction factors for pipelines vary with the material and the age of the pipe. For analysis purposes, the pipeline friction factor assumes that the pipeline has been in service for some period of time, and that some fouling, deposits, and deterioration may have occurred. A roughness factor of 0.013 is typically used to evaluate existing gravity lines and for projection of future sizing needs.

In accordance with District standards, minimum slopes are those that result in a peak daily flow velocity of 2.0 fps at current and ultimate flow volumes and maximum flows not exceeding 10.0 fps. It is desirable to reach a flow velocity of greater than 2.0 fps in the pipeline at least once during a 24-hour period to provide flushing of the pipeline. Preferred minimum slopes are those necessary to maintain a peak velocity of 2.5 to 3.0 fps at 50 or 100 percent flow depth. Existing wastewater collection systems, being already constructed, are compared to the design criteria based on the computed velocity in the pipeline under peak flow conditions. A summary of minimum sewer design slopes is provided in **Table 2-4**.

Table 2-4 RMWD Minimum Slope Criteria to Maintain 2.0 fps

Pipe Diameter (inch)	Minimum Slope (feet)
8	0.0040
10	0.0032
12	0.0024
15	0.0015
18	0.0012
21[(1)]	0.0009
24[(1)]	0.0008
27[(1)]	0.0006

[(1)] Requires special design and District Engineer approval per District policy

2.2.2 Lift Stations

Design of sewage lift stations and forcemains is typically based on projected flow volumes for a projected design flow. Standard design practice for lift station pumps is to provide firm pumping capacity for 130 percent of ultimate peak flows primarily to reduce potential overflow risks due to unanticipated inflow and infiltration, normal wear of the pump impeller, and increased headloss occurring in the discharge pipe due to internal corrosion and/or tuberculation (graphitization). Firm pumping capacity is defined as the capacity of the station operating with its largest pump out of service. Lift stations with a pumping capacity less than 500 gpm are typically equipped with a minimum of two pumps, each pump capable of pumping the design flow. Lift stations with capacity of 500 gpm or greater are typically designed with three pumps. Two pumps operating together are designed to pump peak design flows with the third standby pump able to replace the largest pump. A secondary or emergency power source is required for all lift stations.

Two pump lift stations are operated in an alternating lead/lag configuration with one pump operating and the other pump in a standby mode. This means that under normal operating conditions, only one pump is operating at a time and the pumps alternate operation each pump cycle. However, if the lead pump cannot keep up with the incoming flows or fails to start, the second pump will operate automatically. In three pump lift stations, the first pump operates during low flow conditions, while the second pump comes into operation under peak flow conditions. The third pump is the standby pump. The lead, lag, standby sequence of pump operation is varied sequentially to maintain even pump wear between all pumps.

Wet well volumes are designed to allow for the working volume of the well to store a minimum of 6 hours of peak wet weather flows. Wet wells are not pumped completely empty and therefore a significant portion of their volume is not accessible for storage of incoming flows. The volume available between the lowest pump on level and the overflow level of the wet well is considered to be the working volume.

Standby power is critical in maintaining reliable service and minimizing overflows at lift stations. Standby power can be provided either through the use of a portable power generator or on-site emergency power generators. Currently, all stations are provided standby power through permanent on-site emergency generators.

Forcemains are designed to operate with a minimum velocity of 2.5 fps and a maximum velocity of 6 fps. Velocities of less than 2.5 fps can result in sediments depositing in the forcemain, causing loss of carrying capacity and creating operational problems. Velocities greater than 6 fps can result in scouring of the pipe which can lead to structural damage. In long forcemains, high velocities can create excessive frictional head losses, which result in high operating and maintenance costs, and as a result in long forcemains maximum velocities lower than 6 fps are desired.

For the existing system, lift stations and forcemains are evaluated based on their ability to maintain the design standards of the District. If the design standards are not maintained, the station is identified as deficient and modifications are proposed to rectify the deficiencies. Modifications to existing stations normally include minor changes to the electrical and pumping control systems, changing impeller and motor sizes, or replacement of pumping units with larger units. The wet well of an existing lift station is evaluated on its ability to store flow in order to maintain pump cycling within an acceptable range and provide adequate storage in the event of an emergency. Forcemains are evaluated based on maintenance of an allowable flow velocity, varying between 2.5 and 6 fps.

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Chapter 3
WATER DEMANDS AND SEWER FLOWS

3.1 Summary/Overview

Over the past eight years the effects of economic recession, drought restrictions, increasing water prices, and other factors have combined to produce a fundamental downward shift in District water use and sewer flows. The Master Plan projects **future water demands will be 45 percent lower** than those forecasted in the District's previous master plan, with demands remaining well below historical peak levels. The Master Plan projects future sewer flows will increase from current levels in response to increased residential development within the District's sewer service area.

Historical and projected future water demands are summarized in **Table 3-1** and **Figure 3-1** below.

Table 3-1 Demographic and Water Demand Forecast Summary

Calendar Year:	2013 (actual)	2020	2035	2050	Increase 2013-2050	
Demographic Forecast (per SANDAG)						
Population	19,993	23,789	28,219	28,570	8,577	43%
Employment	--(1)	5,105	6,079	7,307	2,202	43%
Housing Units	8,114	9,414	11,032	11,233	3,119	44%
Demands (Total Water Deliveries)	**21,500**	**20,800**	**20,800**	**20,300**	**-1,200**	**-6%**
Per Capita Potable Demand (gpd)	961	780	660	634	-279	-35%
SB-7 Per Capita Use Goal (gpd)	--	1,168	--	--	--	--

gpd = gallons per day; SANDAG = San Diego Association of Governments
(1) Existing employment information unavailable

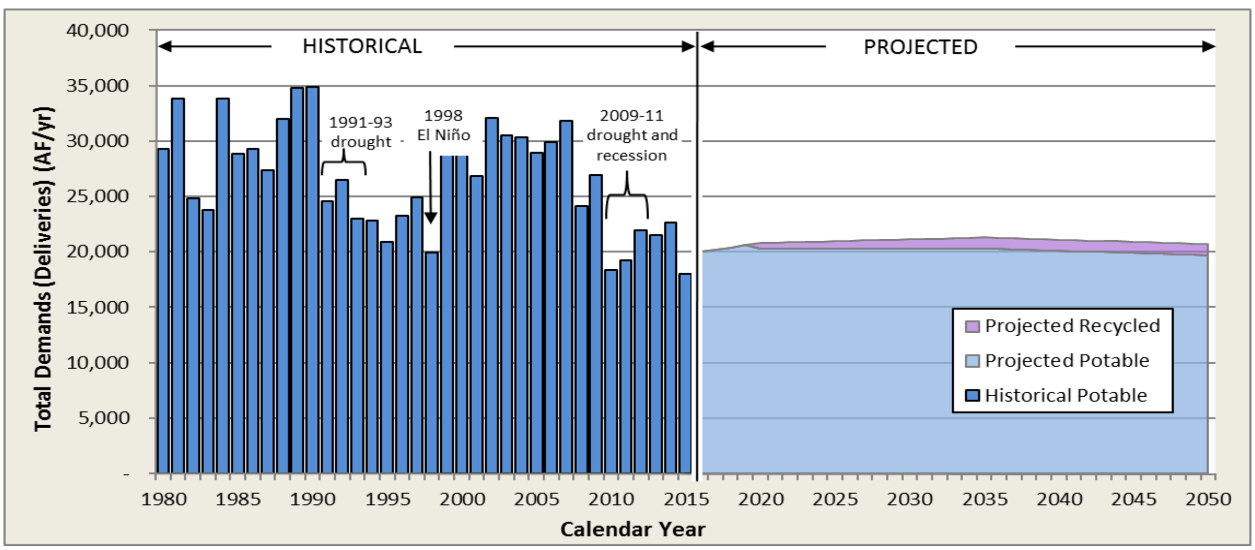


Figure 3-1 Historical and Projected District Total Water Demands

3.1.1 Planning Perspective

The projection of future water demands and sewer flows is central to the Master Plan in that the forecasts determine the future capacity requirements of the District's water distribution and sewer collection systems, and determines the quantity of water supplies the District will need to serve customer demands. These factors in turn determine the make-up of the District's Capital Improvement Program.

Water demand and sewer flow forecasts generally consider how projected changes in land use, population, employment, agricultural production, and conservation levels will alter the water demands existing at the time of the forecast. Over the last 20 years, District master plans have concluded that demands would continue to increase commensurate with increased development. These recent projections are summarized in **Table 3-2**.

Table 3-2 Water Demand and Sewer Flow Forecasts from Recent District Master Plans

Master Plan Year Issued	Planning Horizon	Projected Water Demand		Projected Average Day Sewer Flow
		MGD	AFY	MGD
2006	Buildout (2050)	33.6	37,600	1.5[1]
2015	2035	18.7	20,800	1.39[2]

MGD = million gallons per day, AFY = acre feet per year

(1) Prior District Ordinance 01-02 limited sewer expansion to within 250 feet of existing sewers and total capacity to 1.5 MGD.

(2) This value excludes large developments Meadowood and Warner Ranch located outside of the District which represent a potential additional flow of 0.42 MGD for a total possible flow of 1.81 MGD.

In comparison, the 2015 master plan significantly recalibrates projected water demands and sewer flows. This recalibration is in response to the extraordinary reductions in water demands seen during the past eight years and to other changed conditions, as summarized later in this chapter.

3.1.2 Chapter Outline

This chapter reviews historical and current water demands and sewer flows, and presents the Master Plan's projected future condition demands and flows through 2050. These projected future demand conditions are used by the Master Plan to size and schedule capital improvements for the District's water and sewer systems, as described in **Chapters 5** and **6** of the report. The projected water demands will also be used by the District's 2016 Urban Water Management Plan in addressing the planned balance of supplies with demands.

The remainder of this chapter is organized into the following sections:

- 3.2 Historical and Current Water Use
- 3.3 Land Use and Demographic Projections
- 3.4 Projected Water Demands
- 3.5 Projected Sewer Flows

3.2 Historical and Current Water Use

3.2.1 Historical Use and Recent Trends

For 25 years following its founding in 1954, total water demands in the District service area steadily increased, as agricultural acreage and population increased. By 1984, demands had climbed to almost 34,000 acre feet per year (AFY). Demands then dropped sharply during the drought restrictions of 1991-93, as mandatory cutbacks led to the stumping of avocado groves and other water use reductions, but by 2002 had rebounded almost to pre-1991 conditions.

Beginning in 2008, demands again declined sharply, this time in response to economic recession, price increases, a new round of drought restrictions, and increased adoption of water conservation measures. These factors have combined to produce a fundamental downward shift in per capita water use, with per account use declining by 35 percent from 2006 to 2013. Per capita use reached a minimum during the period from 2010 to 2012, but this was in response to economic recession, cooler than normal summer weather, and other impermanent conditions.

Considering factors of economic equilibrium, average weather conditions, and normal water supply conditions (without water use restrictions in place), the Master Plan has judged calendar year 2013 to be representative of normal water use conditions in the current era, and has defined calendar year 2013 water use as an appropriate baseline condition for use in demand forecasting.

Table 3-3 Historical Demands

Calendar Year	Deliveries (AF)
1980	29,300
1981	33,815
1982	24,843
1983	23,746
1984	33,806
1985	28,886
1986	29,298
1987	27,382
1988	32,028
1989	34,828
1990	34,920
1991	24,567
1992	26,460
1993	22,997
1994	22,832
1995	20,872
1996	23,223
1997	24,906
1998	19,924
1999	28,721
2000	29,203
2001	26,803
2002	32,125
2003	30,472
2004	30,336
2005	28,911
2006	29,929
2007	31,865
2008	24,128
2009	26,894
2010	18,322
2011	19,276
2012	21,918
2013	21,526
2014	22,625
2015	17,868

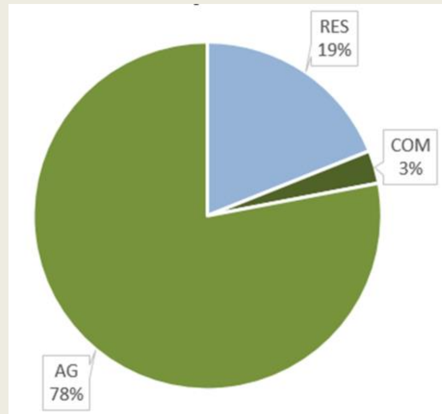
Potable demands most recently peaked in 2006. Subsequently, demands have declined in response to the 2008 recession, price increases, and increased adoption of water conservation measures.

3.2.2 Use by Customer Class

The District accounting system classifies seven categories of water customers:

- D: Single-Family Residential
- MF: Multi-Family
- C: Commercial
- A: Agricultural
- SD: Agricultural/Domestic
- SC: Agricultural/Commercial
- CN: Construction / Temporary Meters

Figure 3-2 shows the distribution of water use by summary customer class, based upon water sales for calendar year 2013. Residential uses account for only 19 percent of total use. The large majority of water use is agricultural.



The green-shaded agricultural uses account for 75 percent of water use.

Figure 3-2 Distribution of Potable Use by Customer Class (Sales)

3.2.3 Seasonal Variation/Monthly Peaking Factors

Water use in the District varies seasonally due to the seasonal nature of landscape irrigation demands. Irrigation demands are low during the winter months, and peak during the consistently dry summer months. Demands during the springtime months exhibit the greatest year-to-year variability, corresponding with variability in springtime precipitation levels.

Recent historical seasonal demand variation and monthly peaking factors are summarized in **Table 3-4**.

Table 3-4 Potable System Monthly Peaking Factors

	2009	2010	2011	2012	2013	2014	2009	2010	2011	2012	2013	2014	Avg.
Jan	50	21	27	39	23	60	0.67	0.41	0.51	0.66	0.39	0.97	0.54
Feb	33	14	31	39	28	47	0.45	0.27	0.58	0.65	0.48	0.75	0.43
Mar	64	29	18	31	46	32	0.87	0.57	0.33	0.51	0.78	0.51	0.67
Apr	81	38	47	37	76	71	1.10	0.75	0.89	0.62	1.29	1.15	0.98
May	88	63	64	65	64	82	1.19	1.26	1.21	1.09	1.08	1.32	1.15
Jun	80	83	69	93	74	76	1.08	1.66	1.30	1.56	1.25	1.23	1.36
Jul	101	80	84	79	91	80	1.37	1.59	1.60	1.33	1.54	1.29	1.45
Aug	100	83	85	89	79	86	1.35	1.65	1.61	1.48	1.33	1.39	1.47
Sep	100	84	81	93	80	74	1.36	1.68	1.53	1.55	1.35	1.19	1.45
Oct	83	42	62	74	60	74	1.13	0.84	1.18	1.23	1.01	1.20	1.14
Nov	79	41	29	55	44	46	1.07	0.82	0.55	0.92	0.74	0.74	0.87
Dec	24	23	36	24	42	16	0.32	0.45	0.68	0.41	0.71	0.25	0.46
Year	**74**	**50**	**53**	**60**	**59**	**62**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**

Notes: Data per SDCWA monthly delivery reports

3.2.4 Non-Revenue Water

In reporting water use data, the District distinguishes between water deliveries, which is the volume of water delivered into the distribution system, and water sales, which is the volume of water recorded by customer meters and billed as sales. Not all water delivered to the system is recorded as sales, and this difference is known as non-revenue water. Non-Revenue water results primarily from aging under-registering water meters, and also includes water loss from leaks in the distribution system, and fire hydrant uses for firefighting and main flushing. Average non-revenue water in the District service area over the past five years is 9.0 percent of deliveries. This is a relatively high level by San Diego area norms, and may reflect an opportunity for the District to reduce the non-revenue percentage through additional meter maintenance and replacement programs, and pipeline leak detection and repair programs.

Detailed data on non-revenue water use is presented in **Appendix A**.

3.3 Land Use and Demographic Projections

3.3.1 Land Use

Land Use Jurisdictions / Adopted Land Use

The District's boundaries and service areas are shown in **Figures 1-1** and **1-2.** All land area in the District is unincorporated, and land use is under the jurisdiction of the County of San Diego and guided by the County's adopted general plan. The land use and demographic projections utilized by the Master Plan as the basis for water demand projections, sewer flows, and system planning are fully consistent with the County's adopted land uses specified in the general plan.

Planned Major Developments

Several large development projects are planned within the District service area, concentrated along and near the State Route (SR) 76 / San Luis Rey River corridor. These are summarized in in **Table 3-5**. A complete list of planned developments including infill projects is included in **Appendix B**.

Table 3-5 Planned Major Developments

Proposed Development	Units / EDUs	SFR Units	MFR Units	Acreage	Development Type	Water Pressure Zone
Upstream of District Office						
Horse Creek Ridge	751	751		381	Single Family (hi-med)	Pala Mesa
Horse Creek Ridge Business Center	100				Commercial	Canonita
Campus Park West	538		283		Mixed	Pala Mesa
Pala Mesa Highlands (Beazer)	130	130		85	Single Family (rural)	Pala Mesa
Palomar College	100				Commercial	Pala Mesa
Dulan	51	51			Single Family (rural)	Pala Mesa
Subtotal	1,670	932	283			
Downstream of Office, Upstream of LS 1						
Ocean Breeze Ranch (Vessels)	400	392		1,385	Single Family (rural)	South
Golf Green Estates	94	94		27	Single Family (hi-med)	Morro
Leatherbury	85	85		178	Single Family (rural)	Pala Mesa
Bonsall Condos	76	76			Single Family (hi-med)	South
Olive Hill Estates	37	37		45	Single Family (rural)	Morro
Subtotal	692	684	0			
Downstream of LS1, Upstream of LS 2						
Polo Club	156	156		442	Single Family (rural)	South
Morris Ranch	89	89		210	Single Family (rural)	South
Hidden Hills	53	53			Single Family (rural)	South
Subtotal	298	298	0			
Totals -- In District	**2,660**	**1,914**	**283**			

EDU = equivalent dwelling units; SFR = single family residential; MFR = multi-family residential
Note: This table excludes large developments Meadowood and Warner Ranch which are located outside of the District. These two developments represent a planned 889 SFR, 735 MFR as well as commercial and institutional development. Including these two developments brings the total EDUs to 4,290.

3.3.2 Population, Housing, and Employment Projections

The Master Plan has utilized the most recent growth and demographic forecast prepared by SANDAG. This forecast is known as Series 13 in SANDAG's history of regional growth plans and forecasts. The SANDAG Series 13 forecast is based on regional demographic and economic forecasts, and on the adopted land use plans of the County and area municipalities. Additional information on the forecast and SANDAG's forecast methodologies are available at the SANDAG website, www.SANDAG.org.

The District worked with SANDAG to obtain custom data reports for the District service area as a whole, and for each of the twelve pressure zones within the water service area. Forecast data by system area is summarized in **Table 3-6**. Additional detailed data are presented in **Appendix B**.

The SANDAG forecast indicates the District service area will continue to grow throughout the forecast horizon, with population projected to increase 43 percent by 2035.

Table 3-6 SANDAG Series 13 Growth Forecast Data for District

Region / Pressure Zone	year	population	household population	group quarters population	total housing units	single family housing units	multi-family housing units	mobile home housing	employment	Persons Per Household
NORTH DISTRICT REGION (SDCWA Connections 1, 9, 10)										
(North, Northside, U1, Vallecitos, Rainbow Heights,	2012	4,328	4,239	89	1,577	1,465	0	112	--	2.74
	2020	4,714	4,628	86	1,707	1,595	0	112	1,426	2.76
	2035	5,616	5,529	87	2,034	1,922	0	112	1,478	2.76
	2050	5,792	5,705	87	2,107	1,995	0	112	1,794	2.75
	Δ	1,464	1,466	-2	530	530	0	0	368	0.00
	Δ (%)	34%	35%	-2%	34%	36%	--	0%	26%	0%
CENTRAL DISTRICT REGION (SDCWA Connections 7, 8)										
(Canonita, Pala Mesa)	2012	8,086	8,077	9	3,361	3,013	10	338	--	2.41
	2020	9,856	9,852	4	3,979	3,631	10	338	1,110	2.48
	2035	12,832	12,822	10	5,076	4,728	10	338	1,771	2.53
	2050	13,080	13,067	13	5,206	4,858	10	338	2,280	2.51
	Δ	4,994	4,990	4	1,845	1,845	0	0	1,170	0.11
	Δ (%)	62%	62%	44%	55%	61%	0%	0%	105%	4%
SOUTH DISTRICT REGION (SDCWA Connections 3, 6, 11)										
(South, Morro, Morro Tank)	2012	11,624	11,475	149	4,614	4,125	323	166	--	2.52
	2020	12,990	12,854	136	5,047	4,558	323	166	3,069	2.57
	2035	15,515	15,344	171	5,925	5,436	323	166	3,218	2.62
	2050	15,530	15,335	195	5,988	5,500	322	166	3,713	2.59
	Δ	3,906	3,860	46	1,374	1,375	-1	0	644	0.07
	Δ (%)	34%	34%	31%	30%	33%	0%	0%	21%	3%
TOTAL DISTRICT										
	2012	24,038	23,791	247	9,552	8,603	333	616	--	2.52
	2020	27,560	27,334	226	10,733	9,784	333	616	5,605	2.57
	2035	33,963	33,695	268	13,035	12,086	333	616	6,467	2.61
	2050	34,402	34,107	295	13,301	12,353	332	616	7,787	2.59
	Δ	10,364	10,316	48	3,749	3,750	-1	0	2,182	0.07
	Δ (%)	43%	43%	19%	39%	44%	0%	0%	39%	3%

Notes: Percentage increase data is for the range from 2012 to 2050. SANDAG categorizes population into Household population, and Group Quarters, with the latter category including college residence halls, residential treatment centers, skilled nursing facilities, group homes, military barracks, and correctional facilities. Housing units are subdivided into Single Family Residential, Multi-family Residential, and Mobile Home units. PPH = persons per household.

3.4 Projected Water Demands

3.4.1 Approach/Methodology

The Master Plan forecasts future water demands using existing unit demands as a baseline, and scales these based on the net effects of growth, conservation, agricultural outlook, and other factors. The forecast methodology is outlined below. Additional detailed information on forecast methodology is presented in **Appendix A**.

a) **Existing baseline unit demands.** The Master Plan uses actual unit use factors for calendar year 2013 as the baseline normal condition demands for the forecast period. 2013 demands are sufficiently distant from the water use restrictions in effect in during 2009-10. Year 2013 was moderately dryer than normal, which would tend to increase use, but this increase is offset by below-normal economic activity as the economy continued to recover.

b) **New development.** New residential development demands are generated using the baseline unit use factors, and the SANDAG Draft Series 13 projections for the District at the pressure zone level of spatial resolution.

c) **Reduced demands due to additional conservation efficiencies and other factors.** The Master Plan projects unit use rates will continue to decline over time in response to increased water rates, conservation education, and shifting landscape preferences. These factors are summarized in **Table 3-7**, and further detailed and quantified in **Appendix A**.

d) **Change in Agricultural demands.** Agricultural demands are forecast based on District estimates, and on price-elasticity of demand response to projected increased water prices. Traditional agricultural customers are expected to have a negative response to projected water price increases while more commercial agricultural customers, specifically nurseries, are somewhat less sensitive to price and are expected to continue to grow within the District. Additional detailed information on forecast methodology is presented in **Appendix A.**

Forecast Methodology Summary

a) Existing Baseline Demands
+
b) New Development Demands
+
c) Net Change from Additional Conservation Efficiencies and Climate Effects
+
d) Net Change from Ag Production Shifts
=
FUTURE DEMANDS

Demand forecast components. The forecast methodology starts with existing baseline demands, and adjusts for growth from new development, and for changes in per account usage due to conservation efficiencies and other effects.

Table 3-7 Summary of Unit Use Adjustment Factors

Factors Driving Unit Use Reductions	
Landscape Ordinances	As required by State law, as of 2010 all land use jurisdictions have adopted landscape ordinances limiting new landscape construction water use to 70% ET, and limiting turf utilization in commercial, industrial, and streetscape uses. As a result, new construction in the District will feature less grass, and be lower water using in comparison to pre-2010 construction.
Weather-Based Irrigation Controllers	Newer landscape irrigation controllers can automatically adjust irrigation schedules consistent with actual climate conditions and plant water needs, reducing unnecessary use due to over-irrigation. The use of these controllers will become increasingly common during the planning horizon.
Turf Retirement	MWD and SDCWA are providing financial incentives to customers who replace grass with low water use landscapes, and customer landscape preferences are shifting away from turf. Existing residential landscapes in the District service area sparsely feature grass.
High-efficiency clothes washers	Newer clothes washing machines, in particular front-loading versions, are more water efficient than older traditional-style washers.
High-efficiency toilets	California regulations enacted in 2011 require new toilets to operate with a maximum of 1.28 gallons per flush (gpf), compared to 1.6 gpf per the previous 1992 requirements. This will reduce water use at new residential construction.
Multi-family Residential Submetering	Future multi-family residential construction will be subject to requirements that individual units be sub-metered and billed by usage. The direct price signal to the consumer results in reduced water use.
Increasing Real Prices / Behavioral Changes	Retail water rates may continue to increase at a rate faster than inflation, driven by increases in wholesale rates. Customers respond by reducing use. The responsiveness of demands to prices is measured by Price Elasticity of Demand, where a price-elasticity coefficient of -0.20 indicates customers will reduce water use by 20% in response to a 100% price increase. Different customer classes will have different P-E coefficients. In general, the District anticipates residential customers will have P-E coefficients in the range of -0.20, that nursery agricultural customers will have somewhat lower coefficients, and other agricultural customers somewhat higher coefficients.
Factors Driving Unit Use Increases	
Climate Change	Per SDCWA's most recent climate change analysis (2013 Water Facilities Master Plan, Appendix E), the median predicted climate change will increase average ETo in the District service area 1.8% by 2035, and approximately 2.9% by 2050.

3.4.2 Projected Demands

The Master Plan forecasts that water demands in the District service area will remain flat relative to existing demands. The forecasted demand levels are **approximately 45 percent lower** than those of the District's previous master plan.

Historical and projected future water demands are summarized in **Table 3-7**, **Figure 3-3**, and **Table 3-8**. Additional detailed forecast data and documentation are presented in **Appendix B**.

Table 3-8 Demographic and Water Demand Forecast Summary

Calendar Year:	2013 (actual)	2020	2035	2050	Increase 2013-2050	
Demographic Forecast						
Population	19,993	23,789	28,219	28,570	8,577	43%
■ Employment	--[1]	5,105	6,079	7,307	2,202	43%
■ Housing Units	8,114	9,414	11,032	11,233	3,119	44%
■ Single Family Residential	7,168	8,468	10,086	10,287	3,119	44%
■ Multi-family Residential	327	329	329	329	2	1%
Mobile Home	616	614	613	605	-11	-2%
Demands (Total Deliveries)						
■ Residential	4,070	4,370	4,890	4,820	750	18%
■ Commercial	660	630	630	630	-30	-5%
■ Agricultural	16,780	15,730	15,260	14,770	-2,010	-12%
■ Temporary	0	60	60	60	60	--
Total Demands	**21,500**	**20,800**	**20,800**	**20,300**	**-1,200**	**-6%**
Per Capita Potable Demand (gpd)	961	780	660	634	-327	-34%
SB-7 Per Capita Use Goal (gpd)	--	1,000	--	--	--	--

gpd = gallons per day
[1] Existing employment information unavailable

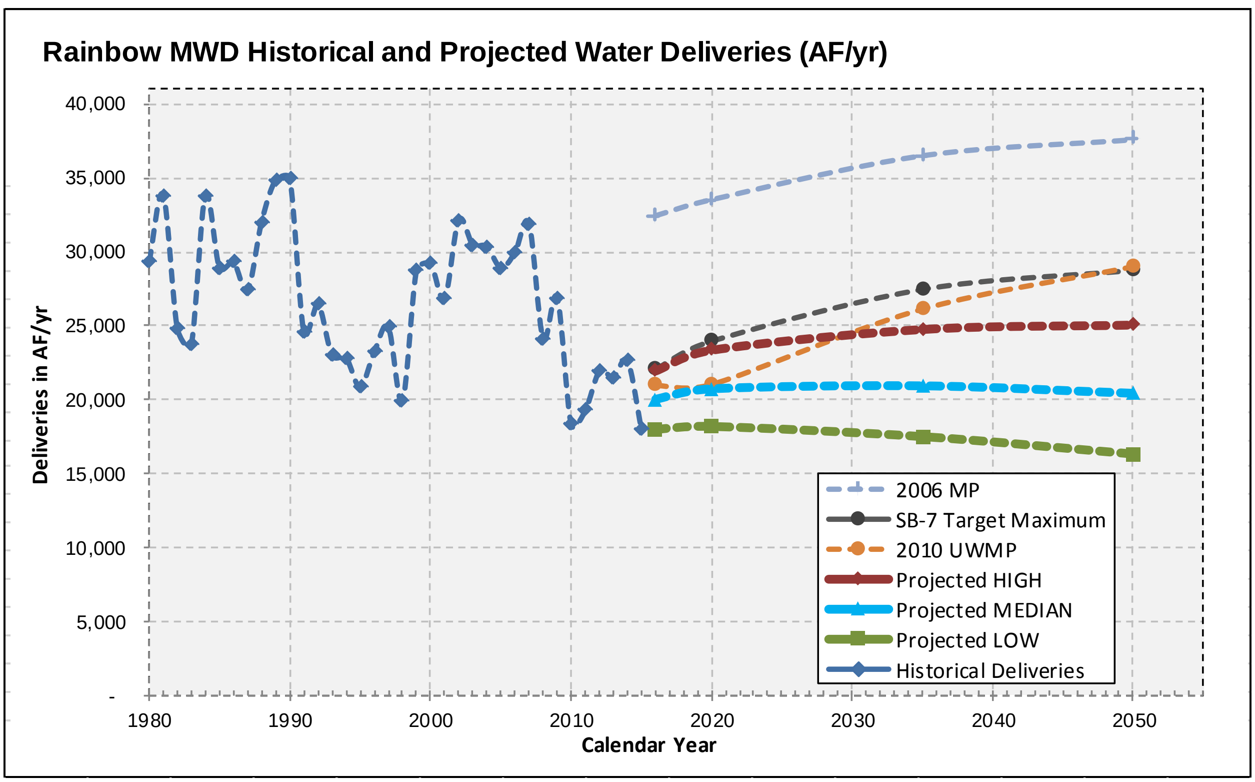


Figure 3-3 Projected Total Water Demands

3.4.3 Forecast Envelope – Alternative Demand Futures

As depicted in **Figure 3-3**, the Master Plan forecast includes a planning envelope to account for the possibility that future demand conditions will develop differently than envisioned by the median demand forecast. The forecast variables used to create the envelope, and to define High and Low forecasts to bracket the Median forecast, are summarized in **Table 3-9** below.

Table 3-9 Forecast Variables for Low, Median, and High Forecast Ranges

Planning Variable	Low	Median	High
Baseline water demand	15% reduction relative to 2013 demands	5% reduction relative to 2013 demands	5% increase relative to 2013 demands
Growth Forecast	Growth rate at 75% SANDAG Series 13	Per SANDAG Series 13	Growth rate at 125% SANDAG Series 13
Price and Price-Elasticity Factors	Real price increase 2050 = 100% P-E Coefficients: -- RES: -0.20 -- COM: -0.05 -- AG: -0.30	Real price increase 2050 = 50% P-E Coefficients: -- RES: -0.20 -- COM: -0.05 -- AG: -0.30	Real price increase 2050 = 0% P-E Coefficients: -- RES: -0.20 -- COM: -0.05 -- AG: -0.30

AG = agricultural; COM = commercial; RES = residential

Upon careful review, the District has elected to use the Median forecast as the planning basis for the Master Plan and its related Capital Improvement Plan. For short-term financial planning, the District plans to use the more conservative Low forecast.

It should be noted that at the time of the preparation of this document the District is also preparing its UWMP for 2016. As part of the demand forecasting conducted for the UWMP, the SDCWA prepares member agency water demand forecasts for all of the agencies it serves. The SDCWA forecast for the District will be reviewed and used as a basis for the District's own UWMP demand forecast. The demand forecast completed in this section was completed prior to the SDCWA releasing its member agency forecasts and therefore may differ from the forecast produced in that document. Despite the potential difference in water demand forecasts, there is negligible impact upon the conclusions reached in this document. Previously the District's existing system has served annual flows as high as 35,000 AFY, 66 percent higher than current demands, and much higher than any revised demand forecast may be anticipated. For these reasons the existing forecasts presented in this chapter will not be augmented once additional forecasting information from SDCWA becomes available and all of the hydraulic conclusions reached will be valid.

3.5 Projected Sewer Flows

3.5.1 Historical Sewer Flows

The District's sewer service area and accompanying sewer flows grew rapidly from the late 1990s into the early 2000s, peaking in the mid-2000s. The peak sewer flows in the mid-2000s were accompanied by increasing water demands before declining somewhat and settling into a normal range thereafter.

Sewer generation rates show significantly less elasticity with respect to economic and drought conditions, with both declines and increases in sewer generation rates appearing to be unconnected to District-wide water conservation, except for at the present time period. In 2015, the District saw significant reductions in both water demand and sewer generation. Reduction in water deliveries to the District was more than 20 percent in response to reduced state water project deliveries as well as mandatory water use restrictions ordered by the state. Sewer flows were also reduced by 15 percent from 2014 to 2015, undoubtedly impacted by reduced water use, but also likely by a host of additional factors.

Fiscal year 2013 was selected as an appropriate baseline condition for use in sewer flow forecasting as it represents a conservative normal condition throughout the District.

Table 3-10 Historical Sewer Flows and Water Deliveries

Calendar Year	Wastewater Flow (MGD)	Water Deliveries (AFY)
1996	0.32	23,223
1997	0.45	24,906
1998	0.47	19,924
1999	0.65	28,721
2000	0.66	29,203
2001	0.76	26,803
2002	0.83	32,125
2003	0.73	30,472
2004	0.79	30,336
2005	0.92	28,911
2006	0.80	29,929
2007	0.81	31,865
2008	0.77	24,128
2009	0.70	26,894
2010	0.70	18,322
2011	0.73	19,276
2012	0.79	21,918
2013	0.76	21,526
2014	0.64	22,625
2015	0.54	17,868

MGD = million gallons per day
AFY = acre feet per year

> Wastewater flows have stayed relatively consistent, peaking during the bubble from 2004-2007 before returning to normal in response to the recession. The state is suffering an extreme, multi-year drought. Associated conservation measures have resulted in significantly reduced water use and sewer flow generation.

3.5.2 Seasonal Variation and Peaking Factors

Sewer flows tend to vary seasonally, with the short wet season typically showing higher than average sewer flow and the dry period that makes up much of the rest of the year hovering very close to the average annual flow. Sewer flow generation, which is flow generated by users connected to the system, typically shows negligible changes across the seasons, suggesting that variations in water use are almost entirely the result of landscape irrigation (outdoor) demands which do not impact the sewer system. Higher sewer generation in the wet season are the result of I&I which can increase dramatically during periods of rainfall. A certain amount of I&I is also always present within the system as a base loading. This concept is discussed further in **Section 3.5.3** and **Appendix C**.

In order to determine the maximum flow that the system is subject to, and therefore should be sized to, flow variations must be analyzed to determine a reasonable peaking factor. Sewer systems are analyzed for both peak dry weather flow (PDWF) and peak wet weather flow (PWWF). PDWF can be observed at any point during the year when there is no rainfall within the three days preceding the peak event, while PWWF is observed on the day of or after a rainfall event. Recent historical PDWF and PWWF flows and peaking factors are summarized in **Table 3-11**.

Table 3-11 Stallion Meter PDWF and PWWF Peaking Factors

	Monthly Max Day Flow (MGD)						Max Day Peaking Factors						
	2009	2010	2011	2012	2013	2014	2009	2010	2011	2012	2013	2014	Avg
Jan	0.75	0.88	0.81	0.84	0.83	0.77	1.07	1.27	1.11	1.06	1.10	1.20	1.14
Feb	0.82	0.78	0.93	0.82	0.93	0.87	1.18	1.12	1.28	1.03	1.24	1.36	1.20
Mar	0.79	0.76	0.87	0.91	0.89	0.90	1.13	1.09	1.19	1.15	1.18	1.40	1.19
Apr	0.91	0.81	0.79	0.89	0.81	0.79	1.30	1.16	1.07	1.12	1.07	1.24	1.16
May	0.74	0.73	0.78	0.86	0.84	0.64	1.06	1.05	1.07	1.09	1.12	1.00	1.06
Jun	0.72	0.72	0.76	0.84	0.82	0.62	1.03	1.04	1.05	1.06	1.09	0.97	1.04
Jul	0.69	0.74	0.74	0.84	0.77	0.60	0.99	1.07	1.01	1.06	1.01	0.94	1.01
Aug	0.72	0.72	0.76	0.86	0.77	0.67	1.03	1.03	1.05	1.08	1.02	1.05	1.04
Sep	0.73	0.70	0.77	0.87	0.78	0.67	1.05	1.01	1.05	1.11	1.03	1.06	1.05
Oct	0.74	0.81	0.79	0.86	0.84	0.67	1.06	1.17	1.08	1.09	1.11	1.05	1.09
Nov	0.75	0.75	0.84	0.88	0.85	0.67	1.07	1.07	1.15	1.11	1.12	1.06	1.10
Dec	0.84	1.34	0.81	0.87	0.82	0.60	1.20	1.93	1.11	1.11	1.09	0.94	1.23

Wet Weather Flow / Peaking Factor
Dry Weather Flow / Peaking Factor
Data per RMWD Stallion Meter daily flow totalizer readings

As can be seen in the data presented in **Table 3-11**, January and February are typically the wettest months within the District. The wet season typically begins in mid to late October and runs through March. Although the PDWF can occur in any month, as long as there is no rainfall corresponding to the date, a pattern of observing the PDWF in April or May was determined through development and analysis of the data.

3.5.3 Inflow and Infiltration

Sewer flows are divided into two categories: those generated by users connected to the sewer system, and those that are the result of surface water inflow and subsurface water infiltration. During wet weather events, surface sheet flow and ponding around manholes can cause inflow into the sewer system. The absorption of surface water into the ground can create or lift a groundwater table which can then infiltrate the sewer system through imperfections in manhole construction as well as through cracks, failing pipe joints and breaks in connections to pipes in the sewer system. Additionally, the presence of a naturally high groundwater table, such as the area surrounding a river, can cause similar infiltration through pipeline imperfections as percolation of surface water.

Inflow is usually minimal and for planning purposes is considered zero during a normal dry weather day. When there is no rainfall, there is not sheet flow or ponding over manhole lids that would cause inflow. Similarly, infiltration of surface flow that can raise the groundwater levels and then penetrate manhole and pipeline imperfections is also not present during dry weather. What is present during dry weather is infiltration into the sewer system that is the result of sewers residing in locations of high groundwater, specifically at the bottom of canyons adjacent to or crossing creeks and rivers. Placement of sewers in these regions subjects them to infiltration on a daily basis rather than only during wet weather events, and although groundwater levels do fluctuate, the amount of flow that enters in the system is thought of as a constant, baseline flow into the sewer system.

For the purpose of planning and projecting a baseline sewer I&I rate, a study of water and sewer records must be performed. In 2010 the District hired consultant IEC to conduct a thorough study of the District's sewer system to determine average, peak dry and peak wet weather flows in its system as well as study base infiltration and rainfall dependent inflow and infiltration. The study determined that the District has a significant volume of both base infiltration and rainfall dependent I&I that is observed primarily in a few relatively small basins. Additional discussion regarding I&I and the IEC study is provided in **Appendix C**.

3.5.4 Oceanside Agreement

The District currently has an inter-agency agreement with the City of Oceanside, established to provide wastewater treatment and disposal services. The agreement is provided in **Appendix D**.

A summary of the 2001 capacity entitlement is shown in **Table 3-12**. Based on fiscal year (FY) 2013-2014 which has been selected as the baseline year for sewer flow data, the average daily discharge was 0.70 million gallons per day (MGD). This leaves a remaining capacity of 0.80 MGD based upon average flows. The agreement with Oceanside also stipulates heavy penalties in the instance that the District exceeds its capacity entitlement more than ten times in a three consecutive calendar month period. This clause was added to allow the District to exceed their allotted flow during wet weather conditions without penalty, but is restrictive enough that should the District's average annual flows reach the allotment of 1.5 MGD, the District will face penalties during the wet season on an annual basis.

Table 3-12 Inter-Agency Agreement with Oceanside

	Capacity Entitlement
Wastewater Treatment Plant	1.50 MGD
Land Outfall	1.50 MGD
Ocean Outfall	1.50 MGD
Transmission Facility First Reach	1.50 MGD
Transmission Facility Second Reach	1.50 MGD

Based on an analysis of average rainfall years, FY 09-10, FY 11-12 and FY 13-14, it is recommended that the District should purchase additional conveyance and treatment capacity rights once average flow reaches 1.35 MGD in order to avoid exceeding the District's capacity entitlement in an average year. FY 10-11 is the wettest period in recent San Diego County history and was used to analyze the actual capacity available in a wet year. Were the District to desire not to exceed their capacity entitlement under any foreseeable circumstance, based on flow data recorded from FY 10-11, it is recommended that the District purchase additional conveyance and treatment capacity rights once average flow reaches 1.25 MGD.

3.5.5 Approach/Methodology

The Master Plan forecasts future sewer flow generation based upon the results of the water demand analysis using both land use and population based unit generation rates as baselines, and adds the net effect of anticipated new large scale development and regional infill. The forecast methodology is outlined below. Additional detailed information on forecast methodology is presented in **Appendix C**.

a) **Existing baseline system flows.** The Master Plan uses actual system-wide sewer flows for fiscal year 2013 as the baseline normal condition demands for the forecast period. 2013 demands are sufficiently distant from the water use restrictions in effect in during 2009-10 as well as the water conservation efforts of the current and ongoing drought. Due to the fact that no records exist for the sewer flow generation of individual users, as opposed to the monthly billing records available for water accounts, previously conducted metering studies were the basis of assigning unit generation rates across the different sewer areas by billing account type.

b) **Baseline sewer inflow and infiltration.** A significant portion of the sewer system, more specifically the main interceptor and outfall sewer, is located in the bottom of valleys adjacent to and in the groundwater basins of both intermittent and perennial streams and rivers. The District is aware that these estuaries historically have caused a significant quantity of infiltration. Based upon the unit generation rates observed in the sewer system and the results of a 2009 sewer monitoring study, a baseline infiltration rate was generated.

Forecast Methodology Summary

a) Existing Baseline Flows
+
b) Baseline Infiltration
+
c) New Development
+
d) Infill Development
=
FUTURE DEMANDS

Flow forecast components. The forecast methodology starts with existing baseline flows, adds approximated infiltration, and adds large and small scale development with lower unit generation rates adjusted for conservation efficiencies.

c) **New development.** Based upon a review of the District's current development forecast as well as a review of the SANDAG Series 13 population and housing projections, a large majority of the District's anticipated growth within the sewer service area is expected to take place in large scale developments. New residential flows are generated using slightly lower baseline unit generation rates developed specifically for new development. New development is assigned its own specific generation rates to account for the fact that new development is required to have more efficient water use systems, which results in less wastewater generation.

d) **Infill development.** Within the Morro (water pressure zone) area there is a difference between the District's development forecast and the SANDAG Series 13 projections that points to a noteworthy volume of infill development within this region of the sewer service area. The sewer flow generation of these properties was forecasted using unit generation rates developed for new single family development.

3.5.6 Projected Flows

The Master Plan forecasts that sewer flows in the District service area will grow substantially relative to existing demands. The forecasted sewer generation is more than 2.5 times the current sewer flows, but are approximately 10 percent lower than those of the District's previous master plan. The District also has two large out of District projects, Meadowood and Warner Ranch, that are currently considering annexation or out of service area agreements that could add an additional 0.42 MGD of flow to the required capacity of the system.

Historical sewer flows are summarized in **Table 3-10** and projected flows in **Table 3-13** and **Figure 3-4** below. Additional detailed forecast data and documentation are presented in **Appendix C**.

Table 3-13 Sewer Flow Forecast Summary

	2013 Water Sales (Actual)	2013 Sewer Flow (Estimated)	2035 Sewer Flow (Projected)	Sewer Flow Increase 2013-2035	
Single Family Residential	1.22	0.38	0.87	**0.48**	120%
Multi-family Residential	0.12	0.09	0.15	**0.06**	69%
Commercial	0.14	0.02	0.17	**0.15**	659%
Agricultural	0.62	0.04	0.04	**0.00**	0%
Baseline Infiltration	--	0.14	0.14	**0.00**	0%
Total	**2.10**	**0.56**	**1.39**	**0.69**	**224%**

	2013 Water Sales (Actual)	2013 Sewer Flow (Estimated)
Per Single Family Connection Residential Demand / Flow (gpd)	597	200
Per Multi-family Connection Residential Demand / Flow (gpd)	3,537	2,700
Per Commercial Connection Demand / Flow (gpd)	3,154	500
Per Agricultural Connection Demand / Flow (gpd)	4,609	325

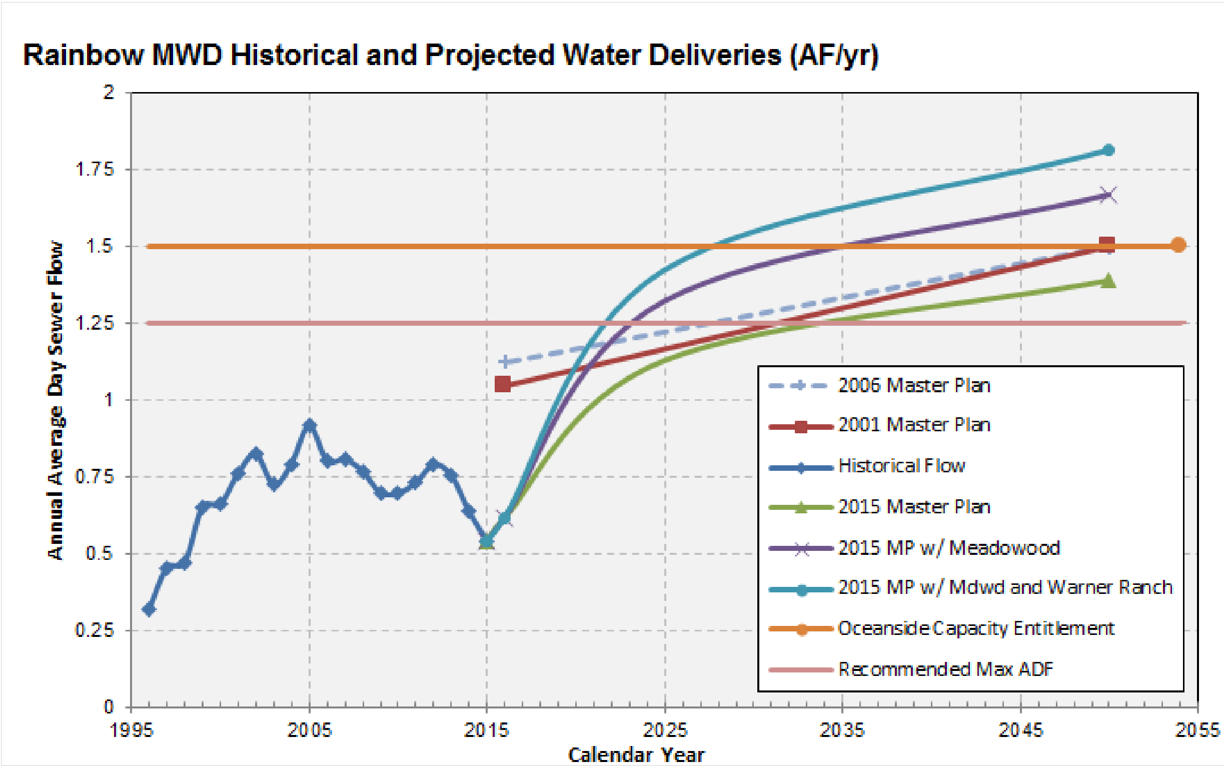


Figure 3-4 Projected Total Sewer Flows

Chapter 4
WATER SUPPLY

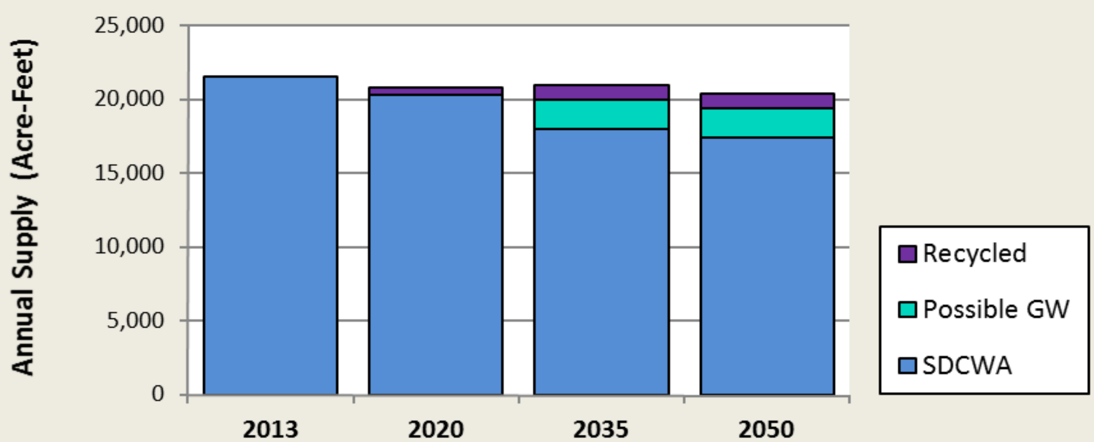
4.1 Overview

The District historically has relied upon imported deliveries from the San Diego County Water Authority for all of its water supply. In recent years, as the price of this supply has continued to increase, and as supply reliability has remained compromised, the District has undertaken evaluations of local supply opportunities including recycled wastewater and local groundwater desalting projects. The Master Plan supply forecast anticipates the District will develop approximately 1,000 acre-feet per year of recycled water supply for use within the District service area by or shortly after 2020, and may also develop an additional 2,000 acre-feet or more of local desalted groundwater supply by 2025. Together, these projects would constitute approximately 15 percent of the District's supply, enhancing supply reliability and reducing the District's reliance on imported water supplies.

The water supply summary for the District is shown in **Table 4-1** and **Figure 4-1**.

Table 4-1 Supply Summary for Normal-Year Conditions, 2013-2050 (AFY)

	2013	2020	2035	2050	Increase 2013-2050	
DEMANDS – Total	21,500	20,800	20,800	20,300	-1,100	-5%
SUPPLIES – Total	**21,500**	**20,800**	**20,800**	**20,300**	**-1,100**	**-5%**
Potable	21,500	20,300	19,800	19,300	-2,100	-10%
-- Possible Groundwater	0	0	2,000	2,000	2,000	--
-- SDCWA	21,500	20,300	17,800	17,300	-4,100	-19%
Recycled	0	500	1,000	1,000	1,000	--



Decreasing Reliance on Imported Supplies: The District's planned development of a local recycled water supply, and its possible development of a local groundwater desalting project, will enhance supply reliability and reduce the District's reliance on imported water supplies.

Figure 4-1 Supply Summary for Normal-Year Conditions, 2013-2050

This chapter of the Master Plan describes the District's present supply situation, and its proposed strategies to diversify its sources to enhance reliability and economy.

This Water Supply chapter is organized into the following sections:

- 4.2 Existing Supplies and Facilities
- 4.3 Supply Reliability – Rainbow Water Shortage Events and Consequences
- 4.4 Possible Future Supplies

4.2 Existing Supplies and Facilities

4.2.1 Existing Conditions and Supply Reliability Challenges

The District obtains 100 percent of its water supply from SDCWA, of which it is one of 24 member agencies. SDCWA in turn obtains most of its water through facilities owned by MWD, which in turn obtains its water from northern California via the State Water Project (SWP), and from the Colorado River via the Colorado River Aqueduct (CRA).

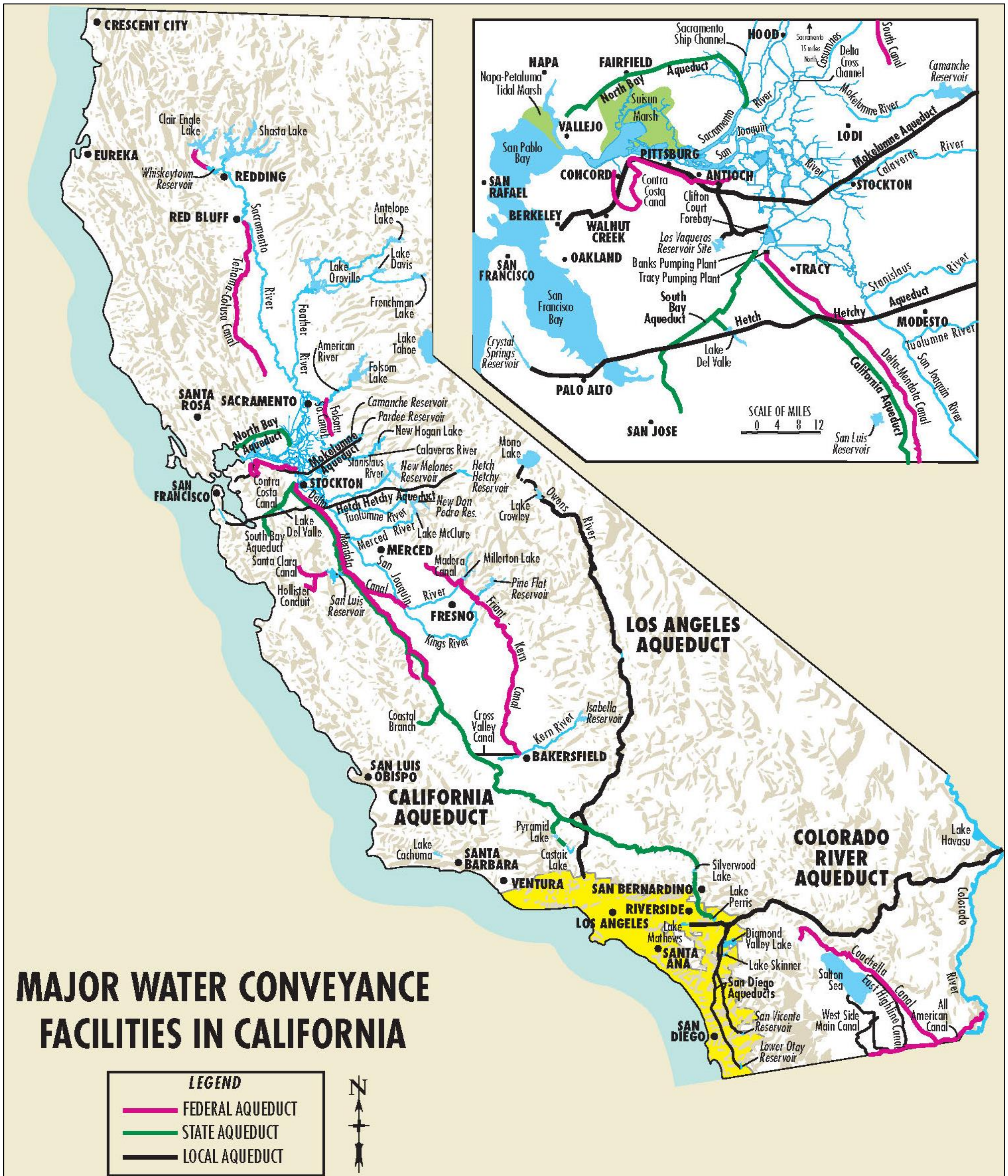
Historically, Metropolitan and the Water Authority have met the growing water demands of southern California's growing population and economy by pursuing new sources of supply and new tools for water supply management, including surface and groundwater storage, water transfer and exchange agreements, and most recently seawater desalination development. In addition, water agencies throughout the region have implemented water conservation, water reclamation, and other local supply and water management measures to help balance supplies and demands and to provide a high level of water supply reliability to their customers. Both agencies recognize that their ability to provide long-term water supply reliability in the region will depend heavily on the collective efforts of retail agencies such as the District to develop conservation and local supply projects suitable for their respective service areas.

Despite these collective efforts to provide water supply reliability, drought conditions have at times led to water supply shortages and the need for water use restrictions and rationing to reduce water demands. Periods of widespread water use restrictions have occurred in 1976-77, 1992-93, 2009-11, and most recently from 2014 to the present.

On April 1, 2015, in response to record low snowpack levels, Governor Brown issued an executive order intended to save water, increase enforcement to prevent wasteful water use, streamline the state's response, and invest in new technologies that will make California more drought resilient. The order required a 25 percent reduction in water use across the state. Under the terms of emergency regulations formulated by the State Water Resources Control Board (SWRCB) to implement the Governor's executive order, the District has been required to achieve a 36 percent reduction in residential per capita use in comparison to 2013 usage. The SWRCB order exempts agricultural uses, which account for nearly 80 percent of District water use, from the cutback requirements.

4.2.2 Metropolitan Water District of Southern California

MWD was formed in 1928 to provide wholesale distribution of supplemental water in southern California for domestic and municipal purposes. MWD is a consortium of 26 cities and water agencies, including the SDCWA. It obtains supplies from the Colorado River via the CRA, which it owns and operates, and from northern California via the SWP. MWD's main sources of supply are shown in **Figure 4-2**.



MWD obtains its water supplies from two sources. One is the Colorado River via the Colorado River Aqueduct, which MWD owns and operates, and is shown in black toward the bottom of the map. The other is the State Water Project, owned and operated by the California Department of Water Resources, and to which MWD holds the largest contract for supply.

Figure 4-2 MWD Sources of Supply

MWD's plans for providing supply reliability to its member agencies are summarized in its 2010 IRP and its 2010 Regional Urban Water Management Plan (RUWMP). MWD's supply reliability goal, as embodied in both these plans, is to provide, in coordination with its member agencies, a mix of imported and local supplies and conservation programs that will provide 100 percent reliability for all full-service demand customers in its service area.

The IRP and RUWMP include a planning buffer to mitigate against planning uncertainties, such as the risk that planned local supply projects may not all be implemented as forecast, or that future demands will be higher than forecast. The planning buffer identifies an additional increment of water that could be developed if needed. The planning buffer is intended to ensure that the southern California region, including the SDCWA and its member agencies, will have adequate water supplies to meet future demands.

4.2.3 San Diego County Water Authority

The SDCWA is one of 26 member agencies of MWD. The SDCWA is MWD's largest member agency in terms of purchases, having purchased approximately 20 percent of all the water MWD delivered in fiscal year 2013-14. The SDCWA delivers treated and raw water into San Diego County through five large diameter pipelines, located in two principal corridors known as the First and Second San Diego Aqueducts. These are shown in **Figure 4-3**.

The SDCWA was formed in 1944 by the California Legislature to provide a supplemental supply of water as the San Diego region's civilian and military populations expanded to meet wartime activity needs. Today, the SDCWA has 24 member agencies and supplies between 75 to 95 percent of the water needs of its service area.

To reduce its dependency on MWD and diversify its supplies, SDCWA in recent years has undertaken several initiatives, including the following:

- **Carlsbad Seawater Desalination Water Purchase Agreement:** To further help diversify regional supplies, SDCWA in 2012 entered into a Water Purchase Agreement under which it agreed to purchase up to 56,000 AFY of desalinated water from the recently completed Carlsbad Seawater Desalination Plant, owned by an affiliate of Poseidon Resources, Inc. The plant became operational in December 2015.
- **Imperial Irrigation District Transfer:** The SDCWA signed a Water Conservation and Transfer Agreement with Imperial Irrigation District (IID) in 1998. Through the transfer agreement, the SDCWA is purchasing water from IID at volumes that will gradually increase year-to-year, reaching 200,000 AFY in 2021. The water is physically delivered to San Diego via MWD's Colorado River Aqueduct.
- **All-American and Coachella Canal Lining Conserved Water:** In 2003, as part of the execution of the Quantification Settlement Agreement on the Colorado River, the SDCWA was assigned rights to 77,700 AFY of conserved water from projects to line the All-American and Coachella Canals. These projects are now complete and the SDCWA is receiving this water. As with the IID transfer water, the water is physically delivered to San Diego via MWD's Colorado River Aqueduct.
- **Water Transfer and Banking Programs:** In addition to the above, the SDCWA has entered into water transfer and water banking arrangements with Central Valley area agricultural agencies and groundwater storage interests. These projects are designed to make additional water available to the SDCWA during dry-year supply shortages from MWD.

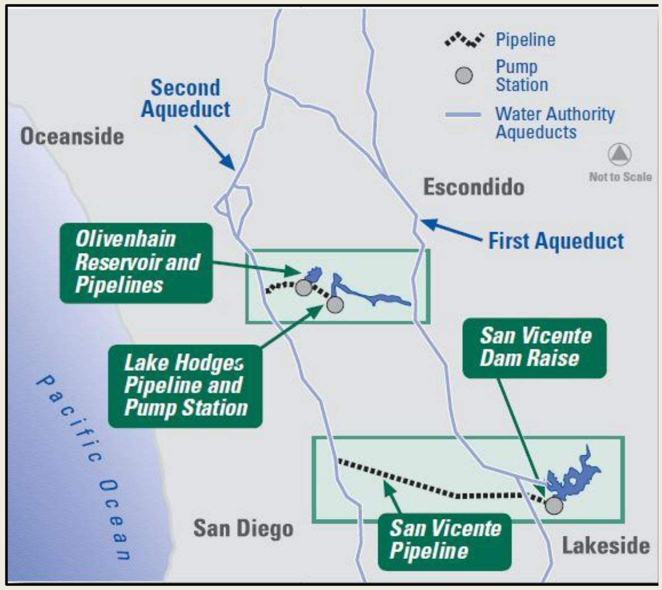
The exhibit shows the SDCWA system as it enters San Diego County. The District receives treated water from both the First and Second aqueducts.

Figure 4-3 SDCWA Aqueduct System

4.2.4 Water Authority Emergency Storage Project

The SDCWA aqueduct facilities shown in **Figure 4-3** connect to treated and raw water feeds from Metropolitan facilities at Lake Skinner, in southern Riverside County. Recognizing the potential for a large earthquake or other emergency condition to cause a sustained outage of the pipelines, the SDCWA in the early 1990s began planning for its Emergency Storage Project (ESP) to safeguard against this risk. Currently, SDCWA has plans in progress for development of the North County ESP.

The primary objective of the ESP is to develop an emergency storage and delivery system able to provide 75 percent of two-month peak water demand for all water users in the Water Authority service area. This is referred to as the "two-month" emergency event. The major facilities of the ESP include the Olivenhain Reservoir and pipeline, the Hodges - Olivenhain Connection, the San Vicente Dam enlargement, and San Vicente – Miramar Pipeline, all as shown in **Figure 4-4**.



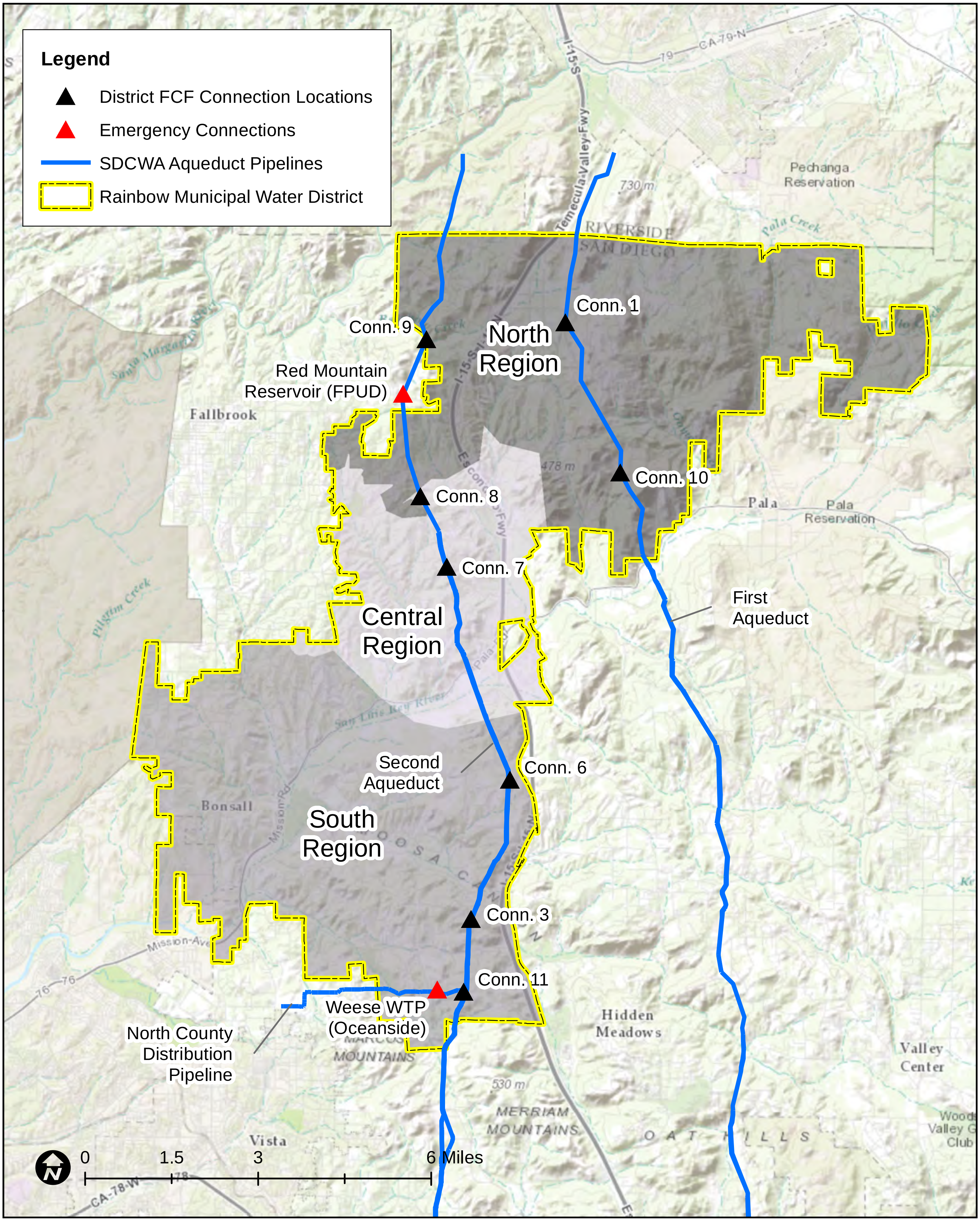
The exhibit shows the major components of the Water Authority's Emergency Storage Project. A key phase of the system required for ESP service to the District -- the North County ESP Facilities -- has not yet been completed by the Water Authority. The Master Plan recommends the District coordinate with the Water Authority to ensure timely completion of this final phase of the ESP.

Figure 4-4 Major Facilities of the ESP System

Although all of the largest components of ESP facilities are now completed or nearing completion, the Water Authority has not yet initiated construction of the final phase of the project necessary to provide ESP service to the northern reaches of the District service area. This phase is known as the North County ESP facilities. Absent the North County ESP facilities, the Water Authority is unable to provide full ESP deliveries to far northern reaches of the First and Second Aqueducts, and hence to the northern portions of the District service area served by those reaches. Currently, however, SDCWA has plans in progress for development of the final phase of the North County ESP and construction is scheduled to begin in 2018.

4.2.5 District Connections to Water Authority

Table 4-2 lists the District's current flow control facility connections to SDCWA Pipeline 4 their rated capacities in cubic feet per second (cfs), and the District systems served. The location of the facility is shown schematically in **Figure 4-5**. The facilities generally have a turn-down ratio of 10:1, meaning that the minimum non-zero flow through the facility is one-tenth, or 10 percent of the rated capacity.



Rainbow Supply Connections

FIGURE 4-5

1/22/2016 gool4566 \\sdofs01\Data\Clients\Rainbow MWD\100044880 2015 MP Update\GIS\mxd\Figure 4-5 RainbowSupplyConnections.mxd

ATKINS

Table 4-2 District Connections to Water Authority System

FCF No.	Aqueduct	Minimum Delivery HGL (feet)	Rated Capacity cfs	Rated Capacity MGD	District Region and Service Zones Supplied
9	Second	1,216	20(1)	13(1)	North Region (North, U1, Rainbow Heights, Magee, Gomez, Vallecitos, Northside)
1	First	1,268	22	14	
10	First	1,242	22	14	
8	Second	1,078	25	16	Central Region (Canonita, Pala Mesa)
7	Second	1,078	40	26	
6	Second	1,078	22	14	South Region (South, Morro, Morro Tank)
3	Second	1,078	22	14	
11	NCDP(2)	1,040	30	19	

cfs = cubic feet per second; MGD = million gallons per day; FCF = flow control facility, HGL = hydraulic grade line
Minimum flow rates are 10 percent of the rated connection capacity.
(1) Due to hydraulic constraints, the actual flow capacity of the No. 9 connection is approximately 5 cfs (3 MGD).
(2) NCDP = North County Distribution Pipeline. The pipeline is fed from Pipeline 4 of the Second Aqueduct.

4.2.6 Rainbow 9 FCF

The Rainbow 9 connection delivers treated water from the Second Aqueduct, Pipeline 4, to the District's North Reservoir and North service zone. Although the connection has a rated capacity of 20 cfs, the limited head differential between the aqueduct delivery gradient of 1,216 feet, and the North Zone nominal operating gradient of 1,212 feet, constrain the actual delivery capacity to approximately 5 cfs. Because the north region of the District is also fed by the District's two First Aqueduct connections, 1 and 10, the constraint on deliveries from the No. 9 connection is usually inconsequential. However, during periods when the First Aqueduct is shut down for inspection and maintenance, the limited capacity of the No. 9 connection can result in operational challenges for maintaining adequate supply to the north region. A possible solution to the limited delivery capability at the No. 9 connection would be to raise the invert elevation of MWD Vent 6 on Pipeline 4, adjacent to Red Mountain Reservoir. An increase of approximately 10 feet would increase the minimum delivery gradient at the No. 9 connection by a like amount, increasing delivery capacity. This portion of the aqueduct is owned by MWD, and such a project would need to be initiated by SDCWA. The Master Plan recommends the District review the potential for such a project with SDCWA.

4.3 Supply Reliability – Rainbow Water Shortage Events and Consequences

An assessment of the District's supply reliability begins with consideration of the types of events that could result in water supply shortages to the District. Possible shortage events facing the District include the following:

1) **Drought and other prolonged reductions of imported water supplies**: Imported water supply shortages, whether caused by drought or other factors, may result in reduced deliveries to the District under the terms of the Water Authority's Drought Management Plan.

2) **ESP Event:** An ESP event is an emergency outage of the San Diego aqueduct pipelines, such as could be caused by a major earthquake on the Elsinore Fault. The Water Authority's ESP Facilities are designed to provide a minimum 75 percent retail service capability for the estimated two-month period required for repair of the aqueducts.

3) **Scheduled Shutdown of Second Aqueduct Pipeline 4 (Treated Water):** With the exception of connections 1 and 10 in the North service area, the District's water connections to the Water Authority aqueduct system are supplied by the Second Aqueduct, Pipeline 4. As with all the Water Authority pipelines, Pipeline 4 is subject to occasional planned shutdowns for inspection and maintenance. These shutdowns have typically occurred approximately once per year. During Pipeline 4 shutdown events, the District historically has relied on its First Aqueduct connections, its treated water storage, and an improvised interconnection to the City of Oceanside's Weese Water Treatment Plant. Because the District's treated water storage is not proportionally distributed among service zones, the District has utilized temporary pumps to move water from storage in Morro Reservoir to supplement supplies in the South service area.

4) **Scheduled Shutdown of First Aqueduct (Treated Water):** The District's 1 and 10 connections in the North service area are supplied by the First Aqueduct. The First Aqueduct for most of its reach contains two pipelines, Pipeline 1 and Pipeline 2, but the two pipelines are interconnected in places and do not operate independently. As with all the Water Authority pipelines, the First Aqueduct pipelines are subject to occasional planned shutdowns for inspection and maintenance. These shutdowns have typically occurred approximately once every other year. During First Aqueduct shutdown events, the District historically has relied on its treated water storage, and its No. 9 connection from Pipeline 4 to the North service area.

5) **Scheduled Shutdown of Both Aqueducts (Treated Water):** A scheduled shutdown of both aqueducts is an infrequent event, occurring on the order of once every 10 years. The District response capabilities are similar to those described for the individual aqueduct shutdowns, and include utilization of an emergency interconnection with Fallbrook Public Utility District (FPUD) to receive treated water from FPUD's Red Mountain Reservoir into the District's North service area.

6) **Unscheduled Aqueduct Shutdowns:** Unscheduled shutdowns of either aqueduct could occur due to facility damage or other causes. The District's response to such events would be similar as for the schedule shutdown events, except that the District may not have had the opportunity to fill its treated water storage in advance of the shutdown.

Table 4-3 summarizes the types of water shortage events that could affect the District, the assets currently available to the District to address the shortage event, and the consequences of each event to the District with existing assets.

4.3.1 Supply Reliability – Discussion and Recommendations

The information in **Table 4-3** suggests the District is able to respond to and manage interruptions and shortages of imported water supplies. Over the past decade, the Water Authority, on behalf of the District and the other Water Authority member agencies, has made significant investments in regional supply reliability through the ESP, the Twin Oaks WTP, the Aqueduct Protection Program, the Carry-Over Storage Project, and other projects, and these benefit the District as reflected in the table, or will upon final completion of the North County ESP Facilities as noted previously. The District also benefits from its interconnection capability with Oceanside and FPUD.

Table 4-3 Summary of Potential Shortage Events and Consequences

Event	Frequency	Duration	Existing Response Assets	Consequence
1) **Drought** (or other prolonged reduction in imported water supplies)	Unknown (Imported supply reliability is dependent on State, MWD, and Water Authority actions)	**1 year** and longer	a) State, Metropolitan, and Water Authority response capabilities b) District drought response ordinance and rate structure c) Water Authority Carry-Over Storage Project (San Vicente Reservoir expansion)	**Significant** (Cutbacks to District treated water customers at same level as Water Authority cutbacks to District)
2) **2-Month ESP Event** (Earthquake-induced or other failure of all or most of the San Diego Aqueduct pipelines)	Low (on the order of one event per 100 years)	**2 months** (per ESP design criteria, based on aqueduct repair time estimates)	a) Water Authority ESP facilities and Twin Oaks WTP (for North region of District, dependent upon completion of ESP North County Facilities ~2020) b) District Treated Water Storage c) District Water Shortage Contingency Plan	**Moderate to Significant** (No Water Authority deliveries for 4-7 days; thereafter deliveries at 75% level of service)
3) **Treated Water Shutdown of Second Aqueduct** (planned event)	Annually (approximately)	**10 days** (Dec. – Mar. window)	a) First Aqueduct connections b) District Treated Water Storage c) Temporary pumps to move water from Morro Reservoir to South service area d) Temporary pumps to receive water from Oceanside's Weese WTP e) Public Information and conservation messaging	**Minor** (Possible drawdown of District storage to below preferred levels)
4) **Treated Water Shutdown of First Aqueduct** (planned event)	Biannually (approximately)	**10 days** (Dec. – Mar. window)	a) Second Aqueduct connections b) District Treated Water Storage	**Minor** (Possible drawdown of District storage to below preferred levels)
5) **Treated Water Shutdown of both aqueducts** (planned event)	Once every 10 years (approximately)	**10 days** (Dec. – Mar. window)	a) District Treated Water Storage b) Temporary pumps to move water from Morro Reservoir to South service area c) Temporary pumps to receive water from Oceanside's Weese WTP d) Emergency interconnection to Fallbrook PUD e) Public Information and conservation messaging	**Minor to Moderate** (Requires activation of emergency connection to FPUD; Possible drawdown of District storage to below preferred levels)

Table 4-3	Summary of Potential Shortage Events and Consequences			
6) **Unscheduled Shutdown of one or both aqueducts** (local emergency event, non-ESP)	Once every 10 years (approximately)	**10 -14 days**	a) Same as for scheduled shutdowns, but without the ability to pre-fill reservoirs in anticipation of an outage, and with potential for event to occur during peak summer months	**Moderate to Significant** (May require emergency conservation actions to conserve treated water storage)

As described above, the Master Plan recommends the District pursue the following improvements relative to its supply reliability:

- **Permanent Pumping Facilities from Morro to South Service Zone:** Provide permanent pumping facilities to convey water from Morro Reservoir to the South service area. This will eliminate the need to procure and install temporary pumping equipment during shutdown events, and improve the District's ability to manage storage in Morro Reservoir.
- **Permanent Pumping Facilities from Weese WTP to South Service Zone:** Provide permanent pumping facilities to convey water from the City of Oceanside's Weese Water Treatment Plant into the South service area, and ensure there is an interagency service agreement in place between the District and Oceanside. This will eliminate the need to procure and install temporary pumping equipment during shutdown events.
- **Completion of North County ESP Facilities:** The Master Plan recommends the District coordinate with the Water Authority to assure timely completion of the North County ESP facilities needed to provide emergency service to Northern portion of the District service area.

4.4 Possible Future Supplies

4.4.1 Recycled Water

In September 2015 the District completed a preliminary study (Atkins 2015) examining the feasibility of constructing a District-owned wastewater reclamation facility and recycled water distribution system. These facilities would be capable of delivering between 1,000 to 1,600 AFY of recycled water to District customers, reducing potable water demands by a like amount. The District is currently embarked on more detailed preliminary design studies to confirm the feasibility of the project. However, based on the preliminary assessment, the District anticipates the project is likely to proceed, and the Master Plan assumes the project will be operational in 2020, with full capacity reached in 2025. The feasibility study, Technical Memorandum No. 1 of the Master Plan, is included in **Appendix E**.

At present, the District conveys the entirety of the wastewater collected within its sewer service area to the City of Oceanside for treatment and disposal. In light of recent and ongoing drought conditions within southern California, the District has contemplated whether construction of its own water recycling project would be more cost effective and resource-efficient than continued conveyance of wastewater flows to the city. The 2015 preliminary study considered several options of plant siting, sizing, and other factors, and compared the overall costs and benefits of these to the No Project alternative of continued wastewater conveyance to Oceanside. The project options being considered could make available between 1,000 to 1,600 AFY of recycled water for distribution within the District service area. Additionally, the District has demand well in excess of the volume of recycled water it can produce and has considered expanding the recycled water volume available by supplementing it with raw water. All of these options are being considered and refined as part of the detailed preliminary design study being performed.

4.4.2 Groundwater Desalter

In January 2016 the District completed a preliminary study (West Yost Associates 2016) examining the feasibility of developing local San Luis Rey River basin groundwater resources for District use. The project would include a well field, and either the construction of a Rainbow groundwater desalting plant, or the conveyance to an expansion of the City of Oceanside's existing groundwater desalting plant for treatment and exchange of supply back to the District. The preliminary study examines a project developing up to 4,000 AFY of new treated supply. The groundwater to be developed originates as District-supplied imported water to the basin, and percolates to the groundwater as a result of agricultural irrigation and soil salinity management practices.

The District is evaluating the findings of the preliminary study prior to committing to further action on the project. Although the preliminary results of the study appear promising, the District recognizes that additional engineering and environmental evaluations will be necessary to confirm project feasibility and sizing. For purposes of the Master Plan, the District anticipates the project will be operational by 2025 with a treated water yield of 2,000 AFY, and that future expansions to higher capacities may be possible but are subject to various planning uncertainties.

4.4.3 Local Supply Option Summary

Local supply options under consideration by the District are summarized in **Table 4-4**.

Table 4-4 Possible Future Local Supplies

Project	Description	Status	Yield (AFY)	Capital Cost ($Million) (1)
Water Reclamation Plant and Recycled Distribution System	The proposed plant would produce recycled water for irrigation uses within the District service area.	Feasibility Studies / Preliminary Design	1,000	$56(2)
Groundwater Desalter	The concept-level project would produce potable water for distribution within the District service area.	Feasibility Assessment	2,000(3)	$32(4)
		Total	**3,000**	**$88**

(1) 2015 dollars

(2) The capital costs includes $36 million for the 0.9 MGD water reclamation plant and related conveyance facilities, including credit for sell-back of Rainbow's unused capacity to Oceanside, and $20 million for 0.9 MGD of recycled water distribution facilities, before grants.

(3) The District's concept study identifies up to 4,000 AFY of project potential. The Master Plan presents a lower yield in the interest of planning conservatism.

(4) Value based on 60 percent of the concept study estimate for a 4,000 AFY project. The cost does not include capacity fees for brine-disposal utilization of the Oceanside land and ocean outfalls.

Chapter 5
POTABLE WATER SYSTEM EVALUATION

This chapter describes the existing potable water distribution system, hydraulic computer model, and analysis methodology. The hydraulic analysis employs the use of *InfoWater* from Innovyze®, which is a fully Graphical Information System (GIS) integrated water distribution modeling and management software application built atop ArcGIS. Hydraulic analysis results for the evaluation of the water distribution system for 2013 and 2035 planning horizon conditions are summarized and system deficiencies are identified.

5.1 Existing System Description

RMWD's existing water distribution system is comprised of 12 major pressure zones with storage facilities. Four of the major zones are supplied directly from SDCWA aqueduct connections and the remaining major zones are supplied through pressure reducing stations or booster pump stations. In addition to the major zones, there are 30 reduced pressure areas that are supplied from the major zones through pressure reducing stations. The RMWD hydraulic profile schematic showing the aqueduct connections, pressure zones, storage facilities, booster pump stations, pressure reducing stations and emergency supply interconnects is provided on **Figure 5-1**. The map on **Figure 5-2** illustrates the location of these distribution system facilities. The major facilities depicted on the schematic and illustrated on the distribution system map are described in the following subsections.

5.1.1 Major Pressure Zones

The twelve major pressure zones within the RMWD system are identified by a name and number that corresponds to the hydraulic grade elevation set by the high water level of the tank or reservoir. The District is characterized by steep and varying terrain, and the pressure zone grades range from 825 feet to 2,160 feet above mean sea level. The hydraulic grade line and water supply sources for each major pressure zone are summarized in **Table 5-1**.

The District was formed from the merging of several water purveyors decades ago, and as a result the gradient spacing between zones is irregular. Zone boundaries have been modified over time to increase pressures in some local critical areas or reduce pressures in older pipelines. Field operators adjust some of the pressure boundaries seasonally to improve water circulation; therefore the boundaries shown on **Figure 5-2** can fluctuate. The Morro, South, Pala Mesa and Canonita zones each include multiple smaller reduced pressure areas that are supplied from pressure reducing stations.

Table 5-1 Major Pressure Zones

Zone	HGL (feet)	Water Supply Source	
		Main	Secondary
Magee	2,160	Rainbow Heights via Booster PS 7	None
Rainbow Heights	1,967	North Zone via Booster PS 1	Magee
Gomez	1,710	North Zone via Booster PS 6	Rainbow Heights
U-1	1,579	North Zone via Booster PS 2	None
Vallecitos	1,338	North Zone via Booster PS 3	Rainbow Heights
Northside	1,282	North Zone thru Booster PS 4	None
North	1,212	Connections 1, 9, and 10	Northside & Rainbow Heights
Canonita	1,019	Connections 7 and 8	Northside & North
South	1,011	Connections 3, 6 and 11	Morro via emergency pumps
Pala Mesa	897	Connection 7	Canonita
Morro Tank	865	Morro Zone thru Booster PS 5	Pala Mesa via Morro Zone
Morro	825	South	Pala Mesa
HGL = Hydraulic grade line			

5.1.2 Distribution Pipelines

The existing distribution system has over 320 miles of pipelines ranging in size from 4-inches to 42-inches in diameter. Most of the smaller diameter pipelines are constructed of asbestos cement pipe (ACP) or steel, although ductile iron pipe (DIP) is used in high pressure areas. Larger transmission mains are constructed of CMLC steel or DIP. The pipelines color coded by pressure zone from the updated existing system model are shown on **Figure 5-1**. **Table 5-2** summarizes pipeline lengths by diameter.

Table 5-2 Pipeline Summary by Diameter

Pipeline Diameter (inches)	Total Pipeline Length (miles)	Pipeline Diameter (inches)	Total Pipeline Length (miles)
4	4.5	20	10.9
6	65.1	22	1
8	114.7	24	5.8
10	17.7	27	0.3
12	42.2	30	0.6
14	20.3	36	0.4
16	27	42	0.6
18	11.7		
		Total Length of Pipe	323

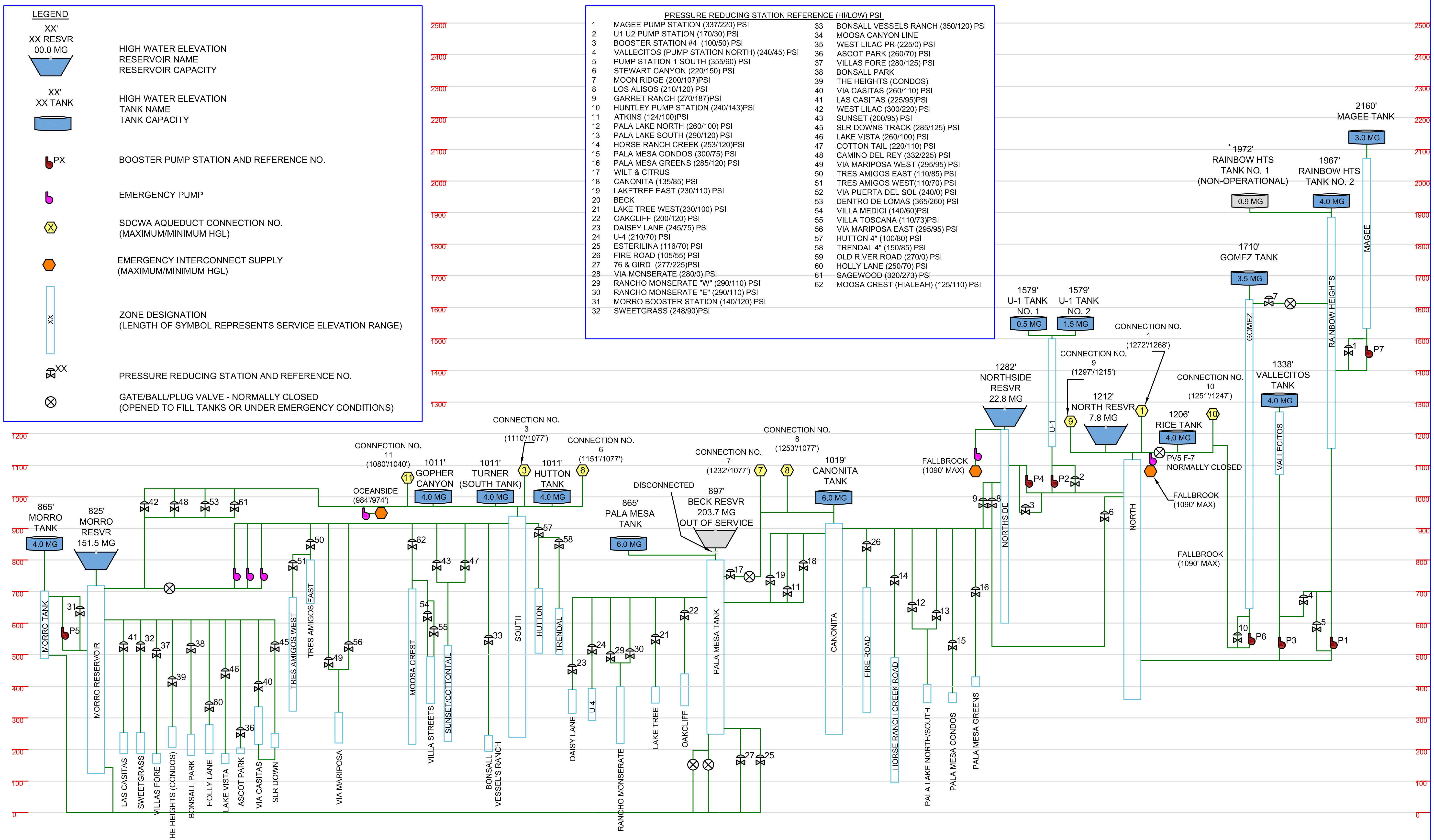


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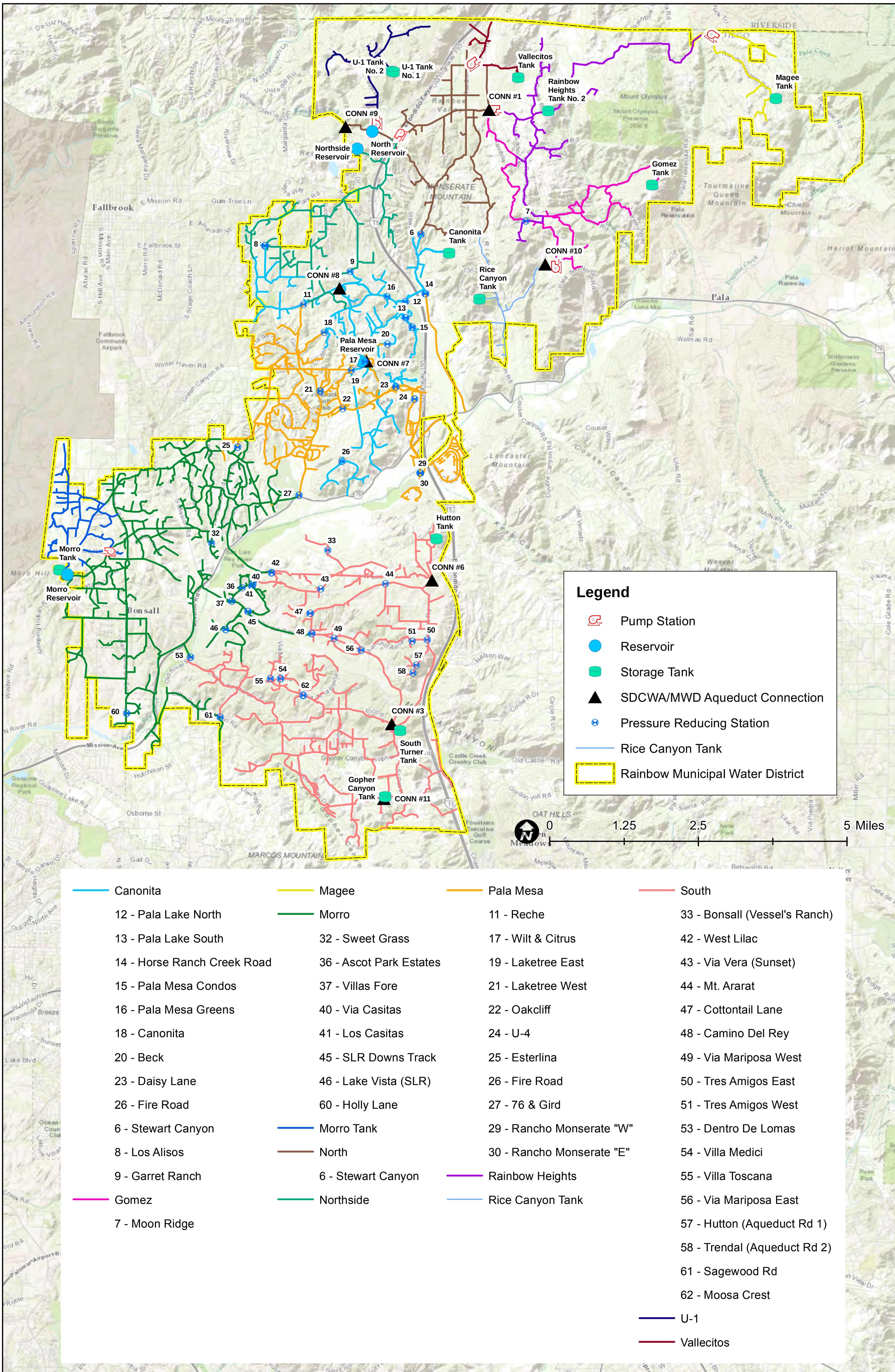
FIGURE 5-1

EXISTING SYSTEM HYDRAULIC SCHEMATIC



Existing Distribution System

FIGURE 5-2

1/25/2016 gool4566 \\sdofs01\Data\Clients\Rainbow MWD\100044880 2015 MP Update\GIS\mxd\Figure 5-2 Existing Distribution System.mxd

5.1.3 Water Storage Facilities

Each major pressure zone has at least one water storage reservoir or tank to regulate pressures and provide operational, emergency and fire flow storage. There are three operational reservoirs which were recently upgraded with floating covers and 13 enclosed storage tanks within the RMWD distribution system. The reinforced concrete or asphalt lined reservoirs with floating covers range in size from 7.8 million gallons (MG) to 151.5 MG. These reservoirs provide additional reserve storage capacity for planned or emergency shutdowns of the aqueduct supply system. The District's newest storage facility, the Pala Mesa Tank, is a 6.0 MG pre-stressed concrete tank which was put into service in January 2013 to replace the open Beck Reservoir. All the other storage tanks in the distribution system are circular above-ground steel tanks ranging in size from 0.4 MG to 6.0 MG. In addition to the operational storage facilities, the 203.7 MG Beck Reservoir and the 0.9 MG Rainbow Heights Tank No. 1 are currently not in service. **Table 5-3** provides a summary of the storage facilities.

Table 5-3 Storage Facilities

Storage Facility	Pressure Zone	Capacity (MG)	Discharge Size (in)	High Water Level (ft)	Max Depth (ft)
Magee Tank	Magee	3.0	16	2,160	40
Rainbow Heights Tank No. 1[(1)]	Rainbow Heights	0.9	--	1,967	40
Rainbow Heights Tank No. 2	Rainbow Heights	4.0	16	1,972	32
Gomez Tank	Gomez	3.5	16	1,710	38
U-1 Tank No. 1[(1)]	U-1	0.6	12	1,579	34
U-1 Tank No. 2	U-1	1.5	12	1,579	46
Vallecitos Tank	Vallecitos	0.4	12	1,338	22
Northside Reservoir	Northside	22.8	24	1,282	42
North Reservoir	North	7.8	18	1,212	20
Rice Canyon Tank	North	4.0	16	1,206	39
Canonita Tank	Canonita	6.0	16	1,019	39
Gopher Canyon Tank	South	4.0	16	1,011	40
Hutton Tank	South	4.0	16	1,011	40
South (Turner) Tank	South	4.0	16	1,011	40
Beck Reservoir[(1)]	Pala Mesa	203.7	24	897	51
Pala Mesa Tank	Pala Mesa	6.0	18	865	19
Morro Tank	Morro Tank	4.0	16	865	41
Morro Reservoir	Morro Res	151.5	36	825	47

[(1)] Out of service facility

The distribution system reservoirs have been designed to be extremely flexible in their ability to transfer water throughout the District. Reservoir and tank water levels are recorded by the RMWD SCADA (supervisory control and data acquisition) system. RMWD Operations Staff closely monitor the water level and quality in each storage facility and operate the water system to cycle water through the reservoirs and tanks for improved turnover rates.

It is noted that the 4 MG Moro Tank, which was built in the later 1970s, has been experiencing uplifting of the floor plate relative to the surrounding grade since the 1990s, which has progressively increased. The District recently hired a consultant to perform an investigation of the tank site, develop site retrofit alternatives, and propose and analyze alternatives to remove the tank from service. An analysis of an option to remove the Morro Tank and utilize the existing booster pump station and the Pala Mesa Zone to supply the Morro Tank Zone was performed with the hydraulic model and results and recommendations of that analysis are included later in this chapter.

5.1.4 Booster Pump Stations

There are seven booster pump stations (PSs) in the RMWD distribution system which pump water up to higher zones with storage facilities. All pumps have constant speed motors and are controlled based upon tank or reservoir water levels. Some pumps can only be operated when a corresponding flow control facility within the zone is active due to high pump capacity. Some pumps are operated only during the night to take advantage of off-peak electricity charges. Pump operating status is recorded by the SCADA system. A summary of each permanent PS is provided in **Table 5-4**.

Table 5-4 Booster Pump Stations

Pump Station Name	Pump Unit	Year Last Tested	Pump Design		Rated Capacity		Pump Station Capacity				Pump Location
							Total Capacity		Firm Capacity		
			HP	TDH	gpm	MGD	gpm	MGD	gpm	MGD	
PS #1 Rainbow Heights	4	1999	290	752	814	1.2	3,509	5.1	2,533	3.6	5463 8th Street
	5	1999	300	752	852	1.2					
	6	2005	250	748	867	1.2					
	7	2005	250	743	976	1.4					
PS #2 U-1	1	2005	75	345	503	0.7	1,615	2.3	1,035	1.5	1040 Rainbow Glen Road
	2	2005	75	345	580	0.8					
	3	2005	75	346	532	0.8					
PS 3 Vallecitos	2	1999	75	225	679	1.0	679	1.0	679	1.0	2718 Rainbow Valley Blvd
PS 4 Northside	A	2005	150	97	4,044	5.8	6,296	5.8	4,044	3.2	933 Rainbow Valley Blvd
	C	2005	75	65	2,252	3.2					
PS 5 Morro Hills	1	2005	150	118	3,455	5.0	3,455	5.0	3,455	5.0	421 Morro Hills Road
PS 6 Huntley Gomez	1	2005	300	541	1,566	2.3	4,552	6.6	2,872	4.1	9215 Huntley Road
	2	1997	300	523	1,680	2.4					
	3	2005	250	521	1,306	1.9					
	4(1)	--	--	--	--	--					
PS 7 Magee	1	2005	100	226	681	1.0	1,398	2.0	681	1.0	39190 Magee Road
	2	2005	50	229	717	1.0					

The District has purchased backup power generators which can be easily wired into pump stations for quick connections in the event of a power outage. In addition to the permanent PSs, RMWD owns a trailer-mounted pump that can be used in emergency conditions, however, it is not large enough to operate pump stations 1 and 6. The District rents additional trailer mounted pumps for planned facility shutdowns or emergencies. The District should consider adding permanent emergency power and soft start motors to all stations or purchasing an additional generator which is larger and can operate any of the District's pump stations.

5.1.5 Pressure Regulating Stations

The RMWD currently operates over 56 pressure regulating stations to supply water to lower pressure zones from higher zones. These stations will include one or more hydraulically actuated pressure reducing valves (PRVs), which are globe valves that have a selectable downstream pressure setting. If the downstream pressure should rise above the PRV setting, the valve will close. Four (4) of the stations operate with pressure sustaining valves (PSVs) or combination pressure reducing and pressure sustaining valves that control flow into a lower pressure zone based upon maintaining a set pressure in the higher pressure supply zone. Additionally, many of the regulating stations have a pressure relief valve in addition to one or more PRVs. The pressure relief valve has a higher pressure setting than the PRVs and vents to atmosphere in the event of PRV failure or over pressurization. In addition to the active pressure regulating stations there are six (6) pressure control stations which have only a pressure relief valve. These stations and station numbers include: Via Monserate (28), Morro Booster Station (31), Moosa Canyon Line (34), West Lilac PR (35), Via Puerta Del Sol (52), Old River Road (59). It is recommended that all existing pressure reducing stations be equipped with pressure relief valves in order to protect the facilities and the customers downstream from damage due to excessive pressure in the event of a pressure reducing valve failure. A general item to address these projects has been added to the CIP list.

Most of the pressure regulating stations are used to supply the 30 small reduced pressure zones without storage reservoirs that are supplied from the Morro, South, Pala Mesa and Canonita Zones. These stations typically have a main reducing valve with a smaller by-pass valve. Several stations separate the major pressure zones and are set to supply flow only in response to a large pressure drop, such as fire flow, or under emergency supply conditions. A few pressure regulating stations are used to fill downstream reservoirs from upper zones. These may also include a pressure sustaining control to limit the pressure drop in the upstream (high) zone. A pressure regulating station is located at each of the PSs (except PS 3 and PS 5) to allow flow back from storage tanks under various operational or emergency scenarios when the pump stations are not operating. A summary of the active pressure regulating stations is provided in **Table 5-5**. Included in the table are the number and size of the valves and the current pressure settings, as provided by RMWD Operations Staff.

Table 5-5 Pressure Regulating Stations

PRS No.	Facility Name	Pressure Zones Upstream => Downstream	PRV/PSV Size (inch)	Settings (psi)	Relief Valve	Comments
1	Magee PS	Magee => Rainbow Heights	12, 8, 2	220-240	No	Normally closed
2	U1 PS	U1 => North	6	30	No	Normally closed
3	PS 4	Northside => North	6	50	No	Normally closed
4	PS 1 North	Rainbow Hts => Vallecitos	8	60	Yes	Normally open
5	PS 1 South	Rainbow Hts => North	6	60	No	Normally closed
6	Stewart Canyon	North => Canonita	8	130	Yes	PRV/PSV; normally closed
7	Moon Ridge	Rainbow Hts => Gomez	8	107	No	Normally closed
8	Los Alisos	Northside => Canonita	6 & 2	100	Yes	6" is PRV/PSV; Normally closed
9	Garret Ranch	Northside => Canonita	8	187	No	Normally closed
10	Huntly PS	Gomez => North	8 & 2	143-150	No	Normally closed
11	Reche (Atkins)	Canonita => Pala Mesa	14 & 4	100	Yes	14" is PRV/PSV; Supply to Pala Mesa Tank
12	Pala Lake North	Canonita => Pala Lake Dr	8 & 2	90	Yes	Primary supply to reduced zone
13	Pala Lake South	Canonita => Pala Lake Dr	8 & 2	110-120	Yes	Secondary supply to reduced zone
14	Horse Ranch Creek Rd	Canonita => Horse Ranch Creek Rd	8 & 2	110-120	Yes	Sole supply to reduced pressure zone
15	Pala Mesa Condos	Canonita => Pala Mesa Condos	6 & 2	68-75	Yes	Sole supply to reduced pressure zone
16	Pala Mesa Greens	Canonita => Pala Mesa Greens	8 & 2	95-100	Yes	Sole supply to reduced pressure zone
17	Wilt & Citrus	Canonita => Pala Mesa	2-12 PSV	22	No	Supply to Pala Mesa Tank from Conn 8
18	Canonita	Canonita => Pala Mesa	10	80	No	Normally closed; supply to Pala Mesa Tank
19	Laketree East	Canonita => Pala Mesa	8	100	No	Normally closed
21	Laketree West	Pala Mesa => Laketree	6 & 2	100-110	Yes	Sole supply to reduced pressure zone
22	Oakcliff	Pala Mesa => Oakcliff	8 & 2½	110-115	Yes	Sole supply to reduced pressure zone
23	Daisy Lane	Pala Mesa => Daisey Lane	8 & 2½	68-75	Yes	Sole supply to reduced pressure zone
24	U-4	Pala Mesa => Old Hwy 395/west side	8 & 4	60-70	Yes	Sole supply to reduced pressure zone
25	Esterlina	Pala Mesa => Moro	8 & 4	63-70	Yes	Normally closed; Backup to Morro Res
26	Fire Road	Canonita => Fire Road	6	55	No	Sole supply to reduced pressure zone
27	76 & Gird Road	Pala Mesa => Moro	8 & 4	218-225	Yes	Normally closed; Backup to Morro Res
29	Rancho Monserate "W"	Pala Mesa => Rcho Monserate (Dulin Rd)	10 & 2	100-110	Yes	Primary supply to reduced zone
30	Rancho Monserate "E"	Pala Mesa => Rancho Monserate (Dulin Rd)	10 & 2	100-110	No	Secondary supply to reduced zone
32	Sweetgrass	Morro => Sweetgrass	6 & 2½	80-90	Yes	Sole supply to reduced pressure zone
33	Vessels Rch	South => Vessel's Ranch	8 & 2	110-120	Yes	Sole supply to reduced pressure zone
36	Ascot Park Estates	Morro => Ascot Park	8 & 2	60-70	Yes	Sole supply to reduced pressure zone
37	Villas Fore	Morro => Villas Fore	6 & 2	119-125	Yes	Sole supply to reduced pressure zone
38	Bonsall Park	Morro => Bonsall Park	2 to 3	80	No	Sole supply to reduced pressure zone

Table 5-5 Pressure Regulating Stations

PRS No.	Facility Name	Pressure Zones Upstream => Downstream	PRV/PSV Size (inch)	Settings (psi)	Relief Valve	Comments
39	The Heights (condos)	Morro => The Heights (condos)	4 to 4	105	No	Sole supply to reduced pressure zone
40	Via Casitas	Morro => Via Casitas /SLR Downs	6 & 2	92-100	Yes	Secondary supply to reduced zone
41	Los Casitas	Morro => Los Casitas	8 & 2½	95-100	Yes	Sole supply to reduced pressure zone
42	W. Lilac	South => Morro	8 & 4	213-220	Yes	Normally closed
45	SLR Downs/Via Casitas	Morro => SLR Downs	6 & 3	100-110	Yes	Primary supply to reduced zone
46	Lake Vista (SLR)	Morro => Golf Club Dr	8 & 2	90-100	Yes	Sole supply to reduced pressure zone
47	Cottontail Ln	South =>Sunset/ Cottontail	6	110	No	Main supply to reduced zone
48	Camino Del Rey	South => Morro	8 & 4	218-225	Yes	Normally closed
49	Via Mariposa West	South => Via Mariposa	4	140	No	Secondary supply to reduced zone
50	Tres Amigos "E"	South => Tres Amigos East	6	85	No	Sole supply to reduced pressure zone
51	Tres Amigos "W"	Tres Amigos East => Tres Amigos West	6	70	No	Sole supply to reduced pressure zone
53	N-N Dentro De Lomas	South => Morro	8 & 4	250-260	Yes	Normally closed
54	Villa Medici	Moosa Crest => Villa Streets	8 & 2½	60-70	Yes	Primary supply to reduced zone
55	Villa Toscana	Moosa Crest => Villa Streets	8 & 2	73-80	Yes	Secondary supply to reduced zone
56	Via Mariposa East	South => Via Mariposa	4 & 2	96-114	Yes	Primary supply to reduced zone
57	Hutton	South => Hutton	4	78	No	Sole supply to reduced pressure zone
58	Trendal	South => Trendal	4	85	No	Sole supply to reduced pressure zone
60	Holly Lane	Morro => Holly Lane	4 & 2	60-70	Yes	Sole supply to reduced pressure zone
61	Sagewood Road	South => Morro	6 & 3	273-280	Yes	Normally closed
62	Moosa Crest	South => Moosa Crest	8 & 4	74-84	No	Sole supply to reduced pressure zone

5.1.6 System Operations

Operation of the RMWD water distribution system is very complex due to the large number of pressure zones, supply locations, and large capacity storage facilities which require frequent cycling or turnover to maintain water quality. Furthermore, the water distribution system is flexible in that supply from the eight aqueduct connections can be routed to different parts of the distribution system by making changes to several key valve settings. Reservoir water levels are connected to the RMWD SCADA system such that the water operators are able to monitor the system throughout the day at the water operations center. However, system operation relies upon a number of manual changes that are made from operator judgment rather than automation such as adjusting the flow orders from FCF connections based on tank levels.

The large storage capacity of Morro reservoir requires special operation of the distribution system to maintain water quality. The distribution system is operated in either a Morro fill or Morro drain mode, with the duration of each mode varying seasonally but typically lasting two weeks or more. Changing between modes requires the manual closing and opening of several pressure stations in addition to a number of operational changes. Tank water levels in several pumped zones are also operated in a fill/drain mode with water levels set low to improve the turnover rate.

In addition to normal supply operations, system operators have several documented procedures for alternative supplies to zones in the event that pump stations fail, tanks need to be removed from service, or when aqueducts are shut down for service. During planned shutdowns of the SDCWA Second Aqueduct (Connections 3, 6, 7, 8, 9, and 11), water from the North and Northside Reservoirs is supplied down to the Canonita Zone through bypass valves and pressure reducing stations. The remaining zones normally supplied from the Second Aqueduct are supplied from excess storage capacity in the Morro Reservoir via portable gas powered pumps. Four portable pumps are utilized to pump water from the Morro Zone to the South Zone. Supply to the South Zone can also be supplemented from the City of Oceanside's Weese Water Filtration Plant from a portable pump.

The Northside Zone, North Zone, and all zones that are pumped from the North Zone are normally supplied from Connections 1 and 10 on the First Aqueduct and Connection 9 on the Second Aqueduct. During a shutdown of both aqueducts, these zones rely on water from in-zone tank storage, the North and Northside Reservoirs, and additional supply from FPUD's Red Mountain Reservoir, which is pumped into the North Reservoir. An emergency pump station at the Beck Reservoir site can also be utilized during a shutdown of both aqueducts to supply the Canonita Zone from the Pala Mesa Zone.

5.2 System Evaluation Overview

Analysis of the water distribution system was performed using the *InfoWater* modeling, analysis and design software developed by Innovyze®. *InfoWater* provides a GIS interface for building and editing model facilities, and a hydraulic analysis engine to perform extended period simulations. The hydraulic model from the 2006 Master Plan, which was last updated as part of a 2013-2014 modeling update, was imported into *InfoWater* and updated based upon the District's water system GIS and other provided facilities information. Models were developed for the existing system and the 2035 planning horizon to analyze peak demands, fire flows and emergency supply scenarios. The existing system model was verified based on a 24-hour aqueduct supply and resulting tank/reservoir inflow/outflow comparison.

5.2.1 Hydraulic Model Development

The District's existing hydraulic model was updated by importing the District's water system GIS and adding elevation data and roughness coefficients. New facilities added to the model include the Pala Mesa Tank, several pressure reducing stations, and pipelines to serve new development. In addition to new facilities, District Staff identified several abandoned or out of service facilities which were deactivated in the model. These include the Beck Reservoir and associated valves and piping. The locations of isolation valves separating pressure zones were also reviewed with District staff and updated, and pressure zone boundaries were adjusted accordingly.

Demands for the existing system were input to the model based upon 2013 water billing records. The annual water consumption for each billing account was assigned to the nearest model node using the account Assessor Parcel number (APN). Prior to importing the billing account data, the model was reviewed to identify "no-demand" nodes on transmission mains or pipelines that extend through a service area for a different pressure zone. Once the billing account data was loaded to the model, the demands were increased using a global peaking factor to match 2013 average water delivery rates based on recorded SDCWA deliveries at the aqueduct connections. Fire flow demands are input at each node based on the billing account category.

To perform extended period simulations, the 24-hour peaking curves developed for the 2006 Master Plan were modified based on peaking factors developed in **Chapter 2**. The ADD and MDD peaking curves are illustrated on **Figure 5-3.** The MDD peaking curve has an average demand of 1.9 times the ADD and a peak hour flow of 2.7 times the ADD. It is noted that these peaking factors are applicable to analysis of the overall system and existing land use. Higher peaking factors are used when evaluating smaller areas of the distribution system with a single land use type.

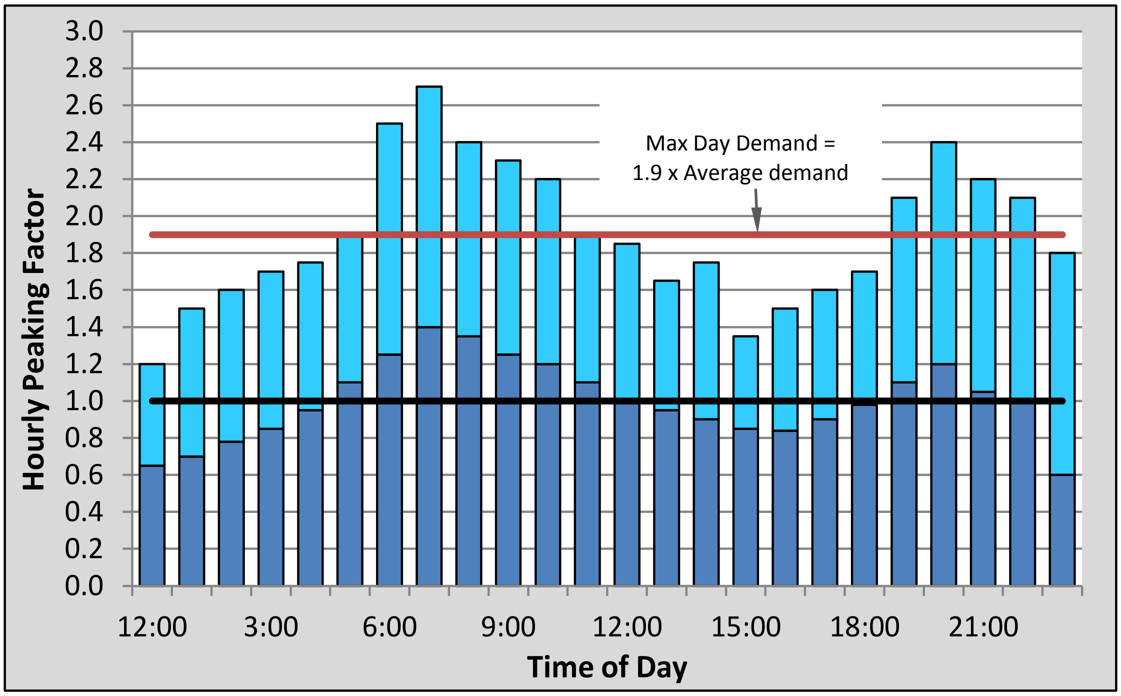


Figure 5-3 Average Day and Maximum Day Demand Peaking Factors

Proper modeling of system operations via control settings is essential for an accurate representation of the distribution system. All pressure regulating valve controls were updated based on current pressure settings and status information provided by District staff. Pump curves were input to the model based upon pump check test data provided and pump controls were added based upon reservoir level set points from the SCADA system. Additionally, pump station control rules were created from discussions with District operations staff to select the number of pump operating at each station under various demand and supply scenarios. For example, more than two pumps can operate at PS 1 only when Aqueduct Connection No. 1 is active, and Pump 4A at PS 4 also can operate only when Connection No. 1 is active. Water supply was discussed with District operation staff to determine how and when water is ordered from each aqueduct connection. Water supply control rules were developed for each aqueduct connection (modeled as an upstream reservoir with a flow control valve) to adjust supply rates under various demand conditions and at set times during hydraulic simulations.

5.2.2 Model Calibration

Data available from the RMWD SCADA system for calibration of the distribution system hydraulic model is limited to pump run times and graphs of inflow/outflow from storage facilities. However RMWD operators fill out daily patrol sheets, which include water purchases from the San Diego County Water Authority aqueduct connections and tank or reservoir water levels and volumes. Using this available data, a "macro" calibration approach was developed to compare field data over an extended period of time to the model.

Patrol sheets that included storage tank levels for 6 months were initially analyzed to identify two 3-week periods in which the Morro Reservoir was either filling or draining. For the Morro filling scenario, the period from August 12, 2014 through September 1, 2014 was selected. The period selected for the Morro draining scenario occurred immediately after, from September 2, 2014 through September 26, 2014.

For each of these periods, the system demand was calculated from water supply rates at the aqueduct connections and the change in storage tank volumes (mass balance technique). Demand curves were then developed based on the average day demand calculated for each period and input to the model. Initial tank levels from field data were set at the start of the simulation and booster pumps were controlled by the SCADA set points based on tank levels. For the Morro reservoir filling scenario, the total number of pump run hours for each pump station over the 3-week model simulation was compared to the SCADA data. Although the pump run times in the model corresponded reasonably well with the actual field conditions, at most pump stations the modeled runtimes were shorter, indicating a higher discharge flow from modeled pumps than the actual pumps. Since pumps will discharge less flow as they age, it was deemed appropriate to derate the pump curves slightly to better match the field data. Pump curves at all stations except one (PS 2) were derated in the model between approximately 0.85 to 0.95 and the 3-week simulation was rerun. With the revised pump curves, modeled pump run times were generally within 10% of the field values.

To further calibrate and refine the model, inflow and outflow graphical data was obtained for the following storage facilities: Canonita Tank, Northside Reservoir and Morro Reservoir. Three days of flow data was extracted from the graphs provided by RMWD and used to validate the model. Generally the modeled tank volumes correlated well with the data in the patrol sheets over the corresponding period. Minor adjustments were made to a few of pressure reducing valve settings to better match the field data. Plots comparing model data with field data for the calibration simulations are provided in **Appendix F**.

5.2.3 Modeled Scenarios

Extended period simulations were performed with the hydraulic model to analyze several operational scenarios. The control settings developed for each modeled scenario include the status for select valves (setting or open or closed), control rules for aqueduct supplies and pump station operations, and initial water levels for storage facilities. The demand sets modeled are existing demands (based on 2013 deliveries) and 2035 planning horizon demands (based on 2035 demand forecasts). It is noted that planning horizon demands for future buildout areas are loaded to existing model pipelines at the assumed connection point to future pipelines.

A separate fire flow analysis was performed to determine the ability of the distribution system to provide the required fire flow at a minimum pressure of 20 psi from the storage facilities. The analysis consists of a series of steady-state simulations with maximum day demands that are performed with the required fire flow (1,500 gpm or 2,500 gpm) applied sequentially at every demand node in the model. All booster pumps are set as non-operational during the fire flow analysis and tank water levels are set at the middle operating range. These settings result in worst case but realistic pressure conditions in most of the distribution system and will verify the ability of storage facilities to provide a fire flow in conjunction with a loss of power.

The hydraulic analysis for this master plan is based on the following modeled scenarios:

- Existing max day demands with Morro Reservoir filling – 24-hour simulation
- Existing max day demands with Morro Reservoir draining – 24-hour simulation
- Fire flow analysis with existing max day demands – global fire flow simulation (steady-state) with Morro Reservoir filling, PSs off, and tanks/reservoirs half-full
- Emergency Supply with Aqueduct No. 2 out-of-service (supply from CWA flow control facilities 1 and 10 only) - 3-day simulation with existing average day demands and operation of emergency pump stations
- Planning Horizon max day demands with Morro Reservoir filling– 24-hour simulation
- Planning Horizon max day demands with Morro Reservoir draining– 24-hour simulation
- Fire flow analysis with planning horizon max day demands - global fire flow simulation (steady-state) with Morro Reservoir filling, PSs off, and tanks/reservoirs half-full

After discussions with District staff, additional simulations were performed to analyze specific future facilities based on the following scenarios:

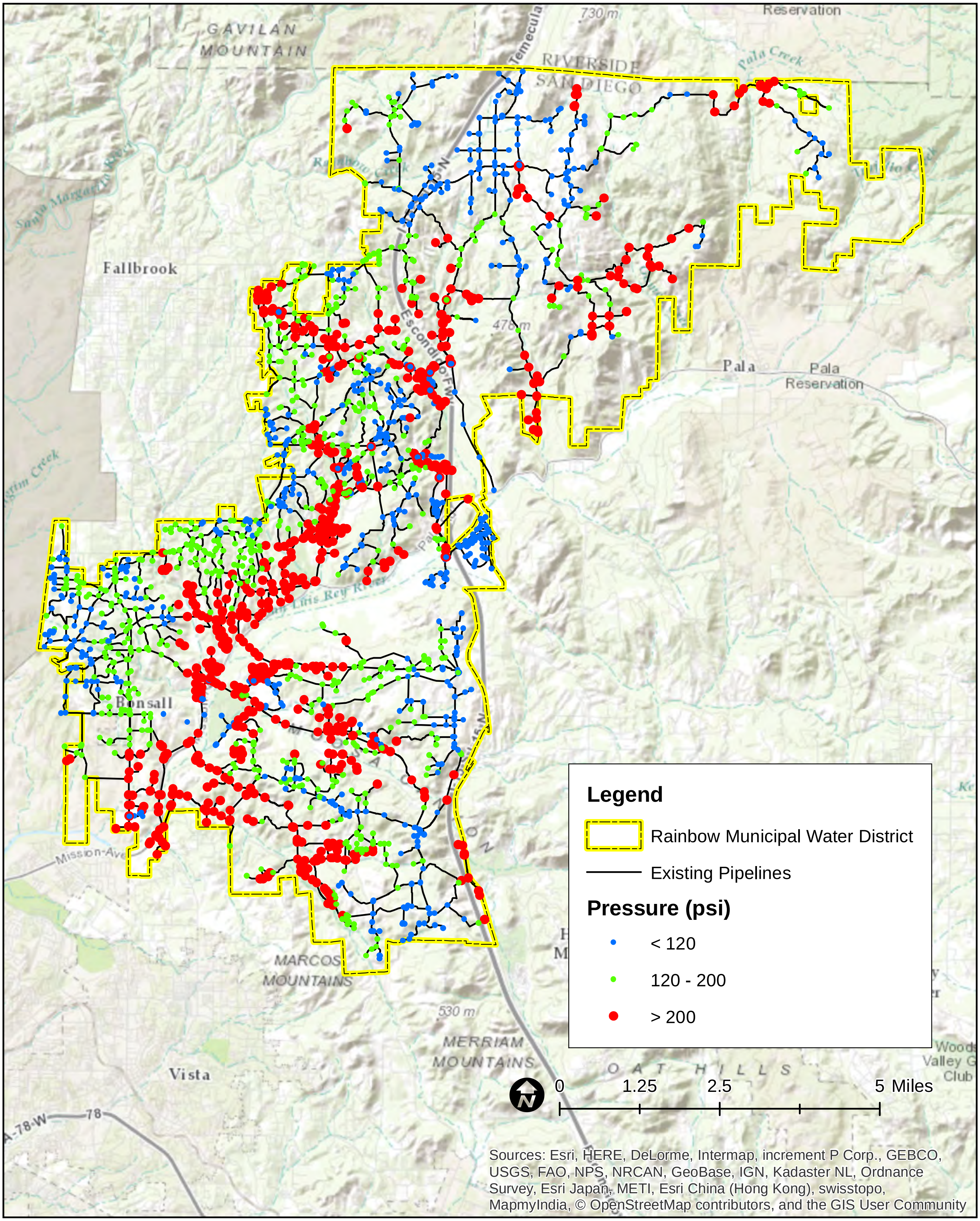
- Emergency supply with CWA flow control facilities 7 and 8 out-of-service and a future supply pipeline and PRV from the South Zone (Hutton Tank) to the Pala Mesa Zone – 3-day simulation with existing average day demands
- Morro Tank out-of-service and supply from the Pala Mesa Zone through a converted 12”/14”/16” Morro Zone pipeline - existing max day demands, Morro reservoir filling, 24-hour simulation

5.3 Hydraulic Analysis Results

Model results from the hydraulic simulations described above were reviewed and analyzed to assess reservoir performance, pipeline capacities and system pressures. Pipeline velocities were evaluated during peak demand periods and reservoir filling conditions to identify areas with significant headloss. System pressures were sorted to identify high pressure, low pressure areas and areas with pressure swings due to insufficient pipeline capacity. System pressures were also evaluated during low demand periods and tank draining periods to identify high pressure areas (greater than 200 psi) in the distribution system.

5.3.1 Static Pressure Analysis

Due to the steep and varying terrain that characterizes the District, there are several areas in the distribution system with pressures higher than 200 psi. **Figure 5-4** illustrates the range of pressures based on average day demands in the Morro draining scenario. This scenario results in the highest observed pressures because it isolates the Morro and South zones from one another and removes significant headloss from the system that is present during the transmission of flow from South to Morro. For the North Region of the District’s system, pressures are similar under most scenarios.



Junction Pressures

FIGURE 5-4

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A hydraulic summary of each pressure zone is provided in **Table 5-6**. The range of design service elevations listed for each zone is based on providing the minimum (60 psi) and maximum (150 psi) design pressures as defined by the design criteria in **Chapter 2**. The actual elevations and static pressures are provided for junctions in the distribution system model that have assigned water meters. It is noted that the Morro, South, Pala Mesa and Canonita Zones each include multiple smaller reduced pressure areas that are supplied through pressure reducing stations. The maximum pressures for these zones may therefore be lower than the pressures in the table, which are based on tank/reservoir high water levels and do not take into account the reduced pressure settings.

As shown in **Table 5-6**, several zones have areas of very high pressures above 200 psi. As mentioned, many areas of the District, primarily in the higher elevation and sparsely developed areas in the north, have steeply varying terrain. It would not be economically practical to create multiple pressure zones in these areas to reduce pressures. While the high pressures exceed the desired maximum pressure criteria, pipelines and appurtenances in these areas have been designed to withstand higher pressures and District staff is experienced in managing and minimizing the associated risks. It is noted that private pumps are being operated to boost pressures at several service meters located near storage tanks.

Table 5-6 Pressure Zone Hydraulic Summary

Pressure Zone	Hydraulic Grade (feet)	Design Service Elevations (feet)	Actual Service Elevations (feet)	Static Pressure (psi) Min	Max
Magee	2,160	1,810 -2,020	1,370 - 2,080	35	342
Rainbow Heights	1,967	1,620 - 1,830	1,240 - 1,890	33	315
Gomez	1,710	1,360 - 1,570	610 - 1,620	39	476
U-1	1,579	1,230 - 1,440	1,060 - 1,520	26	225
Vallecitos	1,338	990 - 1,200	1,080 - 1,230	47	112
Northside	1,282	940 - 1,140	410 - 1,080	87	377
North	1,212	870 - 1,070	350 - 1,140	31	373
Canonita	1,019	670 - 880	230 - 890	56	332
South	1,011	660 - 870	210 - 970	18	333
Pala Mesa	865	520 - 730	230 - 830	15	275
Morro Tank	865	520 - 730	500 - 710	67	158
Morro	825	480 - 690	140 - 750	32	297

5.3.2 Global Fire Flow Analysis

Fire flow analysis results include the "static" pressure (pressure with maximum day demands and no fire flow), residual pressure with the required fire flow, and the available fire flow at a residual pressure of 20 psi. The fire flow analysis was performed with both existing and 2035 planning horizon demands.

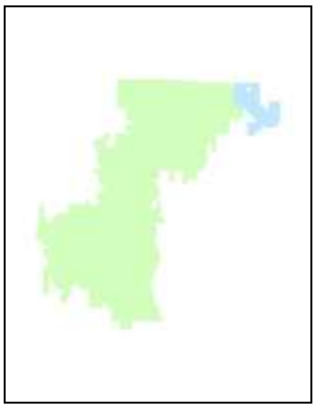
In the 2035 demand analysis, a fire flow of 2,500 gpm was applied to supply locations for the future development projects identified previously in **Table 3-5**. In general, 4-inch diameter pipelines and pressure reducing valves cannot deliver a 1,500 gpm fire flow. Additionally, 6-inch diameter dead-end pipelines can generally provide a 1,500 gpm fire flow only if the length of the pipeline is short and static pressures are high.

The older areas of the District were designed to supply lower fire flows than the current minimum requirement of 1,500 gpm. Since the pipeline upgrades required to bring all areas up to current standards are economically prohibitive, only locations where the model indicates available fire flows are below 750 gpm have been considered deficient.

5.3.3 Zone by Zone Summary

Major features and operations of each of the main pressure zones are described in detail below. The information is based on previous master plans and studies, site visits, and numerous discussions with field and WTP operators.

Magee Zone (2160)



Magee Zone

The Magee Zone is the District's highest elevation pressure zone, with pipelines along Magee Road and Rancho Heights Road. The zone is supplied from PS 7, which takes suction from the Rainbow Heights Zone, and storage is provided in the 3.0 MG Magee Tank. The reservoir is oversized when compared to the steadily declining demands in the zone, and therefore control settings have been set to keep the reservoir at approximately 30 percent full. Before the recent addition of chlorine residual boosting and tank mixing, the operational tank levels were kept approximately 20 percent full.

The Magee Zone average demands are approximately 0.04 MGD, which is the smallest in the Rainbow Water District and is made up almost entirely of domestic users.

Hydraulically, this zone is very stable. Pipelines are appropriately sized to transmit the pump station flow and no significant variation in the hydraulic grade line (HGL) of the zone occurs due to the low demand on the zone. The transmission pipeline to Magee PS is over 3.5 miles long. Because demand in the zone is so low, PS 7 operates infrequently and water in this pipeline can age substantially. This concern was addressed with the recent addition of chlorine and mixing at the Magee tank.

The fire flow simulation indicates that the Magee Zone is capable of supporting a minimum 1,100 gpm fire flow. The area is primarily built-out and residential neighborhoods were designed for a lower fire flow during time of construction. No fire flow improvements are recommended.

Rainbow Heights Zone (1967)

The Rainbow Heights Zone begins at PS 1, which pumps water from the North Zone to the Rainbow Heights Tank. The Rainbow Heights Zone extends north to PS 7 and the Magee Zone, and is separated from the Gomez Zone to the east and south by closed valves.

The Rainbow Heights Zone is the sole supply to the Magee Zone and serves as an emergency supply for the Gomez, Vallecitos, and North Zones.

Demands in the Rainbow Heights Zone are approximately 0.54 MGD and are a mix of domestic and agriculture.

Rainbow Heights Zone

Hydraulically, the Rainbow Heights Zone is very stable. The zone has a single source of supply that fills the zone tank and provides a single source of supply to the Magee Zone. Both transmission pipelines are adequately sized and the zone HGL does not fluctuate significantly due to pump station operations or peak demands.

Under fire flow conditions the zone performs adequately, and there are no locations where a minimum 750 gpm fire flow cannot be provided. The lowest available fire flows are at four remote locations off Rainbow Peaks Trail, Rainbow Heights Road, Mountain Rim Road and Rainbow Peaks Road.

Project No.	Project Description	System Benefit
WP17	Install PRS at Rainbrook	Reduce local pressure, reduce risk of pipe and lateral breaks
WR14	Pump Station 1 (Rainbow Heights) Natural gas motor replacements	Improved efficiency and reliability to pressure zone

Gomez Zone (1710)

Gomez Zone

The Gomez Zone begins at PS 6, which pumps water from Connection No. 10 or the Rice Canyon Tank to the Gomez Tank. In order for PS 6 to operate, Connection No. 10 must be active or the Rice Canyon Tank must have a minimum level. The Gomez Zone extends north to PS 1 and is separated from the Rainbow Heights Zone by a number of closed valves. These closed valves have the ability to provide the Gomez Zone with emergency supply in the case of a pump station outage or a fire. Due to the hilly terrain the Gomez Zone has areas of very high pressure.

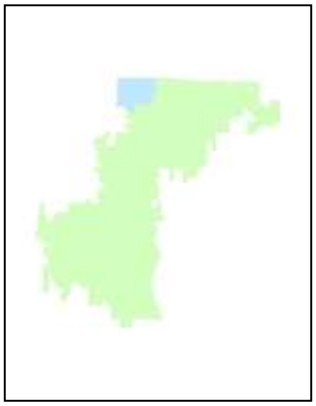
Demands in the Gomez Zone are approximately 0.6 MGD and the water use is primarily agricultural.

Hydraulically, the Gomez Zone experiences HGL swings during tank filling as the transmission path from PS 6 to the Gomez Tank is more than 4.3 miles. The zone can also experience HGL swings during peak demand periods for similar reasons, especially in the remote northern part of the zone. These pressure swings do not have a significant impact upon the zone however, as the zone does not have any low pressure areas which would be negatively affected by pressure swings. The zone contains areas of extremely high pressure, above 450 psi, which would benefit from the installation of a pressure regulating station in order to reduce the risk of pipe and lateral breaks.

Under fire flow conditions, only the extremely remote northern region of the zone is unable to deliver the minimum fire flow by gravity from the Gomez Tank. This area and the area directly to the south, however, are supported by two closed valves and a pressure reducing station from the Rainbow Heights Zone. These connections would be able to supply additional flow if pressure in the area of the Gomez Zone dropped significantly, ensuring that adequate fire flow would always be available.

Project No.	Project Description	System Benefit
WP3	Install PRS at Alex Road and gate valve at Jeremy Way	Reduce extremely high (400+) local pressures, reduce risk of pipe and lateral breaks

U-1 Zone (1579)



U-1 Zone

The U-1 Zone begins at PS 2, which pumps water from the North Reservoir to two adjacent storage tanks. The storage tanks have different capacities (1.5 MG and 0.6 MG) and different bottom elevations, which makes operation of the two tanks together difficult. Only the larger tank is currently in service, which is how the zone was modeled.

Demands in the U-1 Zone are approximately 0.2 MGD and are a mix of domestic and agriculture.

Hydraulically, the U-1 Zone is very stable. The zone has a single source of supply that fills the U-1 Tank as needed. The transmission pipeline to the tank is adequately sized and is not an extremely long run. The transmission lines out into the zone are long and dead ended, but the lack of demand in the zone prevents significant HGL swings under normal operation.

Under fire flow conditions high headloss is observed in the pipeline running to the easternmost portion of the zone, which reduces in diameter from 12inches, to 8 inches, and then 6-inches. In this remote region of the zone, fire flow is restricted to approximately 1,000 gpm. This available flow is considered adequate for an area served by 6-inch pipes, but less than the desired minimum fire flow.

Project No.	Project Description	System Benefit
WR3	U-1 Transmission Pipeline Replacement to Ranchbrook Road	Replace aging pipeline, fewer service outages and resources spent on repairs

Vallecitos Zone (1338)

The Vallecitos Zone begins at PS 3, which pumps water from the North Zone to the Vallecitos Tank. The Vallecitos Tank is undersized at 0.4 MG, and the tank is filled two or three times a day during peak demand periods. Currently only one of the two pumping units can operate at PS 3, as the other is inactive due to air quality restrictions. The Vallecitos Zone is separated from the North Zone to the south by a closed valve located at Rainbow Creek Road. It is also connected to the Rainbow Heights Zone via a series of normally closed valves and an 8-inch pipeline that runs from PS 1 down Select Way, and dead-ends into the Vallecitos Zone at Rainbow Creek Road. For several years PS 3 was out of service, and the Vallecitos Zone was supplied from the Rainbow Heights Zone through a PRV at PS 1.

Vallecitos Zone

The Vallecitos Zone has the smallest service area of the major pressure zones and serves a primarily residential area east of Interstate 15 and north of Rainbow Creek Road. The total demand is just under 0.3 MGD.

Because the Vallecitos Zone is so small, it is also very stable. Despite much of the distribution system in the zone being comprised of 8-inch pipes, the edges of the zone are less than 2 miles from the tank and therefore HGL swings during peak demand periods are reasonable.

Under fire flow conditions the prevalence of 8-inch diameter pipes in the distribution system limits the ability of the zone to deliver fire flows by gravity. More specifically, all of the dead-end pipelines off

Rainbow Valley Road at the northern end of the zone are unable to supply the desired minimum fire flows. However, the zone has an emergency connection to the Rainbow Heights Zone through a PRV at PS 1 which provides sufficient pressures to supply the required fire flow. The District is considering replacing PS 3 to provide a more efficient, reliable supply to the Vallecitos Zone.

Project No.	Project Description	System Benefit
WR2	Pump Station 3 (Vallecitos) replacement	Improved efficiency and reliability to pressure zone

Northside Zone (1282)

Northside Zone

The Northside Zone begins at PS 4, which pumps water from the North Zone and Connection No. 1 to the Northside Reservoir. The Northside Zone is separated from the North Zone by a closed pipe along Rainbow Hills Road. To the south, the Northside Zone is separated from the Canonita Zone by several closed valves.

The total demand in the Northside Zone is approximately 1.25 MGD and the majority of the demand served is agricultural.

The Northside Reservoir supplies flow to the zone through the Northside Transmission Pipeline. PS 4 is the only source of supply into the zone and this pipeline is the only supply conduit to the majority of the customers in the Northside Zone. Were this line to go out of service, currently there are no emergency sources of supply to the customers in the zone. Additionally, PS 4 also discharges to this same transmission line and therefore would be unable to supply the zone. It is recommended that the District develop an additional transmission pipeline into the zone and/or construct a connection for an emergency supply. Previously a new transmission pipeline in Live Oaks Road and Mission Road has been recommended. This new pipeline would connect to the existing transmission pipeline and if a break of the existing transmission pipeline were to occur upstream of the proposed connection point, the new pipeline would provide no benefit. A new transmission pipeline all of the way to the top of the zone would provide redundant transmission capacity to Northside customers but would be extremely long and costly. Instead, a permanent emergency connection to the FPUD Red Mountain Reservoir is recommended to provide emergency supply to this zone. Additionally, similar to the locations in the South Zone which bring flow from the Morro Zone back up to the South Zone, an emergency booster pump station connection could be installed in the Canonita Zone to provide flow to the Northside Zone in an emergency situation.

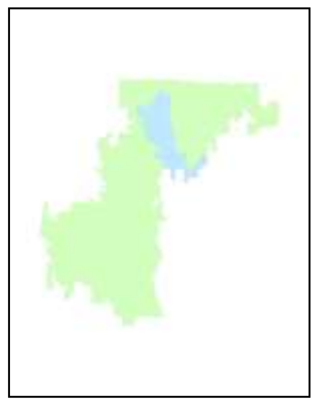
As a backup to PS 4, the existing pipeline in Rainbow Hills Road could also be upsized and connected to the North Zone to provide an emergency supply source to the zone. Although the HGL of the Northside Zone is 70 feet higher than the North Zone, static pressures throughout the Northside Zone are high and in an emergency the North Zone could adequately supply the Northside Zone.

Hydraulically, the Northside Zone experiences significant variations in HGL, but is otherwise very robust. The zone has very high static pressures throughout, with most users having over 100 psi static pressure. Under peak flow conditions there were no areas observed to have low pressure. The pump station which feeds the reservoir is a high capacity pump station and therefore can cause large HGL swings throughout the system. However, the customers within the zone have significant enough static pressure that the swings caused by reservoir filling do not cause low pressure. An area of high pressure at the southern end of the zone along Brook Hollow and Ranger Roads was also observed and could be served by a pressure regulating station.

Under fire flow conditions, the southernmost boundary of the zone at Via Chaparral is unable to provide a 750 gpm fire flow due to the presence of a 4-inch diameter pipe supplying a hydrant. In general, much of the zone is unable to achieve the desired minimum fire flow. This is because the zone is relatively linear and is served primarily through a single transmission pipeline. Headlosses increase as flow travels farther from the reservoir and limit the ability of the outskirts of the zone to receive large flows.

Project No.	Project Description	System Benefit
WP2	Install PRSs at Brooke Hollow Road and Ranger Road	Reduce local pressure to large geographical service area, reduce risk of pipe / lateral breaks
WR4	Upsize Rainbow Hills Road Pipeline to 12-inch and Install New PRS	Provides an emergency supply connection to service large, critical zone
WR12	Northside emergency pump station connection and pipeline at Reche Road	Provide emergency supply to Northside Zone in case of transmission failure
FF6	Upsize 4-inch on Via Chaparral	Increase available fire flow
WS2	Northside Zone permanent FPUD emergency interconnection	Provide emergency supply to Northside Zone in case of transmission failure & additional supply during 2nd Aqueduct outage

North Zone (1212)



North Zone

The North Zone is in the center of the northern part of the District and directly or indirectly supplies six of the twelve major pressure zones (Magee, Rainbow Heights, Gomez, U-1, Vallecitos and Northside). Aqueduct connections 1, 9, and 10 directly supply the North Zone, and storage is provided by both the North Reservoir (7.8 MG) and the Rice Canyon Tank (4 MG). These storage facilities are separated by a distance of over five miles and connected by only an 8-inch diameter pipeline. Since the storage facilities do not operate together hydraulically, there is a closed valve along Rice Canyon Road, just north of the Rice Tank, which separates the North Zone into two separate zones. South of this closed valve, aqueduct Connection 10 supplies the Rice Canyon Tank. North of the closed valve, flow from Connections 1 and 9 supply the North Zone and the North Reservoir.

The total demand in the North Zone is approximately 2.1 MGD and the majority of the customers served are agricultural.

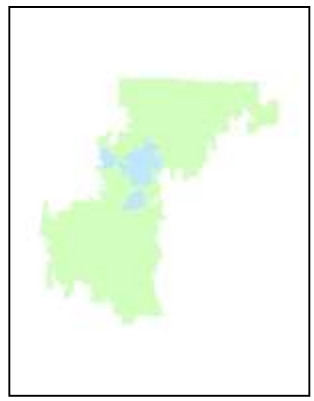
The Rice Tank service area supplies PS 6 and has low demand and high pressure, and therefore has no significant HGL swings. Pressures south of Huntley Road exceed 250 psi, and this area could benefit from a pressure regulating station. The North Reservoir service area supplies PS 1, PS 2, PS 3 and PS 4. These facilities move a significant amount of flow in the northern portion of the zone, causing large HGL swings. Neither PS 1 nor PS 4 can operate at peak capacity without Connection No. 1 being active due to available head and pipeline capacity issues. Additionally, the North Reservoir service area has many users which have low static pressures, exacerbating the problems caused by the volume of flow moving through the zone when various facilities are active. In addition to the high elevation areas in the North Reservoir service area, low elevation areas with pressures above 250 psi exist along Ranger and Hollow Roads and are recommended to be served by a pressure regulating station.

Under fire flow conditions the most northerly point of the zone on Chica Road is unable to deliver adequate fire flow due to the its distance from supply sources and a long stretch of undersized 6-inch diameter pipe. Other parts of this area can provide a fire flow greater than 750 gpm and nearly all the remainder of the North Zone can provide the desired 1,500 gpm fire flow, the only exceptions being dead-end pipelines on Canyon Heights Road, Clearwater Road, Huffstatler Street and Select Way.

Project No.	Project Description	System Benefit
WP4	Install PRS to serve Rice Canyon Road south of Pala Mesa Heights Drive	Reduce extremely high (300+) local pressures, reduce risk of pipe and later breaks
WR7	North Feeder and Rainbow Hills Water Line Replacement	Fewer service outages and resources spent on repairs
WR13	Rice Canyon Tank Transmission PL to I-15/ SR-76 corridor	Improve cycling of Rice Canyon tank and serve new development
FF3	Upsize 6-inch to 8-inch on Chica Road	Increase available fire flow

Canonita Zone (1019)

The Canonita Zone is in the center of the District and is surrounded by the North and Northside Zones to the north and the Pala Mesa Zone to the south. The zone is served by Connection No. 8, which conveys flow to the 6.0 MG Canonita Tank. The Canonita Zone supplies the Pala Mesa Zone through two pressure reducing stations and a pressure sustaining valve at the Pala Mesa Tank. The Canonita Zone also supplies six smaller reduced pressure zones.



Canonita Zone

The total demand in the Canonita Zone is approximately 1.7 MGD and the majority of the existing demand is agricultural, although there will be a significant increase in residential demand by the year 2035.

Hydraulically, the Canonita Zone HGL fluctuates substantially depending upon circumstances within the zone. The pressure reducing and sustaining valves which supply the Pala Mesa Zone can move significant volumes of water through the zone. Additionally, the Connection No. 8 location is over three miles from the Canonita Tank and produces significant headloss when it is active. During filling of the Pala Mesa Tank through the Wilt & Citrus pressure sustaining valves, one of the primary conduits supplying the valves is a 6-inch diameter pipeline on Wilt Road. Upsizing of this pipeline is recommended to remove a significant volume of headloss in the zone.

Under fire flow conditions only a hydrant at the end of Lupine Lane served by a 4-inch diameter pipeline is not able to provide a 750 gpm fire flow. The rest of the zone performs well under fire flow conditions, with most of the zone able to provide the desired 1,500 gpm fire flow.

Project No.	Project Description	System Benefit
WE1	Gird to Monserate Hill Water Line	Loop dead end system and shift demand off of the Canonita Zone
WH2	Upsize 6" to 10" along Wilt Road	Increase system pressures, improve function of Wilt & Citrus PRV into Pala Mesa Tank
FF4	Upsize 4-inch to 8-inch on Lupine Lane	Increase available fire flow

Pala Mesa Zone (865)

Pala Mesa Zone

The Pala Mesa Zone was previously called the Beck Zone when the open Beck Reservoir, which is now out of service, provided storage for the zone. The Pala Mesa Zone receives water from aqueduct Connection No. 7 and from the Canonita Zone via pressure sustaining valves supplying the Pala Mesa Tank. Supply is also provided from the Canonita Zone through two pressure reducing stations. In turn, the Pala Mesa Zone can supply the Morro Zone through two PRSs, which are a backup supply to fill the Morro Reservoir. The Pala Mesa Zone serves five smaller pressure reduced zones.

Demand served from the Pala Mesa Zone is approximately 2.0 MGD and is a mix of agricultural and domestic.

Hydraulically the Pala Mesa Zone has been very stable and the District has seen minimal hydraulic impact of removing the Beck Reservoir from service, although the high water level of the Pala Mesa Tank is 32 feet higher than the Beck Reservoir. This large zone is one of the more developed zones within the District and as such contains several transmission pipelines and is well looped. The zone HGL is relatively steady under peak demand conditions. Transmission pipelines in the Pala Mesa Zone, which aid in filling the Morro Reservoir from the SDCWA Second Aqueduct are adequately sized and prevent excessive headlosses during this scenario. High pressure areas on Knottwood Way, Diego Estates Drive and Sarah Ann Drive were all identified as benefitting from pressure regulation.

Under fire flow conditions the Pala Mesa Zone is very strong and nearly the entire zone is capable of providing the desired fire flow. Only the hydrants at the ends of the reduced zone supplied by the Rancho Monserate PRV off of Dulin Road on the west side of Old Highway 395 is not able to provide a 750 gpm fire flow. The rest of the zone performs well under fire flow conditions, with most of the zone able to provide the desired 1,500 gpm fire flow.

Despite strong hydraulic performance, several upgrades to the Pala Mesa Zone are recommended to provide the zone with additional reliability and redundancy to support the development that is anticipated along the I-15/SR-76 corridor within the planning horizon. Currently under aqueduct outage scenarios, the District does not have the capability to move water from the South or Morro Zones back north into the Pala Mesa Zone. A pipeline has been proposed in Old Highway 395 to connect the Pala Mesa Zone with the Hutton Tank in the South Zone. This pipeline would provide additional reliability to the Pala Mesa Zone by allowing it to access storage at the Hutton Tank as well as supply from Connection No. 6. The proposed pipeline would create a redundant supply that feeds directly into the I-15/SR-76 corridor, which will be the epicenter of the Pala Mesa Zone and Canonita Zone developments. An emergency pump station at the 76 & Gird location is also recommended to allow the District to move flow directly from the Morro Reservoir zone back up to the Pala Mesa Zone. Additionally, once development of the I-15/SR-76 corridor is complete it is recommended that a pipeline be installed across the Shearer Crossing of the San Luis Rey River to provide a redundant source of supply to the areas served from the Rancho Monserate PRV.

Project No.	Project Description	System Benefit
WP1	Install PRSs at intersections of Knottwood Way and Staghorn Lane / Gird Road	Reduce local pressure, reduce risk of pipe and lateral breaks
WP9	Install PRSs at Diego Estates Drive and Sarah Ann Drive	Reduce local pressure, reduce risk of pipe and lateral breaks
WR5	Hutton Tank to Pala Mesa Zone Emergency Connection	Provide redundant supply and increased looping for emergency support
WR8	76 & Gird permanent emergency pump station	Improved zone reliability during outage or transmission main break scenarios
WR19	Lake Rancho Viejo Permanent Connection	Provide redundant supply to reduced zone
FF1	Upsize 6-inch to 8-inch in Via San Alberto	Increase available fire flow

South Zone (1011)


South Zone

The South Zone is the District's largest in size, and the demand supplied from this zone is 30 percent of the total District demand. Water is supplied to the South Zone via aqueduct Connections 3, 6 and 11. In turn, the South Zone supplies the Morro Zone through four pressure reducing stations, which are opened periodically to fill the Moro Reservoir. During aqueduct shut down situations, water is provided to the South Zone from the lower elevation Morro Zone through four emergency pump stations. Operators must make several manual valve position changes to alter zone boundaries when the emergency pump stations are in operation.

There are three identically sized tanks located along the eastern edge of the zone. The balance of tank levels is controlled largely by the flow rates ordered at the closest aqueduct connection. During the emergency supply scenario, the three tanks have differing drain rates and the Turner Tank will drain first while the northernmost Hutton Tank drains the slowest. An emergency interconnect with the City of Oceanside's Weese Water Filtration Plant can supply the Gopher Canyon Tank through a temporary pump.

The South Zone serves a demand of approximately 4.7 MGD, of which approximately 90 percent is classified as agricultural.

Hydraulically the South Zone is extremely diverse, with an HGL of 1,011 feet and service elevations as low as 230 feet, and three reservoirs each served by their own Water Authority connections. Additionally, the manner in which the South Zone is operated is also extremely diverse, with the Morro Reservoir filling and draining and aqueduct outage scenarios all resulting in dramatically different flow patterns. Pipelines in the South Zone are adequately sized for peak demands, however the Morro Reservoir filling scenario puts the greatest strain on the South Zone as the four PRVs supplying this zone divert a substantial amount of flow to fill the Morro Reservoir. This mass movement of flow produces substantial HGL variation throughout the zone, however it does not cause problems with low pressure.

A single bottleneck in a 12-inch diameter pipeline in Dentro De Lomas Street and Paseo Grand Road was identified as the only hydraulic capacity deficiency in the zone and is recommended to be upsized to a 16-inch diameter pipe. This pipe is a critical transmission route for flow out of the zone during filling of Morro

Reservoir. The current pipe size reduces the flow that can be pumped into the South Zone during an aqueduct outage scenario.

The South Zone serves ten separate pressure reduced zones. Despite these reduced zones, there are still areas of high pressure throughout the zone. High pressure areas, typically in canyons, were identified throughout the zone for the potential addition of new pressure regulating stations. The pressure in these areas could be reduced substantially, reducing the risk of damage to the District and its customers. Additionally, several opportunities for looping of dead end pipelines were identified which would improve water quality and provide additional fire flow and reliability to customers served by those pipelines.

Nearly the entire South Zone is capable of providing the desired minimum fire flow. A single area off of Magee Lane served by 6-inch and 4-inch pipelines can only provide a fire flow of approximately 700 gpm. At this location upsizing of the existing piping or looping of the existing pipeline to nearby Daisy Lane would provide adequate fire flow capacity.

Project No.	Project Description	System Benefit
WE3	Highway 76 Realignment - Water Lines	Remove water lines from Caltrans ROW
WE5	Wrightwood to Cottontail Water Line	Replace broken pipe and reinstall previously looped system
WE6	Lake Vista Estates Loop	Improve water quality by eliminating dead ends and improve fire flow
WE7	Tarek Terrace Water Line	Replace old pipe to have fewer service outages and resources spent on repairs
WE8	Rancho Amigos Pressure Station Replacement	Improve maintenance access
WH1	Upsize 12" to 16" along Dentro de Lomas/Paseo Grande Road	Increase system pressures, increase emergency (or permanent) pump performance
WP5	Install PRS to serve South Fork Area along Vista Valley Drive	Reduce local pressure, reduce risk of pipe and lateral breaks
WP10	Install PRS at Via Maria Elena	Reduce local pressure, reduce risk of pipe and lateral breaks
WP12	Install PRS to serve Champagne Boulevard	Reduce local pressure, reduce risk of pipe and lateral breaks
WR6	Moosa Permanent Emergency Pump Station	Permanent Station to provide emergency supply to South Zone
WR9	Line P Permanent Emergency Pump Station	Permanent Station to provide emergency supply to South Zone
WR10	Camino Del Rey Permanent Emergency Pump Station	Permanent Station to provide emergency supply to South Zone
WR11	Dentro De Lomas Permanent Emergency Pump Station	Permanent Station to provide emergency supply to South Zone
WR15	Loop Pipelines in Via Ararat Drive to West Lilac Road	Provide redundant supply and increased looping
WR16	Loop Pipelines in Magee Lane to Disney Lane	Loop lines for redundancy and improved fire flow
WR20	Integrity Court, connect dead end lines	Provide redundant supply and increased looping

Project No.	Project Description	System Benefit
FF5	Upsize 4-inch and 6-inch to 8-inch at Mageee Lane	Increase available fire flow
WS1	Weese WTP permanent emergency interconnect and pump station	Provide permanent connection to emergency supply source to serve South Zone during 2nd Aqueduct outage

Morro Reservoir Zone (825)

Morro Zone

The Morro Zone is characterized by the Morro Reservoir, the largest reservoir in the District with a total capacity of 151.5 million gallons which serves as the primary source of water during planned and unplanned supply emergencies. The zone is at the lowest hydraulic grade in the distribution system, so water must be pumped from Morro Reservoir to supply any other zone. The Morro Reservoir is filled primarily from the South Zone through four separate pressure reducing stations, but additional flow is also supplied from the Pala Mesa Zone through two additional reducing stations. Morro Zone supplies PS 5 and serves ten smaller reduced pressure zones.

The total demand in the Morro Zone is approximately 2.4 MGD and domestic demands are half as large as the agricultural demands.

Similar to the South Zone, the Morro Zone is extremely diverse in its topography and operational scenarios. The HGL of the zone is 825 feet and serves elevations as low as 140 feet. Extremely high pressures are common throughout the zone. The Morro Reservoir filling scenario puts the most strain on the Morro Zone as flow in excess of the required demands is being moved through the zone to the reservoir. However the Morro Zone lacks large transmission mains to facilitate the filling of Morro Reservoir. Instead, multiple pipelines ranging from 10 to 20 inches in diameter transport flow from the six PRVs into the reservoir. Despite the lack of a large transmission conduit to Morro Reservoir, velocity and headloss throughout the Morro Zone are well controlled and there are no large HGL swings. A single bottleneck in Mission Road was identified as the only hydraulic capacity failure in the zone and is recommended to be upsized to a 12-inch diameter pipe.

High pressure areas, typically in canyons, were evaluated throughout the zone for the potential addition of new pressure regulating stations. The pressure in these areas could be reduced substantially, reducing the risk of damage to the District and its customers. Additionally, several opportunities for looping of dead end pipelines were identified which would improve water quality and provide additional fire flow and reliability to customers served by those pipelines.

Under fire flow conditions in the Morro Zone is very strong. Nearly the entire zone is capable of providing the desired fire flow.

Project No.	Project Description	System Benefit
WH3	Remove Bottleneck, upsize 8-inch to 12-inch on Mission Road and North River Road	Reduce headlosses through bottleneck, increase flow capacity during Morro filling
WP6	Install PRS on Baja Mission Road	Reduce local pressure, reduce risk of pipe and lateral breaks
WP7	Install PRS on Limber Pine Road	Reduce local pressure, reduce risk of pipe and lateral breaks

Project No.	Project Description	System Benefit
WP8	Install PRS Club Vista East on Lake Vista Drive	Reduce local pressure, reduce risk of pipe and lateral breaks
WP11	Install PRS at intersection of Mission Road and East Vista Way	Reduce local pressure, reduce risk of pipe and lateral breaks
WP13	Connect and install PRS to serve Orange Hill, Estate Drive and Rio Vista Drive	Reduce local pressure, provide redundancy and reduce risk of pipe and lateral breaks
WP14	Install PRS on Thoroughbred Lane	Reduce local pressure (~300), reduce risk of pipe and lateral breaks
WP15	Install PRS to serve River Village	Reduce local pressure (250+) reduce risk of pipe and lateral breaks
WR1	Line NN transmission upgrades	Provide increased capacity through transmission flow path to allow better utilization of Dentro de Lomas PRV during Morro Filling
WP16	Install PRS to serve Ascot Park area	Reduce local pressure (220+) reduce risk of pipe and lateral breaks
WR18	Install Parallel 10-inch Pipeline on Kari Lane	Provide additional flow path and reduced resistance during Morro filling

Morro Tank Zone

Morro Tank Zone (865)

The Morro Tank Zone is a small zone that begins at PS 5, which pumps water from the Morro Zone to the Morro Tank. This pump station consists of a single 150 horsepower pump with a design flow of 3,455 gpm. In the event that the pump is out of service, the Pala Mesa Zone can supply the Morro Tank Zone. The Pala Mesa Zone has the same hydraulic gradient, however it is separated from the Morro Tank Zone by the Morro Zone. To bring water from the Pala Mesa Zone, a transmission main in the Morro Zone must be isolated and the Pala Mesa to Morro Zone PRV opened.

Demands in the Morro Tank Zone are approximately 0.4 MGD and are a mix of domestic and agriculture.

Because the Morro Tank Zone is so small it is very stable. The tank is large relative to the demand served and the high capacity pump fills the tank quickly, which results in a small zone typically served by a slowly emptying tank. The northernmost edge of the zone is less than three miles from the tank and distribution pipes in the zone are adequately sized, resulting in very minor HGL fluctuations the majority of the time.

Under fire flow conditions the presence 4-inch and 6-inch diameter pipe along Sleeping Indian, Conejo and Caroline Roads results in these areas not being able to provide the required 750 gpm fire flow. Except for a small, low static pressure area in the center of the zone the remainder of the zone is able to provide the desired minimum fire flow.

The Morro Tank will need to be permanently removed from service in the future due to geological instabilities that are worsening. Several options are being investigated by the District, including construction of a new tank, creating a closed zone supplied from a new hydropneumatic pump station, and supplying the zone from the Pala Mesa Zone.

Project No.	Project Description	System Benefit
FF2	Upsize 4-inch and 6-inch to 8-inch and 10-inch along Sleeping Indian, Conejo and Caroline Roads	Increase available fire flow
WS3	Morro Tank Zone permanent FPUD emergency interconnection	Provide emergency supply to Morro Tank Zone in case of fire as portions of the zone do not meet fire flow criteria without increased HGL

5.3.4 Pumping Analysis

Booster pump stations supplying pressure zones with storage facilities should have the capacity to supply maximum day demands with the largest pumping unit out of service. Pumps stations in the RMWD distribution system are generally oversized to allow for maximum operation during off-peak energy periods, when operators may run several pumps at a station and quickly fill tanks or reservoirs to save on energy costs. **Table 5-7** evaluates the capacity of existing booster pump stations based on existing and projected 2035 demands. As shown in the table, all the District's pump stations have sufficient capacity for existing and projected 2035 demands.

Table 5-7 Pump Station Capacity Analysis

Pump Station Name	No./Size of Pumps	Firm Capacity (gpm)	Total Capacity (gpm)	Max Day Demand		Capacity Increase Required
				Existing (gpm)	2035 (gpm)	
PS 1 Rainbow Heights	2 - 250 Hp 1 - 300 Hp 1 - 290 HP	2,533	3,509	750	730	No
PS 2 U-1	3 - 75Hp	1,035	1,615	240	260	No
PS 3 Vallecitos	1 - 75Hp	679	679	390	380	No
PS 4 Northside	1 - 150 Hp 1 - 75 Hp	2,252	6,296	1,690	1,600	No
PS 5 Morro Hills	1 - 150 Hp	3,455	3,455	620	590	No
PS 6 Gomez (Huntley)	2 - 300 Hp 1 - 250 Hp	2,872	4,552	830	790	No
PS 7 Magee	1 - 50 Hp 1 - 100 Hp	681	1,398	50	50	No

It is noted that only one pump is currently operational at Pump Station 3, which supplies the Vallecitos Tank. Backup supply to the Vallecitos Tank can be supplied from Pump Station 1, however, and there is ample capacity at that pump station to supply both the Rainbow Heights Tank and the Vallecitos Tank. Likewise there is only one pump at Pump Station 5 supplying the Morro Tank. Backup supply to the Morro Tank Zone can be provided from the Pala Mesa Zone by isolating the Northside Transmission Main that runs through the Morro Zone.

5.3.5 Storage Analysis

The required storage volumes for each pressure zone based upon both existing and projected 2035 demands are calculated according to the criteria defined in **Table 2-1**. **Tables 5-8** and **5-9** provide a comparison of the required storage volumes for each pressure zone and the existing storage facilities. Calculations are also provided for reserve storage volumes based on 10-days of average demand.

Based on the daily storage requirements per zone, there is sufficient storage capacity in every zone with the exception of the Vallecitos and South Zones. The Vallecitos Tank is very small and is typically refilled two or three times a day. The South Zone has a slight storage deficit of 0.6 MG based on existing demands. The Vallecitos Zone has not been considered for replacement of the existing tank or addition of a new tank. The zone has access to additional storage through its connection with the Rainbow Heights Zone and excess pumping capacity. The deficit shown in the South Zone is covered by available capacity in the Pala Mesa Zone, which can reduce to the South Zone as necessary. Should demands increase in the South Zone beyond what is anticipated, it is recommended that an additional tank be added in the South Zone to provide additional operational storage.

The 10-day storage analysis shows that a large storage deficit exists in the center of the District in the Canonita and Pala Mesa Zones. A small portion of this deficit is serviced by surplus storage available in the northern part of the District which can feed the Canonita Zone through the Stewart Canyon, Los Alisos and Garrent Ranch PRVs. Rather than build additional reservoirs in either the Canonita or Pala Mesa Zones, it is recommended that the District construct an emergency pump station which will allow the District to feed the Pala Mesa Zone from the large surplus of storage at the Morro Reservoir. In addition to shutdown and emergency situations, this station would give the District increased operational flexibility. The preferred site for a station lifting water from the Morro Zone to the Pala Mesa Zone is at the 76 & Gird PRV site.

Table 5-8 2013 Storage Analysis

Major Service Zone	Storage Facility	Reservoir Capacity (MG)	Elevation (feet)		Existing Demand[1]			Daily Storage Requirements (MG)				Surplus/(Deficit) by Zone (MG)	Reserve Storage (MG)	
			HWL	Bott	AAD (MGD)	Peak Day Factor	MDD (MGD)	Operational (0.15xMDD)	Fire Flow	Emergency (1xMDD)	Total		10-day AAD	Surplus/(Deficit)
Magee	Magee Tank	3.0	2,160	2,120	0.04	1.84	0.07	0.01	0.30	0.07	0.38	2.6	49.9	2.1
Rainbow Hts	Rainbow Hts Tank	4.0	1,967	1,927	0.54	1.98	1.07	0.16	0.30	1.07	1.54	2.5		
Gomez	Gomez Tank	3.5	1,710	1,672	0.60	1.98	1.19	0.18	0.30	1.19	1.67	1.8		
U-1	U-1 Tank No. 1	5.0	1,579	1,545	0.18	1.92	0.35	0.05	0.30	0.35	0.71	5.8		
	U-1 Tank No. 2	1.5	1,579	1,533										
Vallecitos	Vallecitos Tank	0.4	1,338	1,316	0.29	1.99	0.57	0.09	0.30	0.57	0.95	(0.6)		
Northside	Northside Res	22.8	1,282	1,240	1.24	1.97	2.45	0.37	0.30	2.45	3.12	19.7		
North	North Res	7.8	1,212	1,192	2.09	1.99	4.17	0.62	0.30	4.17	5.09	6.7		
	Rice Tank	4.0	1,206	1,167										
Canonita	Canonita Tank	6.0	1,019	980	1.98	1.91	3.79	0.57	0.30	3.79	4.66	1.3	42.2	(30.2)
Pala Mesa	Pala Mesa Tank	6.0	865	846	2.23	1.91	4.26	0.64	0.30	4.26	5.20	0.8		
South	Hutton Tank	4.0	1,011	971	5.38	1.99	10.70	1.60	0.30	10.70	12.60	(0.6)	100.1	67.4
	Turner Tank	4.0	1,011	971										
	Gopher Canyon	4.0	1,011	971										
Morro	Morro Reservoir	151.5	825	778	4.16	1.93	8.03	1.20	0.30	8.03	9.53	142.0		
Morro Tank	Morro Tank	4.0	865	824	0.47	1.94	0.92	0.14	0.30	0.92	1.36	2.6		
	TOTALS	**235.1**			**19.2**		**37.6**	**5.6**	**3.6**	**37.6**	**46.8**	**88.0**	**192.1**	**39.4**

[1] Based on 2013 water billing data and calculated system water loss determined from 2013 SDCWA deliveries.

Table 5-9 2035 Storage Analysis

Major Service Zone	Storage Facility	Reservoir Capacity (MG)	Elevation (feet)		Existing Demand[1]			Daily Storage Requirements (MG)				Surplus/ (Deficit) by Zone (MG)	Reserve Storage (MG)	
			HWL	Bott	AAD (MGD)	Peak Day Factor	MDD (MGD)	Operational (0.15xMDD)	Fire Flow	Emergency (1xMDD)	Total		10-day AAD	Surplus/ (Deficit)
Magee	Magee Tank	3.0	2,160	2,120	0.04	1.84	0.07	0.01	0.30	0.07	0.38	2.6	46.5	5.5
Rainbow Hts	Rainbow Hts Tank	4.0	1,967	1,927	0.52	1.98	1.03	0.15	0.30	1.03	1.48	2.5		
Gomez	Gomez Tank	3.5	1,710	1,672	0.56	1.98	1.11	0.17	0.30	1.11	1.58	1.9		
U-1	U-1 Tank No. 1	5.0	1,579	1,545	0.19	1.92	0.36	0.05	0.30	0.36	0.72	5.8		
	U-1 Tank No. 2	1.5	1,579	1,533										
Vallecitos	Vallecitos Tank	0.4	1,338	1,316	0.26	1.99	0.52	0.08	0.30	0.52	0.89	(0.5)		
Northside	Northside Res	22.8	1,282	1,240	1.14	1.97	2.26	0.34	0.30	2.26	2.89	19.9		
North	North Res	7.8	1,212	1,192	1.94	1.99	3.87	0.58	0.30	3.87	4.75	7.1		
	Rice Tank	4.0	1,206	1,167										
Canonita	Canonita Tank	6.0	1,019	980	2.40	1.91	4.59	0.69	0.30	4.59	5.57	0.4	45.8	(33.8)
Pala Mesa	Pala Mesa Tank	6.0	865	846	2.18	1.91	4.17	0.63	0.30	4.17	5.09	0.9		
South	Hutton Tank	4.0	1,011	971	4.97	1.99	9.89	1.48	0.30	9.89	11.67	0.3	95.1	72.4
	Turner Tank	4.0	1,011	971										
	Gopher Canyon	4.0	1,011	971										
Morro	Morro Reservoir	151.5	825	778	4.11	1.93	7.92	1.19	0.30	7.92	9.41	142.1		
Morro Tank	Morro Tank	4.0	865	824	0.43	1.94	0.84	0.13	0.30	0.84	1.27	2.7		
	TOTALS	**235.1**			**18.7**		**36.6**	**5.5**	**3.6**	**36.6**	**45.7**	**85.9**	**187.5**	**44.0**

(1) Based on 2013 water billing data and calculated system water loss determined from 2013 SDCWA deliveries.

Chapter 6
WASTEWATER SYSTEM EVALUATION

This chapter summarizes the existing wastewater customers and facilities within the District which conveys sewer flows from sewer customers; approximately 27 percent of the District's water customers are sewered. These facilities include the gravity lines, manholes, lift stations, forcemains and a flow meter. The majority of the facility information used during the preparation of this master plan was collected from existing GIS data as well as some input from as-built construction drawings, and input from District staff. The GIS was created as part of the previous master plan through a lengthy data collection and inventory of past sewer atlas books, as-built construction drawings, previous reports/studies, and District staff input.

6.1 General

Within the District's service area, land use is transitioning from primarily agricultural use to now include a significant component of rural residential development along with multiple dense, large scale residential and mixed use developments planned for the near future. Commercial land use in the District is very limited and is concentrated along the I-15 and SR-76 corridors. Growth in the District and throughout the County has been steady for several years as residential development spreads further and further away from the metropolitan areas of the County.

The Rainbow area is faced with a unique situation. The low-density development that characterizes the District has primarily utilized on-site septic systems for wastewater disposal. The projected land use for the District, however, indicates that denser, master planned residential and mixed use developments are forthcoming in the District's existing sewer service area. Outside of the existing sewer service area, some rural residential development will continue, but it is likely that the majority of the District will remain on septic systems for the foreseeable future.

6.2 Collection System Description

The District currently owns, operates and maintains approximately 58 miles of wastewater conveyance pipelines, including gravity flow pipelines and forcemains. Collection system pipelines range in size from 6 to 24 inches in diameter. Gravity pipe materials used throughout the system include polyvinyl chloride (PVC), ductile iron (DIP), and vitrified clay (VCP). Forcemains within the District are constructed of cast iron and PVC. **Table 6-1** presents a summary by pipeline diameters of the RMWD conveyance facilities.

Wastewater generated within the District is metered as it flows out of the District by gravity at the Stallion Metering Station (Stallion) to the San Luis Rey Wastewater Treatment Plant (SLRWTP) in Oceanside.

Table 6-1 RMWD Conveyance System Summary

Pipeline Diameter (inch)	Total Length (Gravity - lf)	Total Length (Forcemain - lf)
6	1,123	2,388
8	199,703	0
10	13,397	4,946
12	40,593	2,950
15[(1)]	25,794	236
18	689	850
21	2,183	0
24	11,300	0
System Totals (feet)	**294,782**	**11,370**
System Totals (mile)	**55.8**	**2.2**

[(1)] Includes 14-inch diameter pipeline length
lf = linear foot

The age of the sewer system is summarized in the Districts' 2015 Sewer System Management Plan (SSMP), included in **Appendix G**. There is not a breakdown available by material, although the older pipe tends to be VCP and the newer pipelines PVC. Approximately 20 miles of pipeline is 40 years of age or older. In the near future some of these pipes will become candidates for rehabilitation or replacement, dependent upon condition. It will be critical for the District to embark on a condition assessment program for a large portion of their system to better quantify and budget for these needs over the next decade.

6.3 Lift Stations and Forcemains

Six wastewater lift stations are operated within the District's service area. The lift station type and location are described for each station below:

- ***Lift Station 1.*** This station is located just south of the intersection of Golf Club Drive and Old River Road on the south side of the San Luis Rey River. It consists of a Smith and Loveless packaged lift station with three 5-hp wetwell/drywell pumps and a 3,000 gallon working volume wet well. The existing pumps were rated at 625 gpm each and there is a backup generator in case of a power failure. The District replaced the pumps at this station in kind in 1994. Lift Station 1 is currently under design for replacement which will expand the station's capacity to serve peak wet weather and future projected sewer flow. The replacement design has considered relocating the station to the north side of the San Luis Rey River in order to abandon the siphon crossing beneath the river and replacing it with a force main. In addition, the new design will strive to move the station further away from nearby residences.
- ***Lift Station 2.*** This station is located at the intersection of Little Gopher Canyon Road and Old River Road, in the southwest corner of the District. The station is a Flygt/Xylem packaged lift station consisting of three 70-hp wetwell/drywell pumps and a 14,000 gallon working volume wet well. The existing pumps are rated at 1,500 gpm each. There is also a backup generator in case of a power outage. This station was replaced in 2010 due to a history of problems with overflows. Capacity was increased from 1,000 gpm per pump to the current 1,500 gpm per pump to allow significant capacity to serve the ultimate projected sewer flow.

- ***Plant B Lift Station***. This station is located south of the District offices on Old Highway 395. This station is a Smith & Loveless prefabricated station consisting of two 5-hp wet well/dry well pumps and an 800 gallon working volume wet well. The pumps are each rated at 320 gpm. The station has a standby generator to run the lift station in the case of a power failure. This is the District's oldest lift station and is located in a sub-basin subject to high infiltration. Abandonment of this station is planned to coincide with the construction of the Pankey Sewer Lift Station.
- ***Rancho Monserate Lift Station***. Wastewater generated at the Rancho Monserate Mobile Home Park is tributary to this station, located north of the park off Dulin Road. Collected wastewater is conveyed north via forcemain for approximately 1,740 feet where it intercepts the Rancho Viejo Forcemain. The Rancho Viejo Forcemain transports the wastewater an additional 2,350 feet before it discharges into Manhole No. 20L-M020 at the intersection of Old Highway 395 and Pala Road. The Rancho Monserate lift station is a Flygt/Xylem lift station consisting of two 5-hp wet well/dry well pumps with a 300 gallon working volume wet well. The pumps are each rated at 320 gpm. The station also has a backup power generator in the case of a power failure.
- ***Rancho Viejo Lift Station***. This station is located on Dulin Road east of I-15. This station was built in 1990 to transport wastewater generated in the Lake Rancho Viejo subdivision. The lift station is a Gorman-Rupp prefabricated station consisting of two 40-hp wet well/dry well pumps and a 600 gallon working volume wet well. The pumps are each rated at 805 gpm. This station also has a backup power generator.
- ***Fallbrook Oaks Lift Station***. This station is located south of the intersection of Sarah Ann Drive and Kate Lendre Drive in the Fallbrook Oaks subdivision off Gird Road. This is the only station that contains two submersible Meyer's pumps inside of a 500 gallon working volume wet well. It consists of two 250 gpm, 5-hp submersible Meyer's pumps. The station has a standby generator to provide power to the lift station in the case of a power failure. This station and the associated force main are in poor condition and are in need of repair or replacement.

Table 6-2 provides characteristic information for each of the District's lift stations. All pumps are constant speed. Characteristics of the forcemains that accompany each lift station are summarized in **Table 6-3**.

Table 6-2 Summary of District Lift Station Characteristics

Lift Station	No. of Pumps	Total HP	Firm Capacity(1)	Backup Power(2)	Built	Last Upgraded
Lift Station 1	3	15	1,250	Yes	1974	Under design for full station replacement
Lift Station 2	3	210	3,000	Yes	2010	Replaced original 1974 Station
Plant B (Lift Station 3)	2	10	640	Yes	1964	Planned to be abandoned with construction of Pankey SLS
Rancho Monserate (Lift Station 4)	2	20	640	Yes	1972	Station rehabbed in 1998, 2012
Rancho Viejo (Lift Station 5)	2	80	1,610	Yes	1990	
Fallbrook Oaks (Lift Station 6)	2	10	500	Yes	1988	Pumps replaced in 1994

(1) Firm capacity is the capacity of the station with the largest pump out of service
(2) Backup power is provided at each site by permanently installed diesel, propane or natural gas powered generators

Table 6-3 Summary of District Forcemain Characteristics

Forcemain	Diameter (inch)	Length (feet)	Material	Discharge Manhole
Lift Station 1	10	252	CI	N-3_65
Lift Station 2	12/14/18	2,950/236/850	PVC/HDPE	O-2_2
Plant B (Lift Station 3)	10	850	PVC	J-6_29
Rancho Monserate (Lift Station 4)	6	1,740	PVC/DIP	J-6_22(1)
Rancho Viejo (Lift Station 5)	10	1,492/2,352	PVC/DIP	J-6_22(1)
Fallbrook Oaks (Lift Station 6)	6	648	DIP	J-4_29

(1) Forcemain from Rancho Monserate conveys the wastewater approximately 1,740 feet where it intercepts the Rancho Viejo Forcemain. The Rancho Viejo Forcemain transports the wastewater an additional 2,350 feet before it discharges into Manhole No. J-6_22

DIP = ductile iron; CI = cast iron; PVC = polyvinyl chloride; HDPE = high density polyethylene

6.4 Wastewater Treatment and Disposal

Currently the District maintains no facilities for the treatment and disposal of wastewater. The District transports all of its wastewater to the SLRWTP in Oceanside for treatment, solids disposal and disposal of the treated wastewater to the ocean outfall. However, the District has completed a preliminary study (Atkins 2015) to examine the feasibility of constructing a District-owned wastewater reclamation facility due to the potential to economically relieve the District of its reliance on treatment and disposal by the City of Oceanside while simultaneously producing a beneficial new water supply. The results of the study showed that a proposed project could be economically viable and the District has embarked on a preliminary design study of the treatment plant and recycled water system to confirm the feasibility of the project. The initial feasibility study, Technical Memorandum No. 1 of the Master Plan, is included as **Appendix E**.

Based on the results of the preliminary assessment the District believes the project may be likely to proceed and for the purposes of analyzing future sewer system conditions and capacity requirements, a District-owned plant at the site available at the District office is being assumed as the baseline condition at a capacity of 0.9 MGD. The District may opt to select the option of a larger plant and/or a different plant location as part of a preliminary design report currently being prepared. The Master Plan assumes the baseline project will be operational in 2020, with full capacity reached in 2025.

6.5 Existing System Hydraulic Evaluation

The level of safety and reliability of a sewer system that serves a community is provided by the implementation of industry established and verified criteria which guides planning and design of the system. The primary means of assessing the performance of a wastewater collection system and its components are by evaluating available information according to the criteria accepted by the agency managing the assets. Chapter 2 of this Master Plan describes in detail the criteria that the District has standardized upon and that will be used to evaluate the performance of the sewer system. This chapter will discuss in detail the analyses conducted that formulate the results of the evaluation and the accompanying recommendations.

The hydraulic evaluation primarily employs the use of the *InfoSewer* hydraulic modeling software. The hydraulic model performs calculations based upon industry standard open channel flow equations and algorithms, as well as pressurized flow and the interface between pressurized flow and gravity flow which occurs when a pipeline exceeds capacity and causes back water affects such as surcharging. *InfoSewer* also has the ability to perform extended period simulations (EPS) which allows the user to route flows through the conveyance system according to varieties of time patterns to observe a more accurate peaking scenario and how it affects total flow rate, depth, velocity and other metrics throughout the sewer system.

6.5.1 Hydraulic Model Development

The District provided its existing sewer hydraulic model for update as part of this study. The existing model contains databases of manholes, gravity pipelines, lift stations, force mains, outfall locations and other facilities which make up the District's wastewater system. Physical data as well as attribute data for each facility is maintained within the model databases. In order to update the hydraulic model the District provided updated GIS and As-Built records of projects completed since the last model update. The model mirrors the District's assets, containing over 1,200 manholes, 1,100 pipe segments and 6 lift stations and force mains. Dynamic components of the sewer system, such as lift stations, also have additional characterization information such as pump curves and lift station control settings which are integral to accurately modeling the system.

6.5.2 Dry Weather Flows

Dry weather flow (DWF) conditions are those that exist throughout the majority of the year when there is not an active or recently occurred rainfall event. Dry weather flows represent primarily the wastewater generated through indoor water to sewer return flow as well as exterior flows not generated by customers. The District monitors system-wide sewer flows out of the District at the Stallion Flow Meter, which measures flow conveyed to the City of Oceanside for treatment and disposal or reuse. Currently, this is the only permanent flow metering facility available within the District. It is recommended that additional permanent flow metering locations be installed within the District's system. **Section 3.5** provides additional information regarding historical flows and trends, seasonal variation of flow and peaking factors measured and observed within the District at the Stallion Flow Meter.

Based on the review of daily flow data from the past six years provided in **Section 3.5** and summarized in **Table 3-11**, dry weather flow daily peaking factors were determined. For dry weather flows the max day peaking factors varied from 1.08 to 1.30 with most years falling between 1.11 and 1.16. For the purposes of analysis a peaking factor of 1.15 was selected and applied to the modeled sewer generation.

Additional studies have been completed by the District which have observed and studied sewer flows within smaller basins within the District's sewer service area. The sewer flow monitoring study completed by IEC in 2009 is the starting point for much of the sewer system hydraulic analyses. In that study flow was monitored at 20 locations within the system, four of which observed the total flow from three small basins and one large basin which combined made up over 85 percent of the total sewer flow at the time within the District. Diurnal curves for those systems were derived from that monitoring data and are used in the model to route flow into the model on a time basis. These curves were then adjusted during the model calibration process, which is discussed later. The four sewer diurnal patterns applied to the model are shown below in **Figure 6-1**.

Dry weather wastewater flow generation was applied to the model following a detailed analysis of water use by sewer customers within the sewer service area. In order to apply the wastewater generation as accurately as possible across the sewer service area, water use within each water pressure zone, only within the sewer service area, was reviewed and characterized. The wastewater generation rates for each area were adjusted to account for their actual water use during this exercise. **Table 6-4** presents the baseline sewer generation factors, characterizes the users, water use and anticipated wastewater generation within the sewer service area.

Table 6-4 Water Sales, Estimated Sewer Flow and Forecasted Unit Sewer Flow

User Billing Account Type	Water Sales[1] (MGD)	Estimated Sewer Generation (MGD)	Per Connection Sewer Generation (gpd)	Forecasted Per Connection Sewer Generation Rates (gpd)
Single Family, < 1" Meter	0.59	0.23	181	160
Single Family, >= 1" Meter	0.63	0.16	221	220
Multi-Family	0.12	0.09	75%	150
Commercial	0.14	0.02	512	500
Agriculture[1,2]	0.20	0.02	318	--
TSAWR Agriculture[1,2]	0.42	0.02	600	--
Totals	**2.10**	**0.56**		

MGD = million gallons per day; gpd = gallons per day

(1) Most agriculture customers do not have a sewer connection. Sewer flows on these properties are treated by septic tanks.

(2) There are no new planned agricultural developments.

The forecasted unit generation rates displayed in **Table 6-4** are based upon a regionally typical individual sewer generation of 65 gallons per capita per day (gpcd). According to the SANDAG Series 13 projections, the persons per household forecasted throughout the District ranges from 2.4 to 3.1, with an average of 2.6, which correspond to household generation rates ranging between 156 and 201 gpd. For existing multi-family connections, 75 percent of the observed water use at those connections was assumed to convert to sewer flow while the forecast for projections was assumed to be 150 gpd. The forecasted projections mirror the water forecast in the sense that they recognize efficiencies in indoor use that is present in new construction.

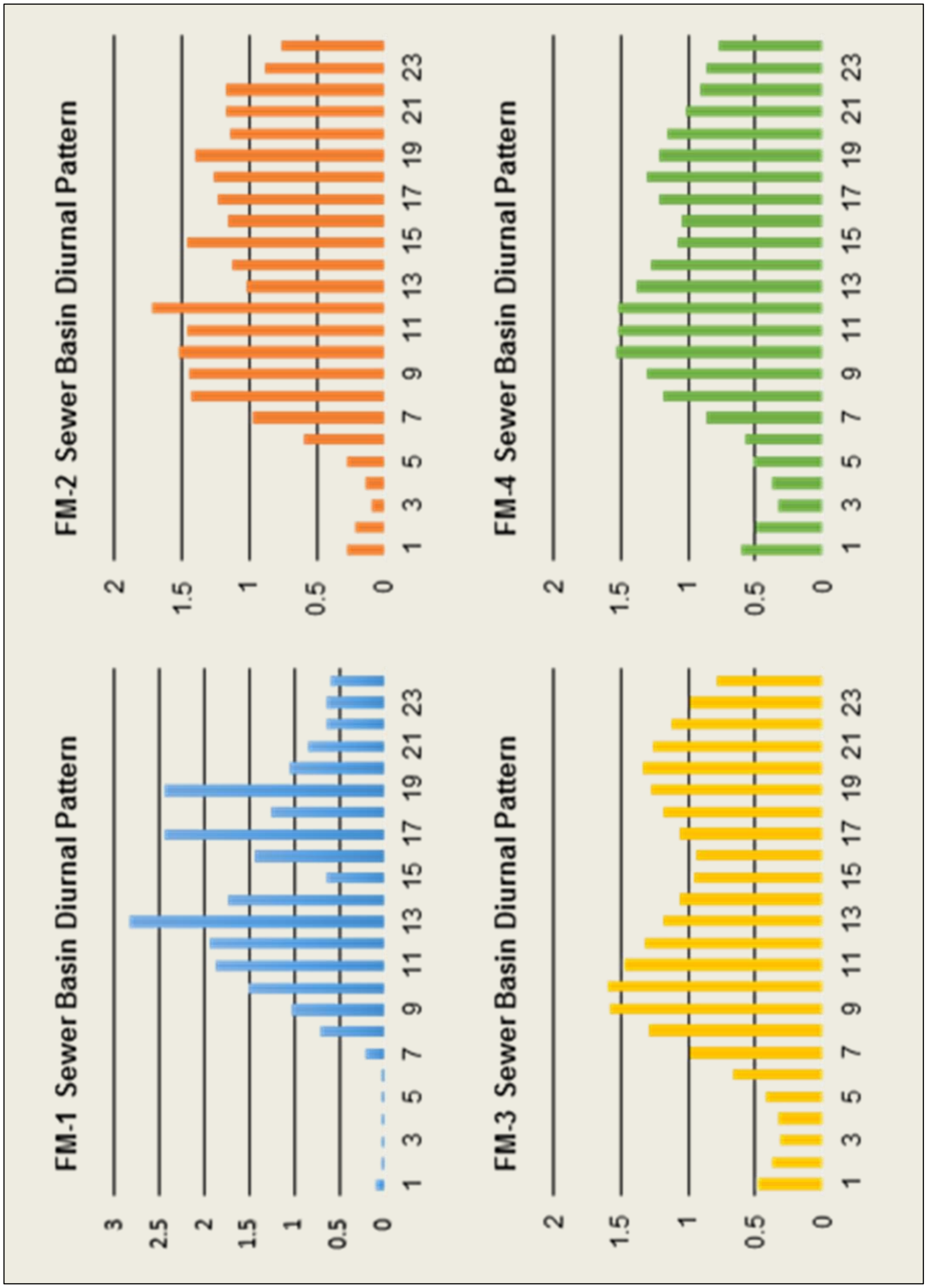
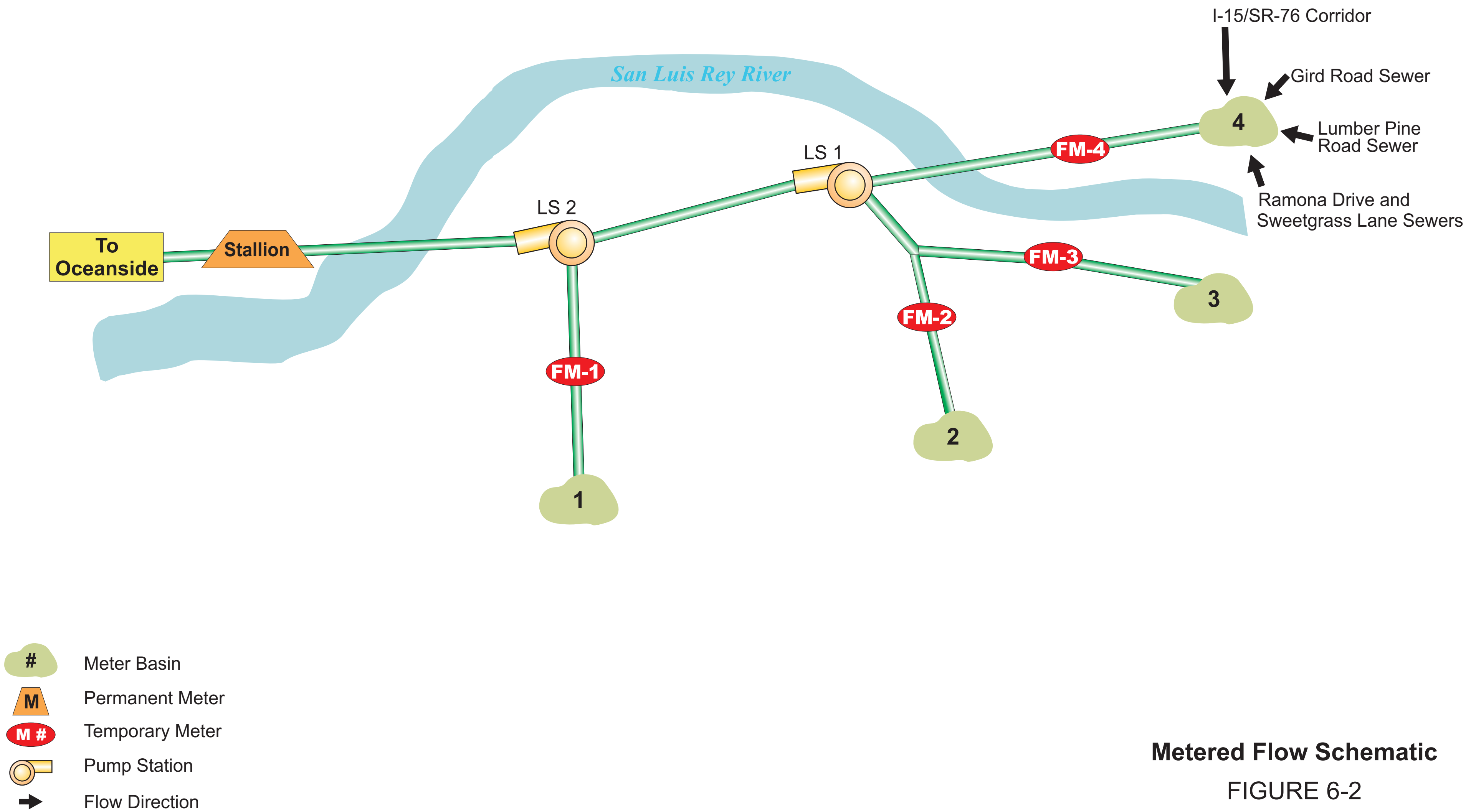


Figure 6-1 Calibrated Diurnal Patterns



Metered Flow Schematic

FIGURE 6-2

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The remaining component of the total dry weather flow are flows which come from a baseline infiltration load. Much of the sewer system is located nearby or within the groundwater basin of perennial and intermittent creeks and rivers whose groundwater basins are known to infiltrate into the sewer system. Based upon the work done in the 2009 flow monitoring study and the unit generation rates derived for existing users, an estimated baseline infiltration was determined and is shown in **Table 6-5**.

Table 6-5 Estimated Baseline Sewer System Infiltration

Flow Type	Flow (MGD)
Estimated Wastewater Generation	0.56
Total Sewer System Baseline Flow	0.70
Estimated Sewer System Baseline Infiltration	0.14

In order to route the baseline infiltration flow through the hydraulic model, the total flow has to be spatially allocated and assigned to specific junctions (which represent manholes) throughout the model. This was done by a careful review of the 2009 flow monitoring study. The study determined approximate rates of dry weather infiltration for each sewer basin observed. These estimates were used within the basins where significant baseline inflow was observed to determine a total inflow, while the location of the manholes within each basin relative to sources of infiltration was used to apply the loading spatially.

6.5.3 Wet Weather Flows

Wet weather flows (WWF) are those that enter into the sewer system as the result of a rainfall event. As discussed in **Section 3.5.3**, WWF enters the system through surface water inflow and/or subsurface water infiltration. Dry weather flow can be well characterized by using the monitoring data provided at the Stallion Flow Meter, allowing wet weather flows for specific storm events to be reasonably estimated.

Wet weather flow enters the sewer system and combine with dry weather flows. Unlike water use which is often drastically reduced during rainfall events, indoor water use and therefore sewer flow generation is not significantly affected. The result is that WWF events are normally the impetus behind sewer system planning and design as they require more capacity than PDWF to adequately convey the generated flows.

Rainfall events are highly variable, and the impact of similar events upon the same sewer system will vary depending upon a host of circumstances, most notably ground water levels and ground saturation levels at the time of the event. Despite this fact however, it is possible to assess historical information and approximate the total volume of flow infiltrating a system for a typical rainfall event. Due to the fact that rainfall events can be large, it is important to choose a reasonably sized storm upon which to design and plan infrastructure capacity.

The NOAA publishes rainfall intensity-duration-frequency tables and graphs which list and illustrate the amount of rainfall within a certain period of time that can historically be expected to occur within an average frequency at an approximate location. The combination of a frequency in concert with a duration (typically 1-day) and a certain amount of rainfall is referred to as a “design storm.” Typically sewer systems are designed to accommodate the I&I of between a 2 and 10 year storm in San Diego County. The 2009 flow monitoring study observed two small rainfall events, however, a more detailed study of the sewer system response to rainfall events was done using daily flow information collected at the Stallion Flow Meter, going back through year 2009. The results of this assessment are shown in **Table 6-6** which presents data the approximate rainfall intensities associated with various storm frequencies in the District and associated estimates of rainfall dependent I&I.

Table 6-6 Design Storm Rainfall Intensities and Wet Weather Sewer Flows for RMWD

	Storm Frequency				
	1-Year	**2-Year**	**5-Year**	**10-Year** (6)	**25-Year**
Design Rainfall Intensity (in/day) (1)	2.1	2.7	3.5	4.2	5.1
Rainfall Intensity (in/day) (2)	2.04	2.88	3.15	--	5.19
Average DWF (MGD) (3)	0.72	0.60	0.69	--	0.69
Observation Year(s)	'09, '10, '14	'10, '14	'10	--	'10
Average Total Flow (MGD) (4)	**0.81**	**0.73**	**0.85**	**--**	**1.34**
Average I&I (MGD) (5)	0.09	0.13	0.16	0.28	0.65
Infiltration Rate (MGD/in)	0.044	0.045	0.051	0.068	0.125
Peaking Factor	1.13	1.22	1.23	1.49	1.94

Note: Data obtained from NOAA for station GHCND:US1CASD0026 and Stallion Flow Meter
(1) Design rainfall intensity estimates vary by location throughout the District.
(2) Where multiple rainfall events were analyzed, average rainfall is shown
(3) Average DWF shown is during the time of the observed rainfall event and excludes flows recorded during the rainfall event
(4) Average Total Flow shown is during the time of the observed rainfall event
(5) Average WWF shown is approximated by subtracting the DWF observed during the month of the event from the Total Flow on the day of the event
(6) Polynomial regression of the data analyzed for 1, 2, 5 and 25 year storms was used to estimate these values

The storm in December of 2010, which falls between a 10-year and 25-year storm depending upon the storm duration and is the basis for the 25-year storm data shown in **Table 6-6**, is the largest storm that the County of San Diego and the District have had in recent history. Since that time, the December 2010 storm has been used throughout the County for PWWF analysis despite the fact that it is larger than the typical design PWWF event. This Master Plan used this event as the basis for analysis and planning of its sewers for a number of reasons, including:

- to account for the District's known I&I problem which increases significantly when the ground is already wet, and
- to acknowledge and plan for observed events, and
- to minimize the risk to the District of sewer spills in environmentally sensitive areas and associated Regional Water Quality Control Board (RWQCB) fines.

As a result of the peaking factor evaluation performed in **Section 3.5.2** and the information researched and presented in **Table 6-6**, a peak wet weather volume of 0.65 MGD was selected. This volume represents the approximate I&I observed during the December 2010 storm event. This is the highest I&I volume observed in recent history and is a considerably conservative I&I volume for PWWF analysis.

Wet weather flows were applied to the hydraulic model based on the approximate rates of wet weather infiltration observed in the 2009 flow monitoring study. Due to the fact that the flows being applied were substantially larger than those observed in the 2009 flow monitoring report, wet weather flows were applied to the various sewer basins based on the results in a proportional manner to those observed in the study period.

6.5.4 Hydraulic Model Calibration

The hydraulic model was calibrated to flow meter data from the 2009 flow monitoring report for the date of March 14, 2009. The flow monitoring report recorded data at 19 sites, plus the Stallion Flow Meter location; however, flow monitoring sites FM-1, FM-2, FM-3 and FM-4 were selected for the calibration effort. Simulated flow hydrographs at each selected meter location were compared with recorded discharge measurements.

The purpose of the comparison is to allow for refinement of estimated model parameters so that the simulated flow conditions reasonably approximate the measured flow conditions, especially peak flow conditions. The parameters that were refined included diurnal curve patterns and flow ratios (peaking factors). Diurnal curve refinement included “sharpening” the curves by raising their peaks and lowering their valleys. This procedure reduces the flattening of peaks that occurs because of the travel time from upstream users to downstream users. This is generally necessary because the pattern recorded at the flow meter is at the outlet of a basin and much of the flow being recorded in that basin actually occurred more than an hour ago depending on the size and length of the basin. The flows observed at the meters were also reduced to coincide with the flows loaded into the model. The baseline model demands are 0.70 MGD while the day that is being used for calibration experienced a flow of 0.77 MGD. Therefore to accurately compare the results of the model with the results of the metering, the metering flows observed were proportionately reduced 9 percent.

Flow meter FM-1 captures flows upstream of Lift Station 2; meters FM-2, FM-3, and FM-4 capture flows upstream of Lift Station 1. Results of the dry weather calibration are best presented graphically, and are shown in **Figure 6-3** for Meters FM-1 through FM-4.

6.5.5 Existing System Capacity Analysis Results

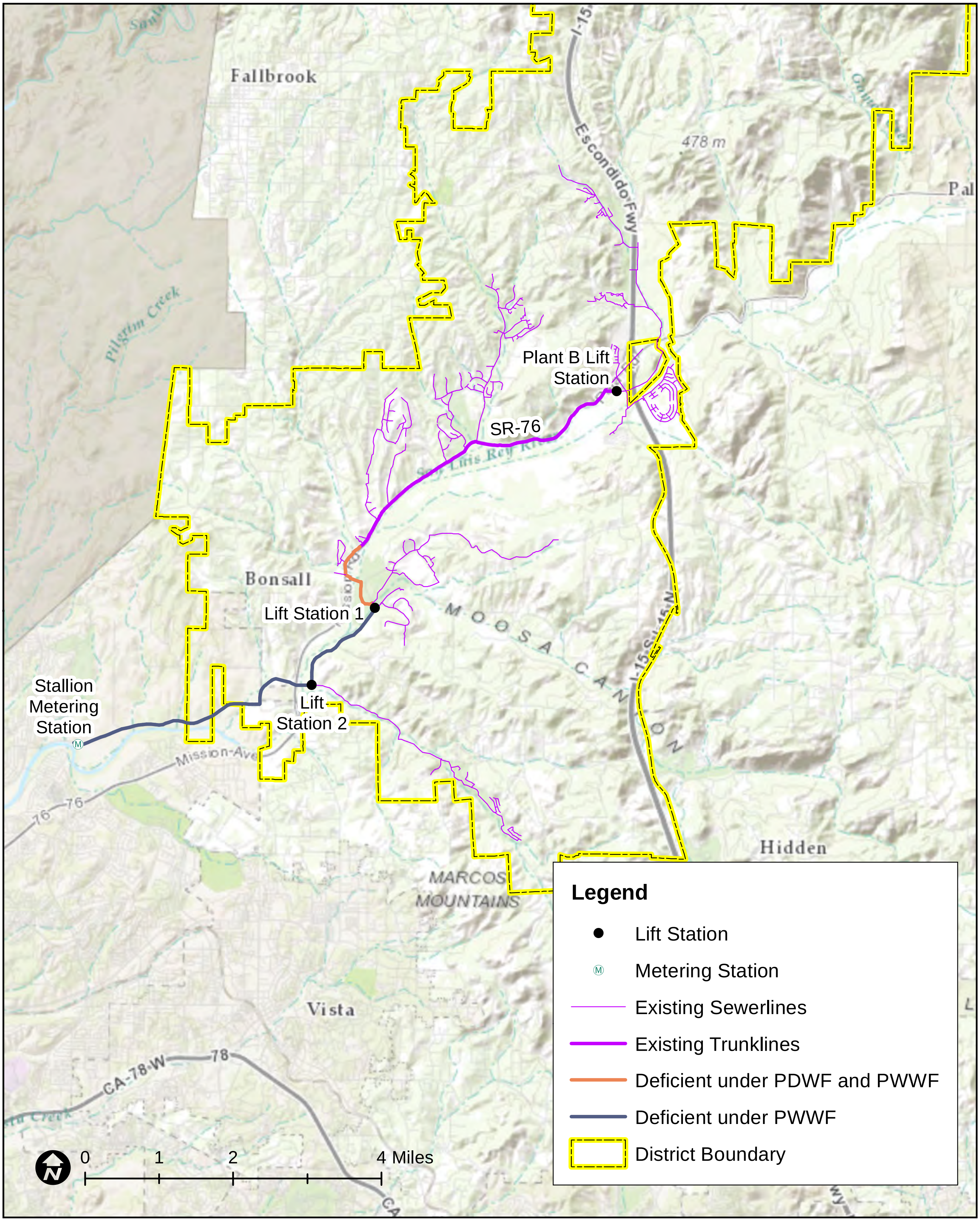
Analysis of the existing collection system including both dry and wet weather flows identified locations and facilities within the sewer system which are deficient based on the analysis criteria presented in **Chapter 2**. Pipelines identified as deficient are primarily in three locations along the SR-76 main trunk sewer which collects and conveys flow out of the District. Those pipelines which are deficient under PDWF and PWWF are shown on **Figure 6-4**. Deficient pipelines are also listed below in **Table 6-7**.

Table 6-7 Existing Sewer System Capacity Deficiencies

Trunk Sewer	Existing Diameter (in)	Replacement Diameter (in)	Length (ft)	Deficiency Scenario
San Luis Rey Interceptor from Mission Road to Lift Station 1 exceeds capacity	12, 15	18	7,100	PDWF, PWWF
From Lift Station 1 to Lift Station 2 exceeds capacity	15	18	7,500	PWWF
From Lift Station 2 to Stallion Flow Meter exceeds capacity	15	24	16,000	PWWF
Total			**30,600**	

Lift Stations	Existing Capacity (GPM)	Recommended Capacity (GPM)	Deficiency Scenario
Lift Station 1	1,250	1,800	PWWF
Lift Station 1 wet well deficient capacity	3,000 gal	5,700 gal	PWWF
Rancho Viejo wet well deficient capacity	600 gal	1,320 gal	PWWF

Figure 6-3 Flow Meter Dry Weather Calibration



Existing System Capacity Deficiencies
FIGURE 6-4

The deficiencies represent the remainder of District's trunk sewer which conveys flow to the Stallion Flow Meter. These pipelines have been identified in previous studies of the District's sewer system as deficient and are programmed in the District's short term CIP.

Lift station facilities were also evaluated in the existing sewer system evaluation. The primary criteria for evaluating lift stations are the firm pumping capacity of the station and the wet well volume. Deficient lift stations and wet wells are also listed in **Table 6-7**. Lift Station 1 and its wet well were known to be deficient under peak wet weather conditions and was in design for replacement and expansion of existing capacity. Additionally, the existing wet wells at the Rancho Viejo and Plant B lift stations both lack adequate capacity under peak wet weather flow. The wet well volume at the Rancho Viejo Lift Station should be addressed, while the storage volume at the Plant B lift station can be disregarded as this station is planned for abandonment.

Under existing conditions the District has adequate treatment and disposal capacity for both dry and wet weather. The largest flow recently observed was 1.34 MG during the December 2010 storm event. Other than the December 2010 event the District has not regularly exceeded 1.0 MGD since 2005.

6.6 Planning Horizon System Hydraulic Evaluation

An analysis of the sewer system has been conducted for a 20-year planning horizon, which is necessary to ensure that adequate conveyance, treatment and disposal capacity is available to existing and future customers. Forecasted wastewater flows are based on the characteristics of the existing system and its customers as well as the size of the service area and the types of land uses projected to be developed within the planning horizon. The forecast of wastewater flows allows for an evaluation of the capacity available within the existing system and the additional or upgraded facilities required to convey those flows that are beyond the capacity of the existing system.

An integral piece to the planning horizon evaluation which is new to this plan is the analysis of a Water Reclamation Plant (WRP) owned and operated by the District as the baseline condition for planning and analysis purposes. The implementation of a WRP has significant effects on where and how capacity is required within the sewer system and will be discussed at length within this section. Several options were presented for siting of the proposed plant in Tentative Map 1, with a site at the District offices selected for this plan as the baseline assumption. The District has not yet made a distinction of its preferred alternative for plant location and size and has commissioned an additional study to determine such. The primary alternatives to the baseline condition being reviewed are a larger District owned plant further into the District's system, located at or near either Lift Station 1 or Lift Station 2. Both of these alternatives and their impacts upon the sewer system will be discussed further in this section.

6.6.1 Projected Wastewater Service Area and System

The District is characterized by low density residential development and the presence of a significant volume of agriculture. Although the District's water demands have never declined below 16 MGD in the last 35 years, its sewer flows have never risen above an average of 1.0 MGD. Neither rural residential nor agriculture land uses generate large enough volumes of sewage to have negative impacts which would necessitate sewering and municipal sewage treatment, therefore the District's wastewater is primarily treated and disposed of via on-site septic systems.

For many years the District enforced Ordinance 01-02 which stated that "no parcel that is greater than 250 feet from the sewer mains and trunk lines active shall be allowed to connect to the sewer system." This ordinance in effect limited the potential growth of the sewer customer base to those parcels and properties low in canyons and valleys near the trunk sewer system.

In recent years however, the District has seen a surge of planned development activity within and around its boundaries of medium to high density projects requiring sewerage. Much of the planned growth was outlined in the County's 2020 General Plan which targeted areas near the SR-76 and I-15 for growth. These projects are anticipated to account for a majority of the growth expected within the planning horizon and may slightly expand the wastewater service area. Approximately 5 years ago the District rescinded Ordinance 01-02 to better accommodate the planned growth under the approved County General Plan.

The existing wastewater service area and known proposed developments requiring sewer service are shown on **Figure 6-5**. Developments shown are located both inside and outside of the District's sewer service area. Major proposed developments are also listed in **Table 3-5**.

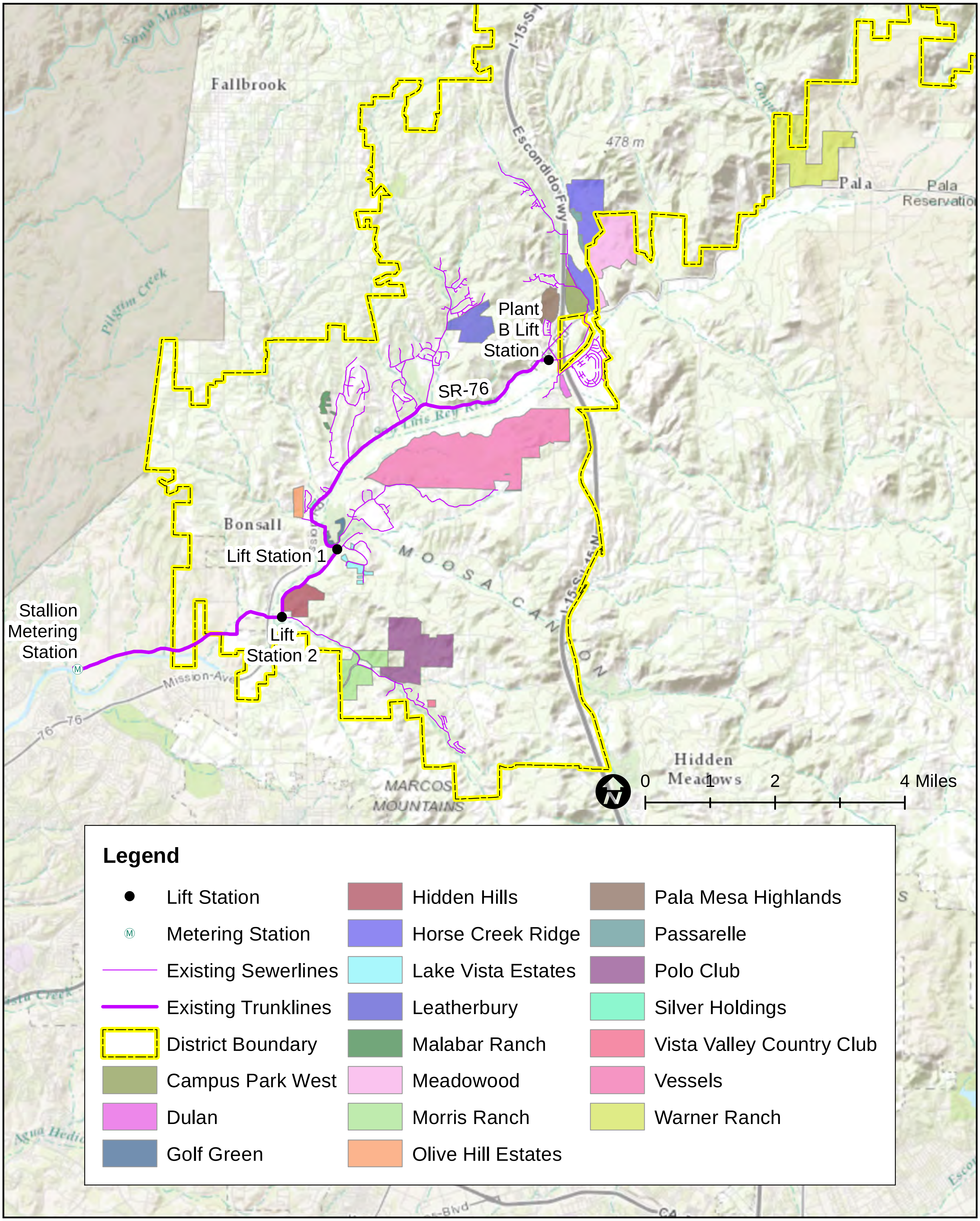
The majority of the proposed new developments to be served by the District are within the sewer service area and will construct their own onsite sewer system and connect to the District's existing system. Some of the developments however, are outside of the District's existing sewer service area and will be required to construct offsite sewer infrastructure and either annexed or enter into out of service agreements. The Master Plan presents a baseline CIP with only "in District" planned development, but also notes the potential impact should outside flows be conveyed by the District. Those developments, the facilities they will construct and the impact upon the sewer service area are described below.

Horse Creek Ridge and Campus Park West

The proposed residential density and proximity to the San Luis Rey River basin will require developments to be sewered. Horse Creek Ridge (HCR) is a planned residential and mixed use development on the eastern boundary of the District that has been required to construct the sewer infrastructure necessary to serve their projects. In addition, the proposed Campus Park West (CPW) development, whose annexation is pending, will also be required to construct a sewer collection system. To serve these projects and to improve the overall function of the sewer system the District plans to abandon the existing Horse Creek sewer (also known as the "Plant B" interceptor) and divert its flows to the new sewer to be constructed by the developer in Horse Creek Ridge Road. Additionally, the Horse Creek sewer drains to the Plant B lift station, which is the District's oldest lift station. The developers will construct the Pankey Sewer Lift Station (Near Pankey Road and SR-76) to convey the existing flows from the Horse Creek sewer, as well as from the new development, which will allow for the abandonment of the Plant B lift station in addition to the Horse Creek sewer.

Palomar College

This development is within the District adjacent to HCR. Construction of the new sewers through the Horse Creek Ridge and Campus Park West projects will provide sewer service to this development. In addition, the District will need to construct a short section of sewer to divert flows from Pala Mesa to Horse Creek Road to allow abandonment of the old Plant B Interceptor (Horse Creek sewer).



Sewer Service Area and Planned Developments

FIGURE 6-5

1/26/2016 gool4566 \\sdofs01\Data\Clients\Rainbow MWD\100044880 2015 MP Update\GIS\mxd\Figure 6-5 SewerServiceArea.mxd

ATKINS

Ocean Breeze Ranch (Vessels Ranch)

The other large planned development is Vessels Ranch located on the south side of San Luis Rey River upstream of Lift Station 1. This development will be required to construct an on-site sewer system to convey flows to new Lift Station 2, should Lift Station 1 be relocated. The project will potentially be a corridor for future recycled water transmission especially if a plant is located near Lift Station 1.

Out of District Developments

The Meadowood development project neighbors the HCR project on the east side of the I-15, but resides outside of the District boundary. Meadowood was annexed into VCMWD and is pursuing water and wastewater service with the District through out of service area agreements. Were Meadowood to be served by the District it would construct its own conveyance facilities from the project to the Pankey SLS which is being constructed by the HCR and CPW projects and participated in any oversizing.

The Warner Ranch development project is located approximately 4 miles north-east of the HCR project and adjacent to the south-eastern boundary of the District near the Gomez water pressure zone. This project is being considered for annexation into the District. Annexation is not pending and no detailed plans for water or sewer service have yet been developed, although it is believed that the District has the ability to serve the development.

6.6.2 Wastewater Flow Projections

In addition to limiting the growth of the sewer system, District Ordinance 01-02 also stated that “sewer capacity must be reserved on a first come first served basis and will only be reserved to a total flow of 1.5 MGD or 6,000 EDUs, whichever comes first.” As such there were several projects that had reserved sewer capacity.

With the Ordinance rescinded this master plan takes a fresh look and focuses on re-rating the capacity of the sewer system based on existing customers and existing sewer flows and projects future flows to 2035. Approved land use development information, SANDAG Series 13 population forecast and a review of vacant parcels within the wastewater service area were all reviewed and used to determine the wastewater flow forecast.

The major development activity anticipated within the District was presented previously in **Table 3-5**. SANDAG Series 13 population and housing forecasts for the sewer area are presented below in **Table 6-8**. The major developments are presented again in **Table 6-9** along with their projected sewer flows, the infill development anticipated in the sewer service area, the projected sewer flows accompanying that infill development and the total forecasted sewer flow for the planning horizon. Baseline existing flows remain the same in the sewer forecast and are increased by new sewer flows.

Table 6-8 SANDAG Series 13 Population and Housing Forecast – RMWD Sewer Service Area

Calendar Year:	2013 (actual)	2020	2035	Increase 2013-2035	
***Demographic Forecast** (per SANDAG)*					
Population	18,545	21,669	27,147	8,602	46%
Housing Units	7,517	8,560	10,531	3,014	40%

Annexations and out of service area agreements have the potential to add significant additional flow to the District's sewer system. Two large projects near the District's borders, Meadowood and Warner Ranch, have the potential to be provided sewer service through the District. Current estimates of sewer flow generation at these two developments are shown in **Table 6-9**. These developments are not currently part of the District and therefore are not included in the hydraulic analysis or the associated recommended improvements. However, the potential impact to the interceptor system is discussed and would be subject to more detailed capacity analysis.

Table 6-9 Proposed Development and Forecasted Sewer Flows

Proposed Major Development	Units / EDUs	Development Type	Projected Sewer Flow (MGD)
Horse Creek Ridge	751	Single Family	0.19
Horse Creek Ridge Business Center	100	Commercial	0.03
Campus Park West	538	Mixed	0.13
Pala Mesa Highlands (Beazer)	130	Single Family	0.03
Palomar College	100	Commercial	0.04
Dulan	51	Single Family	0.01
Vessels	400	Single Family	0.08
Golf Green Estates	94	Single Family	0.02
Leatherbury	85	Single Family	0.02
Bonsall Condos	76	Single Family	0.01
Olive Hill Estates	37	Single Family	0.01
Polo Club	156	Single Family	0.03
Morris Ranch	89	Single Family	0.02
Hidden Hills	53	Single Family	0.01
Other Developments (1)	43	Single Family / Commercial	0.01
Total Projected Major Development	2,703		0.63
SANDAG Series 13 Proj. New Housing Units	3,014		
Remaining Infill Development	311		0.06
Forecasted New Sewer Flow			0.69
Baseline Existing Sewer Flow			0.70
Total Forecasted Sewer Flow			**1.39**
Out of District Potential Sewer Flow(2)			**0.42**

(1) Proposed developments include Lake Vista Estates, Malabar Ranch, Silver Holdings, and Vista Valley Country Club.
(2) The out of District flows are generated by the Meadowood (0.28 mgd) and Warner Ranch (0.14 mgd) developments.

6.6.3 Projected Capacity Analysis Results

The hydraulic analysis performed of the projected sewer system with forecasted peak dry and wet weather flows discovered no capacity related deficiencies in the District's existing system under the baseline assumption. The addition of a new plant at the District offices allows for a reduction in flow to the existing outfall to Oceanside of approximately 0.65 MGD. Under this operating assumption, there is capacity available in all of the District's sewer lines at both PDWF and PWWF criteria. The Rancho Viejo Lift Station wet well would still suffer from a PWWF storage deficiency however, and it is still recommended that Lift Station 1 be replaced. The plant location allows the avoidance of significant infrastructure replacement, most significantly long sections of pipeline located in the SR-76.

The presence of existing capacity however, does not rectify the age and condition related issues that exist within the sewer system. The current trunk sewer would need rehabilitation to allow it to continue to function in the long term should the WRP come online between 2020 and 2025 as planned. Similarly, Lift Station 1 will reach its useful life regardless of the presence of sufficient capacity and will need rehabilitation should the District choose not to replace it due to the construction of a WRP.

Alternative WRP plant locations were also selected for evaluation and were re-evaluated to confirm or expand upon the findings of TM-1. The two alternative locations studied were: near Lift Station 1 and near Lift Station 2.

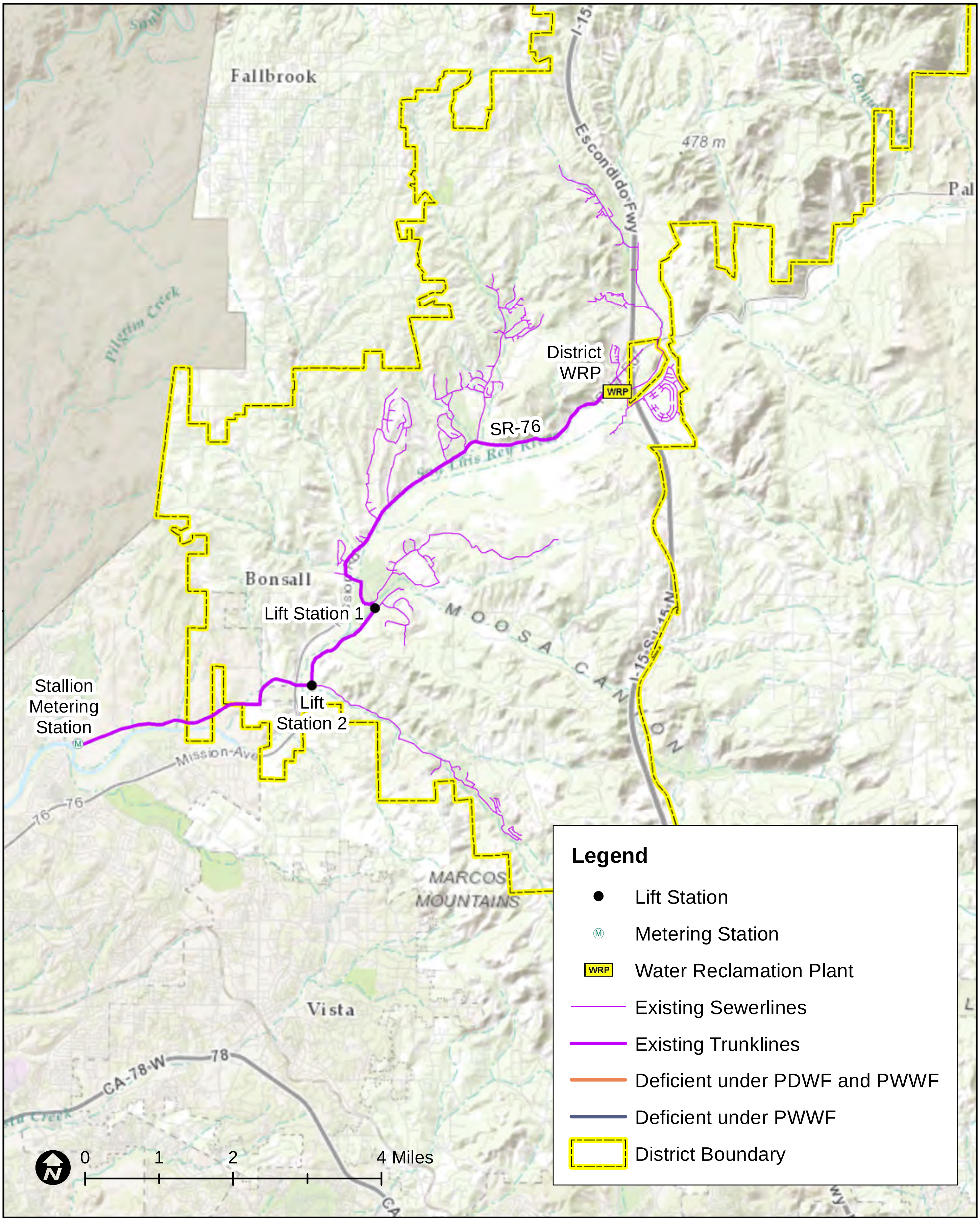
The baseline future system including the general location of the WRP is shown on **Figure 6-6**.

Lift Station 1 WRP Location Alternative

Providing the District with a new treatment plant at or near the Lift Station 1 site provides several benefits to the system. The primary benefit provided by locating the plant at Lift Station 1 is an increased flow volume, and thus the ability to produce larger volumes of recycled water. The District sees significant value in generating an extremely reliable, local water supply and thus values the possibility of a larger treatment plant. This location would also allow the system to serve a more diverse customer base should customers near the plant or along the transmission pipeline back to the recycled water reservoir desire service. However, a plant at this location does not avoid capacity deficiencies upstream of this location. With flows increasing substantially due to new development in the I-15/SR-76 corridor, the infrastructure upgrades in the SR-76 up to the Lift Station 1 location will all still be required. Capacity deficiencies downstream of Lift Station 1 do not occur due to approximately 1.2 MGD in flow reduction to the existing outfall to Oceanside, however, rehabilitation of the outfall pipeline from Lift Station 2 to the Stallion meter would still be needed to provide safe and reliable conveyance capacity of the remaining flows generated downstream.

Lift Station 2 WRP Location Alternative

Providing the District with a new treatment plant at or near the Lift Station 2 site provides several benefits to the system. As with the Lift Station 1 site, the primary benefit of this location is an increased flow volume, and thus the ability to produce larger volumes of recycled water. This site also captures virtually all of the District's sewer generation and would allow the District to liquidate a significant amount of the sewer treatment capacity rights at the San Luis Rey Wastewater Treatment Plant that it currently owns. This location would also allow the system to serve a more diverse customer base should customers near the plant or along the transmission pipeline back to the recycled water reservoir desire service. However, a plant at this location does not avoid capacity deficiencies upstream of this location. With flows increasing substantially due to new development in the I-15/SR-76 corridor and elsewhere throughout the entire District, the infrastructure upgrades in the SR-76 up to the Lift Station 2 location will all still be required. Capacity deficiencies downstream of Lift Station 2 do not occur due to approximately 1.3 MGD in flow reduction to the existing outfall to Oceanside, however, rehabilitation of the outfall pipeline from Lift Station 2 to the Stallion meter would still be needed to provide safe and reliable conveyance capacity of the remaining flows generated downstream.



Future System Capacity Deficiencies

FIGURE 6-6

1/26/2016 gool4566 \\sdofs01\Data\Clients\Rainbow MWD\100044880 2015 MP Update\GIS\mxd\Figure 6-6 FutureSystemCapacityDeficiencies.mxd

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No Water Reclamation Plant Alternative

Were the option to construct a District-owned WRP determined to be infeasible based upon further study which is underway, the District would continue to send all of its flow to the City of Oceanside for treatment and disposal. Hydraulically, the capacity deficiencies would be similar to those of the existing model. All of the existing trunk sewers as well as the outfall sewer from Lift Station 2 to the Stallion meter would remain undersized. The sizes recommended in the existing system hydraulic simulations results are large enough to convey future flows according to District criteria with all of the flows from the current developments planned inside of the District.

Previous studies of the District's outfall sewer recommended the construction of a 30-inch pipe for the ultimate or build-out conditions. This recommendation was conservative based upon the potential for growth and high unit sewer generation factors. A 24-inch pipe would have sufficient capacity to serve the maximum potential flow from the current Lift Station 2 with nearly half of its total capacity remaining.

The District would also require additional conveyance and treatment capacity through the City of Oceanside under the planning horizon conditions were a WRP not built. As shown in **Table 6-9** and discussed previously in **Section 3-6**, the District's wastewater generation is forecasted to rise to 1.39 MGD over the course of the planning horizon. The maximum recommended average daily flow for remaining inside of the District's existing capacity entitlement under average rainfall conditions is 1.35 MGD and the maximum recommended average daily flow for remaining inside of the District's existing capacity entitlement under peak foreseeable rainfall conditions is 1.25 MGD.

Additional and/or Out of District Developments

Prudent planning also dictates that the District consider the potential impact of any additional flows that could be added to the system from additional development within the District or potential annexation or out of area service agreements. Referring to **Table 6-9**, a maximum potential flow of 1.8 MGD may be realized should projects currently outside of the District successfully pursue annexation or out of service area agreements. The impact of the Meadowood development on the District's existing and future systems has been analyzed as part of a study produced by the District for the developer to quantify potential impacts its project may have on the system and any upgrades required to serve the project. That study is provided in **Appendix I**. Concerning the Warner Ranch project, once additional details regarding the size and infrastructure of the project are completed, and should the developer pursue service or annexation into the District, a similar study should be conducted to quantify potential impacts.

The Master Plan effort briefly reviewed the impact of these two projects on the projected future system. Under the baseline forecast scenario in which a WRP is constructed at the District office, the capacity deficiency conditions will remain the same. This means that the two developments would likely not have significant impacts upon the existing conveyance system which has no deficiencies under the forecasted flow conditions. Additional capacity would be required at the Pankey SLS to carry flow from the development area across I-15 to the WRP, but sufficient capacity in the gravity pipelines to the proposed WRP location exists to carry the projected flow of both developments.

Were any of the other alternatives chosen, at Lift Station 1 or Lift Station 2 or the No Plant Alternative, the capacity deficiencies in the trunk sewer along SR-76 from Mission Road to the outfall would be exacerbated and would require an increase in the size of the pipelines or a relief sewer pipeline. The study conducted for the Meadowood development concluded that an upsize from 18-inch to 21-inch would be required to convey the additional flow from that development, as well as increases in capacity at any lift station on the trunk line upstream of the WRP location. The impact of the Warner Ranch project on the existing sewer system has not been thoroughly studied, but it is anticipated that an increase to from 18-

inch to 21-inch would be required to serve the project's flows as well. Were both projects to be served by the District, it is believed that a 21-inch sewer would still be adequate, however, additional study is necessary to confirm.

Chapter 7
RECOMMENDED CAPITAL IMPROVEMENT PROJECTS

7.1 Overview and Summary

The recommended CIP for this Master Plan Update includes proposed projects for the water, sewer and the future recycled water system under the baseline assumption of a District owned 0.9 MGD WRP. Improvement projects are recommended to mitigate existing and forecasted capacity deficiencies, improve system reliability, redundancy and operating efficiencies, and conduct strategic system maintenance and replacement programs. The recommended improvement projects are organized into separate lists for water, sewer and recycled water projects with corresponding project location maps. The tables include planning level cost estimates to assist RMWD in budgeting for future capital improvements and future updates of water and sewer capacity fees. Although analysis was performed for both existing and 2035 planning horizon conditions, improvement projects required for specific planned developments are not included, as these are assumed to be developer funded.

The proposed CIP projects will require future environmental review as each project is implemented. In many cases streamlined environmental review such as a Negative Declaration or Mitigate Negative Declaration may be appropriate under CEQA. Alternatively, upon completion of the Master Plan the District may elect to complete a program-level EIR for all of the CIP projects to streamline future implementation.

7.2 Recently Completed Projects

Since the last Master Plan, the District has constructed a number of improvement projects. The major water projects include the installation of floating covers on the Morro, North, and Northside Reservoirs, construction of the 6.0 MG Pala Mesa Tank and removal of the Beck Reservoir from the potable water distribution system, construction of several new pressure reducing stations, valving and appurtenances to accommodate emergency pumps, and pipelines to serve new developments. Many of these projects were not anticipated when the previous master plan was prepared and were therefor not included in the 2006 Master Plan CIP. Major sewer system improvements include the replacement and upgrading of Lift Station 2, and the replacement and upsizing of the trunk sewer in SR-76 west 0.4 miles from Old Highway 395 and 2 more miles between Gird Road to Mission Road.

There are currently seven water system construction projects for pipelines and pressure reducing stations that have been funded in the District's current CIP. These projects are in various stages of completion, and several were included in the 2006 Master Plan CIP. For the purposes of this master plan update, the water projects in the District's current CIP are considered to be part of the existing distribution system.

7.3 Unit Costs

The unit costs estimates presented reflect the full capitalization of the proposed projects inclusive of planning, engineering design, environmental, legal, construction, construction management, contract administration and contingency. The values are presented in mid-2015 dollars based on an ENR of 10030 for the Los Angeles/Orange County area. These estimates are based upon representative available data at the time of this report; however, since project specific conditions are not for every project and since costs of materials and labor fluctuate over time new estimates should be obtained at or near the time of construction of proposed facilities or execution of proposed programs.

Unit costs were developed based in part on input from District staff on recent construction projects within and around the service area for similar projects and similar unit costs used by Atkins for other local agencies. Many of the projects require public involvement, traffic control, utility relocations, and paving replacement, and therefore often have high unit costs. Where project specific information is available, such as relatively short pipeline projects, difficult environmental conditions, etc., scaling factors have been included to address economies of scale or anticipated additional costs.

7.3.1 Water System Unit Costs

Water system unit costs are presented in **Table 7-1** and **Table 7-2**. Additional information regarding the development of the unit costs presented in those tables is provided below:

Pipelines

Base unit costs for pipelines include material costs and installation, including repaving and system appurtenances. Base unit costs are presented as a range, which recognizes the varying levels of cost associated with pipeline installation throughout the District. Pipelines throughout the District are installed in open, undeveloped space as well as within the SR-76. The range of costs presented recognizes the increased cost of pipeline work in busy locations. Additionally, a small adjustment for installation of new pipe versus replacement and disposal of existing pipe is also provided in the unit cost range. Scaling factors are applied to the CIP following project cost developed with unit costs. Scaling factors are applied where appropriate to pipeline projects to reflect items such as more expensive pipe materials for high pressure installations and difficult environmental conditions.

Reservoirs

The cost for new reservoirs is based on total reservoir capacity and includes the cost of materials, site work and tank or reservoir construction in addition to all associated site piping and appurtenances. Base unit costs are based on recent bids provided by DN Tank, and were then factored appropriately to include costs for engineering and site work. Additionally, whether the proposed reservoir project resides on an existing site or an undeveloped site adjusted the unit cost of any proposed tank.

Booster Pump Stations

Base unit costs for booster pump stations were calculated based on the results of a study of pump stations costs which found a correlation between the station horsepower and the station construction cost. The cost produced was then factored up to include costs for planning, design, environmental, management, administration and contingency.

Pressure Regulating Stations

The costs for new pressure regulating stations are based on an above-grade station with a main valve and a smaller bypass valve as well as a pressure relief valve for pressure reducing stations. Site specific issues may require some stations to be located in below-grade vaults. Replacement or upgrade to existing stations assumes an average cost to replace two valves and add a pressure relief valve and minor piping upgrades at the existing site.

Table 7-1 Water Pipe Unit Cost Range by Diameter

Pipe Diameter	Unit Cost Range
8	100 - 210
10	125 - 260
12	150 - 310
16	210 - 420
20	265 - 530
24	320 - 640
30	405 - 810
36	500 - 1000

Table 7-2 Water Reservoir Unit and Total Cost

Tank Size (MG)	EX. SITE Construction Cost ($/gal)	NEW SITE Construction Cost ($/gal)	EX. SITE Construction Cost ($M)	NEW SITE Construction Cost ($M)
2	$1.84	$2.15	$3.7	$4.3
3	$1.61	$1.88	$4.8	$5.6
4	$1.43	$1.66	$5.7	$6.7
5	$1.30	$1.51	$6.5	$7.6
6	$1.22	$1.42	$7.3	$8.5
7	$1.19	$1.39	$8.3	$9.7

7.3.2 Sewer and Recycled Water System Unit Costs

No specific sewer system or recycled water system unit costs were developed for this study. The sewer and recycled water system projects presented in both the baseline case and the no project alternative have been presented in recent previous studies. This project relied upon the findings of those studies to project the total cost of the sewer system and recycled water system CIPs.

7.4 Recommended Capital Improvement Projects

The recommended CIP identifies facilities or programs, which are recommended for a variety of reasons, primarily to provide the District's customers with a system that meets the District's capacity criteria, is in good condition and can be operated efficiently and reliably. Should demands and flows forecasted to develop during the planning horizon not materialize, there may be opportunities to defer or eliminate some projects. Contrarily, some projects are needed immediately. Phasing is provided along with the proposed projects, with Phase 1 being projects recommended to be completed within the next five years (by 2020) due to an existing need, Phase 2 projects are those needed within ten years (by 2025) and Phase 3 projects are those recommended to be addressed within the planning horizon (by 2035). Due to the rapid development planned for the District as well as potential "rebound" from mandatory and voluntary water use restrictions, another master plan should be conducted in five years, at which point demands, flows and phasing can be revisited.

7.4.1 Water System CIP

The recommended projects are largely the result of the hydraulic analysis completed within **Chapter 5**. Projects identified fell into various improvement categories including: hydraulic capacity, pressure regulation, operations, redundancy and reliability, and fire flow capacity. The water system CIP consists of 61 projects that are listed in **Table 7-3** and illustrated on **Figure 7-1A and Figure 7-1B**. **Figure 7-1B** illustrates only pressure regulation projects, while **Figure 7-1A** illustrates the remainder of the Water System CIP. Additional detail regarding the nature of the various recommendation categories follows below:

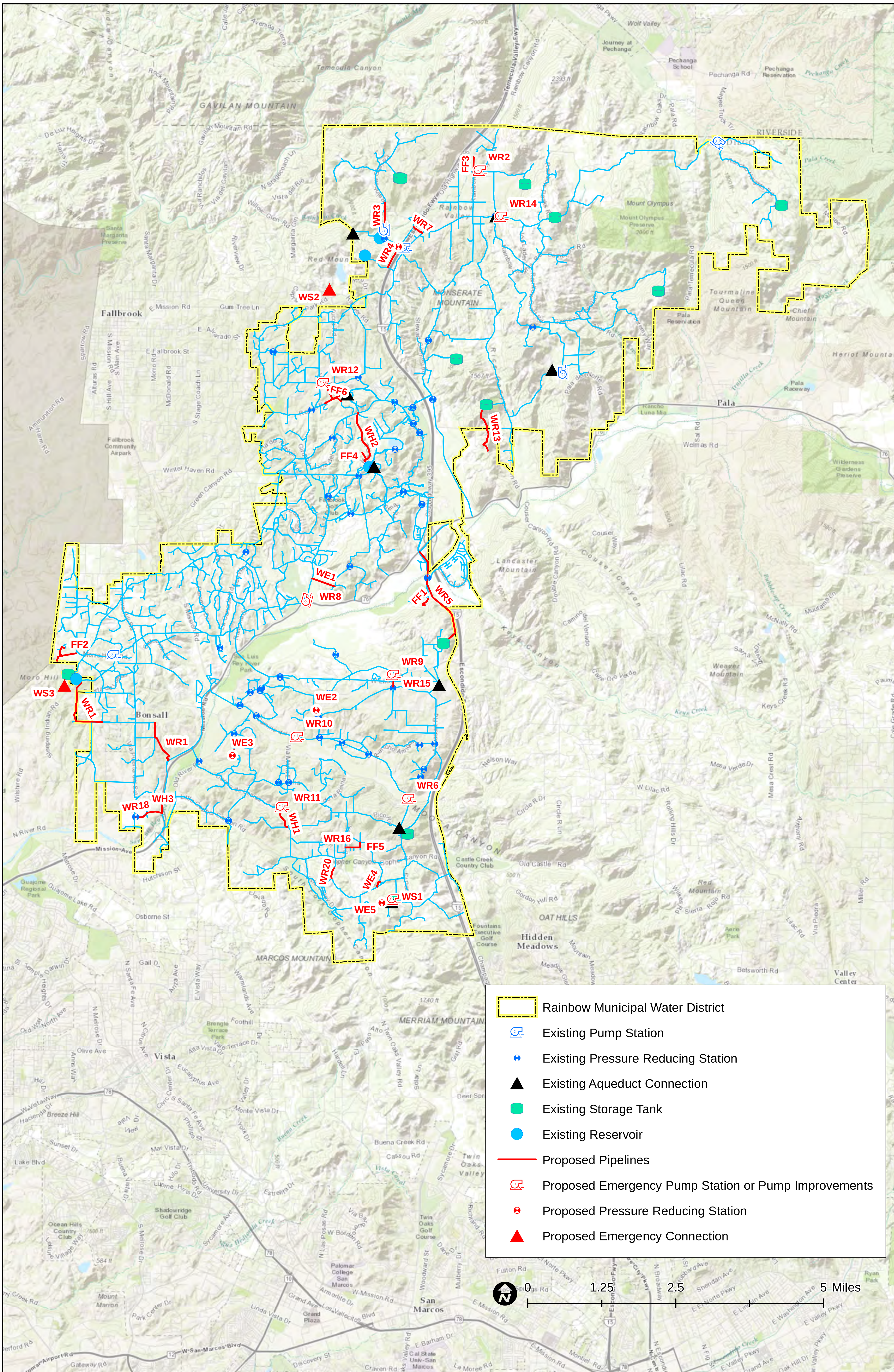
- **Hydraulic Capacity** – consists primarily of pipeline upsizing to correct deficiencies in capacity caused by excessive velocity and headloss under peak demand conditions. Pump stations and storage reservoirs were also reviewed for appropriate capacity
- **Pressure Regulation** – recommend potential reduced pressure service zones by constructing pressure reducing stations to protect pipelines, laterals and appurtenances
- **Operations, Redundancy and Reliability** – includes a diverse set of construction, implementation, maintenance and assessment projects to add and improve emergency supplies, increase the system and supply reliability for vulnerable or future service areas, improve operating efficiencies, upgrade and/or replace facilities that don't meet current standards and assist with strategic planning and replacement of critical facilities
- **Fire Flows** – upsizing of small diameter pipelines to increase fire flows at critically deficient areas
- **Water Supply** – consists of projects for construction of facilities to deliver new water supplies under normal or emergency conditions

The total estimated cost of the water CIP based on planning level costs estimates is **$49.8M.**

7.4.2 Sewer System CIP

The sewer system CIP generated from the baseline sewer system hydraulic analysis are listed in **Table 7-4** and illustrated on **Figure 7-2**. As discussed previously, the District made the decision to move forward with the assumption of a WRP and recycled water system as the baseline case for the sewer system for this study. The District has commissioned additional study into the development of a water reclamation plant to assist in determining which of the available alternatives, if any, is the most beneficial option. Were that additional study to find that a WRP and recycled water system are not viable and/or feasible, it is important the District be aware of and understand the implications to its sewer system CIP. For that reason, an alternative sewer system CIP for the sewer system alternative condition, which is the "No Project Alternative," are also listed in **Table 7-4** and illustrated on **Figure 7-2**. The recommended projects are the result of the hydraulic analysis completed within **Chapter 6** as well as additional recommendations centered on maintenance and assessment of the system. Also included in **Table 7-4** are the CIP required should the WRP study show that a plant at the LS 2 site is the most beneficial, as well as the CIP required to serve the Out of District developments, Meadowood and Warner Ranch.

The total estimated cost of the sewer CIP which includes the District-owned WRP based on planning level costs estimates is **$49.7M**.



Water System CIP
FIGURE 7-1A

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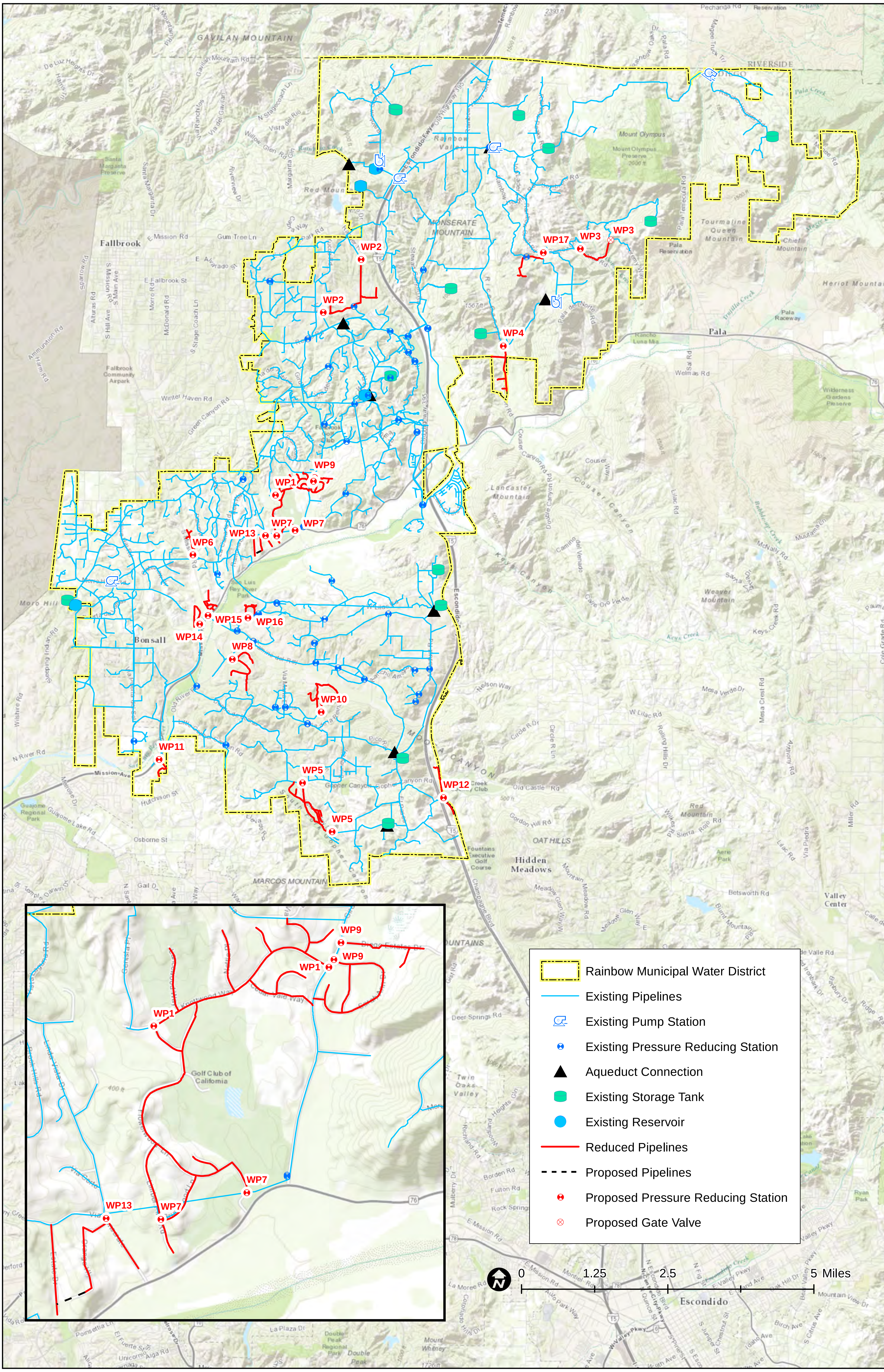
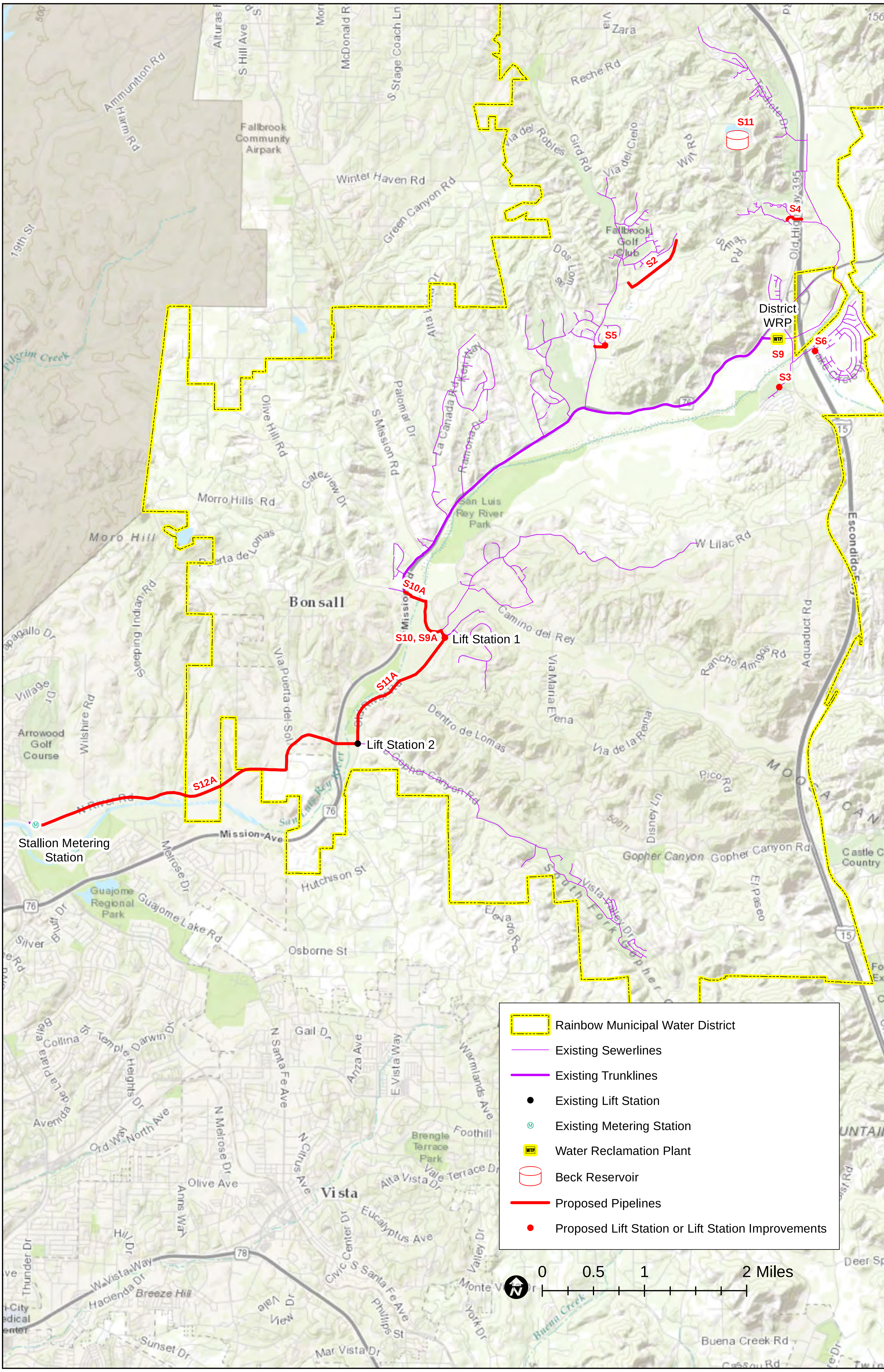


Water System CIP - Pressure Regulation Projects

FIGURE 7-1B

3/18/2016 bobs6781 U:\WO\Projects\Rainbow MWD\100044880 2015 MP Update\09_Calcs\09C_GIS\Maps\Figure 7-1B Water System CIP - Pressure Regulation Projects.mxd



Sewer System CIP

FIGURE 7-2

3/18/2016 bobs6781 U:\WO\Projects\Rainbow MWD\100044880 2015 MP Update\09_Calcs\09C_GIS\Maps\Figure 7-2 Sewer System CIP.mxd

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7.4.3 Recycled Water System CIP

The recycled water system CIP consists of 4 general projects which accompany the baseline sewer system condition and are listed in **Table 7-5**. The recycled water system CIP exists only under the baseline assumption that the District will develop and construct a WRP and recycled water system. Should the additional study being conducted by the District find that a WRP and recycled water system are not viable and/or feasible, there would be no recycled water system CIP. The recycled water system projects currently presented are not fully developed projects. The initial study of the recycled water system (see **Appendix E**) did not identify specific areas for development of a recycled water system, but rather proposed a recycled water system to serve the entire recycled water demand that was identified, and developed a unit cost per MGD of the systems required to serve any increment of demand. Those are the costs that are presented.

The total estimated cost of the sewer CIP based on planning level costs estimates is **$20.2M.**

7.5 Additional Recommendations

The available fire flow rate from the InfoWater model should be interpreted as an approximation. The actual available flow rate from any given fire hydrant with a 20 psi residual pressure is dependent on the exact location, elevation, and type of hydrant, and the physical condition of the upstream pipelines. The operational status of aqueduct connections, pumps and reservoir levels will also affect the actual flow that can be delivered. Results from the fire flow analysis were used to identify and prioritize pipeline replacement projects. It is recommended that hydrant flow tests be performed to confirm analysis results.

During calibration of the hydraulic model, most of the pump curves were derated by 5 to 15 percent to better match field conditions. The discharge capacity of a pump and pumping efficiency will decrease over time as components age and the impeller wears. It is recommended that the District conduct flow tests on all the booster pumps to determine current pumping capacities and efficiencies.

7.6 Conclusions

The projects and programs recommended by this study for the next 20 years for the water, sewer and potential recycled water systems are shown in **Table 7-3** through **Table 7-5** and **Figure 7-1A**, **Figure 7-1B** and **Figure 7-2**. Phasing of proposed projects and programs is also presented in **Table 7-3** through **Table 7-5** and the total estimated cost by Phase for each system is presented below in **Table 7-6**. Additional detail regarding recommended projects is presented in **Appendix H**.

The total estimated cost of all phases of the water, sewer and recycled water CIPs based on planning level costs estimates is **$120M.**

The estimates of cost by project, by system and by phase can be used by the District as a basis for developing system Capacity Fees. Project cost estimates should be retained, updated by observed inflation on an annual basis and replaced with more detailed and accurate cost estimates as they become available.

The District's next step will include the update of District-wide water and sewer capacity fees to help fund expansion projects. The District's water and sewer rates paid by existing customers will be used to fund replacement, rehabilitation and betterment projects. It is recommended that the capacity fee study explore appropriate methodologies considering a buy-in fee component as well as a water supply fee component for the new recycled water supply.

Table 7-3 Water Capital Improvement Plan

Project No.	Water Pressure Zone	Description	System Benefit	Notes	Size	Quantity	Phase	Construction Costs: Unit Cost	Construction Costs: Total Cost
Water System Existing Improvement Projects									
WE1	Canonita	Gird to Monserate Hill Water Line	Loop dead end system and shift demand off of the Canonita Zone		12-inch	2,150 ft	1	--	$950,000
WE2	South	Wrightwood to Cottontail PRS	Replaced broken pipe. Install PRS to re-constitute previously looped system	Pipeline is complete, need to install PRS to allow connection to operate	8-inch	1	1	--	$100,000
WE3 200950	South	Lake Vista Estates Loop and PRS	Improve water quality by eliminating dead ends and improve fire flow	Short segment of pipeline and PRS to connect Morro and South Zones	--	--	1	--	$144,000
WE4 201573	South	Tarek Terrace Water Line	Replace old pipe to have fewer service outages and resources spent on repairs		8-inch	500 ft	1	--	$143,000
WE5 201359	South	Rancho Amigos Pressure Station Replacement	Improve maintenance access	Improve safety and lessen staff required for maintenance	8-inch	--	1	$75,000	$75,000
Hydraulic Capacity Projects									
WH1	South	Upsize 12" to 16" along Dentro de Lomas/Paseo Grande Rd	Increase system pressures, increase emergency (or permanent) pump performance	Downstream of Dentro De Lomas Emergency Pump Station	16-inch	2,100 ft	1	$335	$704,000
WH2	Canonita	Upsize 6" to 10" along Wilt Road	Increase system pressures, improve function of Wilt & Citrus PRV into Pala Mesa Tank	Only first ~2,200 feet fails criteria	10-inch	5,200 ft	3	$195	$1,010,000
WH3	Morro	Remove Bottleneck, Upsize 8-inch to 12-inch on Mission Road & North River Road	Reduce headlosses through bottleneck, increase flow capacity during Morro filling		12-inch	3,500 ft	3	$310	$1,090,000
Pressure Regulation Projects									
WP1	Pala Mesa	Install PRSs at Intersections of Knottwood Way and Staghorn Lane / Gird Road	Reduce local pressure, reduce risk of pipe and lateral breaks	Install two PRVs on Knottwood Way, close valves GV145 and PV231. 90 psi+ reduction possible	6-inch 4-inch	1 1	1 1	$75,000 $35,000	$75,000 $35,000
WP2	Northside	Install PRSs at Brooke Hollow Rd and Ranger Road	Reduce local pressure to large geographical service area, reduce risk of pipe/lateral breaks	95 psi+ reduction possible	8-inch 6-inch	1 1	1 1	$100,000 $75,000	$100,000 $75,000

Table 7-3 Water Capital Improvement Plan

Project No.	Water Pressure Zone	Description	System Benefit	Notes	Size	Quantity	Phase	Construction Costs	
								Unit Cost	Total Cost
WP3	Gomez	Install PRS at Alex Road and gate valve at Jeremy Way	Reduce extremely high (400+) local pressures, reduce risk of pipe and lateral breaks	Install PRV after PV25 and install gate valve at intersection with Jeremy Way. 200 psi+ reduction possible	6-inch	2	1	$75,000	$150,000
WP4	North	Install PRS to serve Rice Canyon Road South of Pala Mesa Heights Drive	Reduce extremely high (300+) local pressures, reduce risk of pipe and later breaks	Install PRV after PV23. 175 psi+ reduction possible	6-inch	1	1	$75,000	$75,000
WP5	South	Install PRS to serve South Fork Area along Vista Valley Drive	Reduce local pressure, reduce risk of pipe and lateral breaks	Install PRVs at Vista Valley Drive intersections with Gopher Canyon Road and Laurel Valley Drive. Close PV35. 100 psi+ reduction possible	8-inch	2	2	$100,000	$200,000
WP6	Morro	Install PRS on Baja Mission Road	Reduce local pressure, reduce risk of pipe and lateral breaks	Install PRV at intersection of Baja Mission Rd and La Canada Road. Close GV 28. 100 psi+ reduction possible	6-inch	1	2	$75,000	$75,000
WP7	Morro	Install PRS on Limber Pine Road	Reduce local pressure, reduce risk of pipe and lateral breaks	Install PRV on Limber Pine Road Flowerwood Lane and close valve PV127. 90 psi+ reduction possible	6-inch	2	2	$75,000	$150,000
WP8	Morro	Install PRS Club Vista East on Lake Vista Drive	Reduce local pressure, reduce risk of pipe and lateral breaks	Install PRV directly east of Ex. Club Vista PRV east of intersection with Club Vista Lane. 90 psi+ reduction possible	6-inch	1	2	$75,000	$75,000
WP9	Pala Mesa	Install PRSs at Diego Estates Drive and Sarah Ann Drive	Reduce local pressure, reduce risk of pipe and lateral breaks	Install PRVs at Gird Road intersections with Diego Estates Drive and Sarah Ann Drive. Close PV65. 130 psi+ reduction possible	6-inch	2	2	$75,000	$150,000
WP10	South	Install PRS at Via Maria Elena	Reduce local pressure, reduce risk of pipe and lateral breaks	Install PRV after GV23. 60 psi+ reduction possible	6-inch	1	2	$75,000	$75,000
WP11	Morro	Install PRS at Intersection of Mission Road and East Vista Way	Reduce local pressure, reduce risk of pipe and lateral breaks	Install PRV after PV51. 140 psi+ reduction possible. Serves very small area	6-inch	1	2	$75,000	$75,000
WP12	South	Install PRS to serve Champagne Boulevard	Reduce local pressure, reduce risk of pipe and lateral breaks	Install PRV after PV20. 100 psi+ reduction possible. Serves very small area	6-inch	1	2	$75,000	$75,000

Table 7-3 Water Capital Improvement Plan

Project No.	Water Pressure Zone	Description	System Benefit	Notes	Size	Quantity	Phase	Construction Costs	
								Unit Cost	Total Cost
WP13	Morro	Connect and Install PRS to serve Orange Hill, Estate Drive and Rio Vista Drive	Reduce local pressure, provide redundancy and reduce risk of pipe and lateral breaks	Install PRV after PV145. Close valve GV16 and PV42. Install 1,300 ft of 8-inch pipe to connect dead ends. 100 psi+ reduction possible	6-inch 8-inch	1 1,300 ft	2 2	$75,000 $145	$75,000 $189,000
WP14	Morro	Install PRS on Thoroughbred Lane	Reduce local pressure (~300), reduce risk of pipe and lateral breaks	Install PRV after PV4. 180 psi+ reduction possible. Serves very small area	6-inch	1	2	$75,000	$75,000
WP15	Morro	Install PRS to serve River Village	Reduce local pressure (250+) reduce risk of pipe and lateral breaks	Install PRV after GV19. 150 psi+ reduction possible. Serves very small area	6-inch	1	2	$75,000	$75,000
WP16	Morro	Install PRS to serve Ascot Park Area	Reduce local pressure (220+) reduce risk of pipe and lateral breaks	Install PRV after PV17 and PV70. 100 psi+ reduction possible. Serves very small area. 6" pipe, cannot reduce pressure too far	6-inch	2	2	$75,000	$150,000
WP17	Rainbow Heights	Install PRS at Rainbrook	Reduce local pressure, reduce risk of pipe and lateral breaks		6-inch	1	2	$75,000	$75,000
Operations, Redundancy and Reliability Projects									
WR1	Morro	Line NN Transmission Upgrades	Provide transmission flow path to allow better utilization of Dentro de Lomas PRV through new Line NN during Morro Filling		16-inch	9000 ft	1	$315	$2,800,000
WR2	Vallecitos	Pump Station #3 (Vallecitos) Replacement	Improved efficiency and reliability to pressure zone	Increase discharge size from 6-inch. Provide at least 2 pumps for redundancy	75 HP	600 gpm	1	--	$1,030,000
WR3	U-1	U-1 Transmission Pipeline Replacement to Ranchbrook Road	Replace aging pipeline, fewer service outages and resources spent on repairs	Replace aging pipeline that is the sole transmission source into zone	12-inch	3200 ft	1	$235	$752,000
WR4	Northside	Northside Zone Supply Redundancy. Upsize Rainbow Hills Road Pipeline to 12-inch and Install New PRS	Provides an emergency supply connection to service large, critical zone	Replace 6-inch pipe on Rainbow Hills Road with 12-inch. Could provide emergency service during a pump station outage. Only ~70' difference between North and Northside zones.	12-inch	2200 ft	1	$235	$517,000

Table 7-3 Water Capital Improvement Plan

Project No.	Water Pressure Zone	Description	System Benefit	Notes	Size	Quantity	Phase	Construction Costs	
								Unit Cost	Total Cost
WR5	South/Pala Mesa	Hutton Tank to Pala Mesa Zone Emergency Connection	Provide redundant supply and increased looping for emergency support	PL along Old Highway 395 to Pala Road. Similar zone connection through the Vessels development also possible	16-inch	9,900	2	$400	$4,000,000
WR6	South	Moosa Permanent Emergency Pump Station	Permanent Station to provide emergency supply to South Zone	Assumed at existing location. Additional study necessary to confirm pump flow/size	200 HP	2000 gpm	2	--	$2,500,000
WR7	North	North Feeder and Rainbow Hills Water Line Replacements	Fewer service outages and resources spent on repairs	Replace corroded pipelines which have suffered several breaks	30-inch 27-inch	3788 ft	2	$515	$2,000,000
WR8	Pala Mesa	76 & Gird Permanent Emergency Pump Station	Improved zone reliability during outage or transmission main break scenarios	At same site as 76 & Gird PRV Station	100 HP	2000 gpm	2	--	$1,600,000
WR9	South	Line P Permanent Emergency Pump Station	Permanent Station to provide emergency supply to South Zone	Assumed at existing location. Additional study necessary to confirm pump flow/size	100 HP	2000 gpm	2	--	$1,600,000
WR10	South	Camino Del Rey Emergency Pump Station	Permanent Station to provide emergency supply to South Zone	Assumed at existing location. Additional study necessary to confirm pump flow/size	100 HP	2000 gpm	2	--	$1,600,000
WR11	South	Dentro De Lomas Permanent Emergency Pump Station	Permanent Station to provide emergency supply to South Zone	Assumed at existing location. Additional study necessary to confirm pump flow/size	100 HP	2000 gpm	2	--	$1,600,000
WR12	Northside	Northside Emergency Pump Station Connection and Pipeline at Reche Road	Provide emergency supply to Northside zone in case of transmission failure	Upsize ex pipeline rather than providing a new parallel. Pump station similar to other emergency PSs proposed.	16-inch	3700 ft	2	$285	$1,050,000
WR13	Northside	Northside Emergency Pump Station Connection and Pipeline at Reche Road	Provide emergency supply to Northside zone in case of transmission failure	Upsize ex pipeline rather than providing a new parallel. Pump station similar to other emergency PSs proposed.	50 HP	1000 gpm	2	--	$980,000
WR13	North	Rice Canyon Tank Transmission PL to I-15/SR76 Corridor	Improve cycling of Rice Canyon tank and serve new development	Project will likely be developer funded	12-inch	3000 ft	2	$150	$450,000

Table 7-3 Water Capital Improvement Plan

Project No.	Water Pressure Zone	Description	System Benefit	Notes	Size	Quantity	Phase	Construction Costs	
								Unit Cost	Total Cost
WR14	Rainbow Heights	Pump Station #1 (Rainbow Heights) Natural Gas Motor Replacements	Improved efficiency and reliability to pressure zone	Cost provided by District, 196k, exclusive of SDG&E requirements and contingencies.	250 HP	2	1	$150,000	$300,000
WR15	South	Loop Pipelines in Via Ararat Drive to West Lilac Road	Provide redundant supply and increased looping	Reliability Connection to provide additional looping for increased system pressures.	8-inch	615 ft	2	$145	$89,000
WR16	South	Loop Pipelines in Magee Lane to Disney Lane	Loop lines for redundancy and improved fire flow	Could be combined with FF4	8-inch	300 ft	2	$100	$30,000
WR18	Morro	Improve Flow Path to Morro Reservoir, Install Parallel 10-inch pipeline on Kari Lane	Provide additional flow path and reduced resistance during Morro filling	Parallel existing pipeline on Kari Lane	10-inch	2800 ft	3	$180	$504,000
WR19	Pala Mesa	Lake Rancho Viejo Permanent Connection	Provide redundant supply to reduced zone	Not shown on Figure 7-1A	8-inch	150 ft	3	$145	$22,000
WR20	South	Integrity Court, connect dead end lines	Provide redundant supply and increased looping		8-inch	1000 ft	3	$145	$145,000
WR21	Districtwide	Water System Condition Assessment Program	Provide the District with an accounting of the characteristics of its water system	Integral part of the implementation of an Asset Management Program	--	--	1	--	$1,500,000
WR22	Districtwide	Pressure Reducing Station Replacement Program	Replace valves that are aging, under designed and lacking redundancy	Old and small valves and valves with no PR station should be replaced, assumed 20	--	20	1	$40,000	$800,000
WR23	Districtwide	Isolation Valve Installation Program	Reduce shutdowns of service to any area serving 50+ persons	Allow District to serve during isolated emergencies, assume 50 installations	--	50	1	$15,000	$750,000
WR24	Districtwide	Water System Billing Meter - Systemwide AMI Conversion	Replace existing meters with AMI technology	Instantaneous sales history access. Identify and control leaks and other water losses. Cost estimate provided by District staff	--	--	1	--	$3,000,000
WR25	Districtwide	Water System Monitoring Program	Install measuring devices to track flow balance into system and through zones	Identify and control leaks and other water losses, assume 25 installations	--	25	1	$35,000	$875,000

Table 7-3 Water Capital Improvement Plan

Project No.	Water Pressure Zone	Description	System Benefit	Notes	Size	Quantity	Phase	Construction Costs	
								Unit Cost	Total Cost
WR26	Districtwide	New District Headquarters	Construct new District Headquarters to appropriately house staff	Replace aging buildings and provide room for new staff as development occurs	--	--	2	--	$3,000,000
WR27	Districtwide	Install Permanent Emergency Generators at Pump Stations	Provide system reliability in cases of extended power outage	Include update of all stations to include transfer switches and soft start motors	--	7	3	$125,000	$875,000
Fire Flow Projects									
FF1	Pala Mesa	Upsize 6-inch to 8-inch in Via San Alberto	Increase available fire flow	Available flow less than 500 gpm	8-inch	1,000 ft	1	$155	$155,000
FF2	Morro Tank	Upsize 4-inch and 6-inch to 8-inch and 10-inch along Sleeping Indian, Conejo and Caroline Roads	Increase available fire flow	Available fire flow is less than 500 gpm	10-inch 8-inch	1,300 ft 2,000 ft	1 1	$195 $155	$254,000 $310,000
FF3	North	Upsize 6-inch to 8-inch on Chica Road	Increase available fire flow	Available flow less than 600 gpm	8-inch	1,300 ft	1	$155	$202,000
FF4	Canonita	Upsize 4-inch to 8-inch on Lupine Lane	Increase available fire flow	Available flow less than 700 gpm	8-inch	700 ft	2	$155	$109,000
FF5	South	Upsize 4-inch and 6-inch to 8-inch at Mageee Lane	Increase available fire flow	Available flow less than 700 gpm	8-inch	1,500 ft	2	$155	$233,000
FF6	Northside	Upsize 4-inch on Via Chaparral	Increase available fire flow	Available flow less than 700 gpm	8-inch	850 ft	2	$155	$132,000
Water Supply Projects									
WS1	South	Weese WTP Permanent Emergency Interconnect and Pump Station	Provide permanent connection to emergency supply source to serve South zone during 2nd Aqueduct outage		50	1,000	1	--	$1,200,000
WS2	Northside	Northside Permanent FPUD Emergency Interconnection	Provide emergency supply to Northside zone in case of transmission failure & additional supply during 2nd Aqueduct outage		--	--	1	--	$150,000

Table 7-3 Water Capital Improvement Plan

Project No.	Water Pressure Zone	Description	System Benefit	Notes	Size	Quantity	Phase	Construction Costs: Unit Cost	Construction Costs: Total Cost
WS3	Morro Tank	Morro Tank Zone Permanent FPUD Emergency Interconnection	Provide emergency supply to Morro Tank zone in case of fire as portions of the zone do not meet fire flow criteria without increased HGL		--	--	2	--	$150,000
								Water System CIP Total Cost	**$49,700,000**

Table 7-4 Wastewater Capital Improvement Plan

Project No.	Description	System Benefit	Notes	Size	Quantity	Phase	Construction Costs: Unit Cost	Construction Costs: Total Cost
Sewer Projects Recommended Under All Alternatives								
S1	Plant B List Station (LS3), Forcemain and Horse Creek Sewer Abandonment	Abandon old, low, high infiltration sewer and aging LS with deficient wet well capacity	Replaced by Pankley LS and FM & Horse Creek Ridge sewer. 850 ft of FM and approximately 13,650 ft of gravity sewer abandoned	--	--	1	--	$350,000
S2	Lake Garden Sewer Rehabilitation	Reduce inflow and infiltration, thereby reducing maintenance and treatment costs	3,475 of pipe and 12 manholes to be rehabilitated	8-inch --	3,475 ft 12	1 1	$80 $5,250	$280,000 $63,000
S3	Rancho Viejo LS (LS5) Wet Well Expansion	Provide 6 hours PWWF storage at Rancho Viejo LS to protect against sewer spills	New wet well should be at least 1400 gal	--	1,400 gal	1	--	$150,000
S4	Almendra Court Sewer Rehabilitation, I-15 Crossing, Structural Pipe Lining	Rehabilitate freeway sewer crossing which is corroding	Provide system reliability	8-inch	938 ft	1	$80	$80,000
S5	Fallbrook Oaks LS (LS6) Rehabilitation and Forcemain Replacement	Rehabilitate existing LS and FM and extend useful life	Replace 6" forcemain with 8"	-- 8-inch	-- 252 ft	1 1	-- $155	$200,000 $39,000
S6	Replace Rancho Monserate LS Emergency Generator	Prevent sewage spill in the case of a power outage	--	--	1	1	--	$125,000
S7	Sewer System Condition Assessment Program	Provide the District with an accounting of the characteristics of its sewer system	Integral part of the implementation of an Asset Management Program	--	--	1	--	$400,000
S8	Sewer System Permanent Flow Monitoring	Allow the District to monitor and predict system flows and performance	Greater understanding of sewer generation and control of system	--	5	1	25000	$130,000
Sewer Projects – Baseline, District Office Plant Location								
S9	Construct 0.9 MGD Water Reclamation Plant (WRP) at District Office Location	Provide a reliable local water source and water supply offset. Provide sewer outfall within District to avoid exceeding interceptor capacity	Cost per TM #1	0.9 MGD	--	1	--	$37,000,000
S10 201040	Lift Station 1 Replacement	Replace critical station reaching useful life and wet well with deficient capacity	Cost per TM #1	--	700 ft	2	--	$3,300,000

Table 7-4 Wastewater Capital Improvement Plan

Project No.	Description	System Benefit	Notes	Size	Quantity	Phase	Construction Costs Unit Cost	Total Cost
S11	WRP Conveyance (Pump Station and Pipeline) and Failsafe Storage (Beck Reservoir Rehab and Raw Water Connection)	Provide conveyance to storage and storage for treated wastewater	Cost per TM #1	0.9 MGD	--	1	--	$3,200,000
S12	Sewer System Rehabilitation Program	Rehabilitate and repair existing sewer trunk infrastructure	Keep aging pipes and manholes with no capacity deficiencies in good condition	12-inch 15-inch	--	1	--	$4,500,000
							Baseline Sewer CIP Total Cost	**$49,800,000**
Sewer Projects – Baseline, District Office Plant Location								
S9A 201040	Lift Station 1 Replacement and Upgrade	Replace and expand critical station reaching useful life	Cost per TM #1	--	1,800 gpm	1	--	$8,200,000
S10A 201260	San Luis Rey Interceptor Replacement from Mission Road to LS 1	Provide adequate conveyance capacity	Cost per District Budget, Highway 76 Realignment - CalTrans UPSIZE	18-inch	7,100 ft	1	--	$3,200,000
S11A	San Luis Rey Interceptor Replacement from LS 1 to LS 2	Provide adequate conveyance capacity	Cost per TM #1	18-inch	7,500 ft	1	--	$3,000,000
S12A 201266	Sewer Outfall Line RMWD Replacement	Provide adequate conveyance capacity	Previously recommended as a 30-inch pipe. Recommended to be reduced to 24-inches. Unit cost for previous project retained	24-inch	16,000 ft	2	$27/in-ft	$10,400,000
S13A	Sewer Capacity Purchase	Provide conveyance and treatment capacity to District customers	Unit Cost per TM #1, Additional flow per MP recommendation of maximum ADF of 1.25 MGD and total forecasted flow of 1.39 MGD	--	0.14 MGD	2	$20/gpd	$2,800,000
							No Project Alternative Sewer CIP Total Cost	**$29,300,000**
Sewer Projects – LS 2 Plant Location (Not shown on Figure 7-2)								
S9B	Construct 1.6 MGD Water Reclamation Plant (WRP) at LS 2 Location	Provide reliable local water source & water supply offset. Provide sewer outfall within District to avoid exceeding outfall capacity	Cost per TM #1	0.9 MGD	--	1	--	$66,000,000
S10B	WRP Conveyance (Pump Station and Pipeline) and Failsafe Storage (Beck Reservoir Rehab and Raw Water Connection)	Provide conveyance to storage and storage for treated wastewater	Cost per TM #1	0.9 MGD	--	1	--	$13,900,000

Table 7-4 Wastewater Capital Improvement Plan

Project No.	Description	System Benefit	Notes	Size	Quantity	Phase	Construction Costs	
							Unit Cost	Total Cost
S11B 201040	Lift Station 1 Replacement and Upgrade	Replace and expand critical station reaching useful life	Cost per TM #1	--	1,800 gpm	1	--	$8,200,000
S12B 201260	San Luis Rey Interceptor Replacement from Mission Road to LS 1	Provide adequate conveyance capacity	Cost per District Budget, Highway 76 Realignment - CalTrans UPSIZE	18-inch	7,100 ft	1	--	$3,200,000
S13B	San Luis Rey Interceptor Replacement from LS 1 to LS 2	Provide adequate conveyance capacity	Cost per TM #1	18-inch	7,500 ft	1	--	$3,000,000
S14B	Sewer System Rehabilitation Program	Rehabilitate and repair existing sewer trunk infrastructure	Keep aging pipes and manholes with no capacity deficiencies in good condition	15-inch	--	1	--	$2,400,000
LS 2 Plant Location Alternative Sewer CIP Total Cost								**$98,400,000**
Sewer Projects – Changes to Serve Out of District Developments (Not shown on Figure 7-2)								
S9C	San Luis Rey Interceptor Replacement from LS 1 to LS 2	Provide adequate conveyance capacity	Additional cost per VCMWD Meadowood Memo	21-inch	7,500 ft	1	--	$280,000
S10C 201260	San Luis Rey Interceptor Replacement from Mission Road to LS 1	Provide adequate conveyance capacity	Additional cost per VCMWD Meadowood Memo	21-inch	7,100 ft	1	--	$260,000
S11C	Lift Station 1 Replacement	Provide adequate conveyance capacity	Additional cost per VCMWD Meadowood Memo	--	--	1	--	$177,000
Out of District Sewer CIP Additional Cost								**$700,000**

(1)RMWD Job Number also listed for existing projects
(2)Includes costs for existing sewer projects and projects recommended under all alternatives
(3)New facilities required to serve the developments, such as Pankey SLS, to be paid for by developers. Cost participation in other projects, such as the Sewer Outfall Line Replacement, will be required

Table 7-5 Recycled Water Capital Improvement Plan

Project No.	Description	System Benefit	Notes	Size	Quantity	Phase	Construction Costs	
							Unit Cost	Total Cost
Baseline Recycled Water System CIP								
RW1	Recycled Water Pump Stations	Convey flows to storage in various pressure zones	Cost per TM #1	--	0.9 MGD	1	--	$4,600,000
RW2	Recycled Water Storage	Provide operational storage to recycled water customers	Cost per TM #1	--	0.9 MGD	1	--	$3,600,000
RW3	Recycled Water Transmission and Distribution System Pipeline	Provide transmission and distribution capacity to recycled water customers	Cost per TM #1	--	0.9 MGD	1	--	$11,000,000
RW4	Recycled Water System Customer Retrofit Assistance	Assist customers in connecting to the recycled water system	Cost per TM #1	--	0.9 MGD	1	--	$1,000,000
							Baseline Recycled Water System CIP Total Cost	**$20,200,000**

Table 7-6 Capital Improvement Plan by Phase

Phase	Program Description	Total Cost
1 (2016-2020)	Water System CIP	$17,200,000
	Sewer System CIP (Baseline)	$32,600,000
	Recycled Water System CIP	$10,100,000
	Phase 1 CIP Total	***$59,900,000***
2 (2021-2025)	Water System CIP	$22,600,000
	Sewer System CIP (Baseline)	$17,200,000
	Recycled Water System CIP	$6,100,000
	Phase 2 CIP Total	***$45,900,000***
3 (2026-2035)	Water System CIP	$9,800,000
	Sewer System CIP (Baseline)	$0
	Recycled Water System CIP	$4,000,000
	Phase 3 CIP Total	***$13,800,000***
	Combined Baseline CIP Total	**$120,000,000**