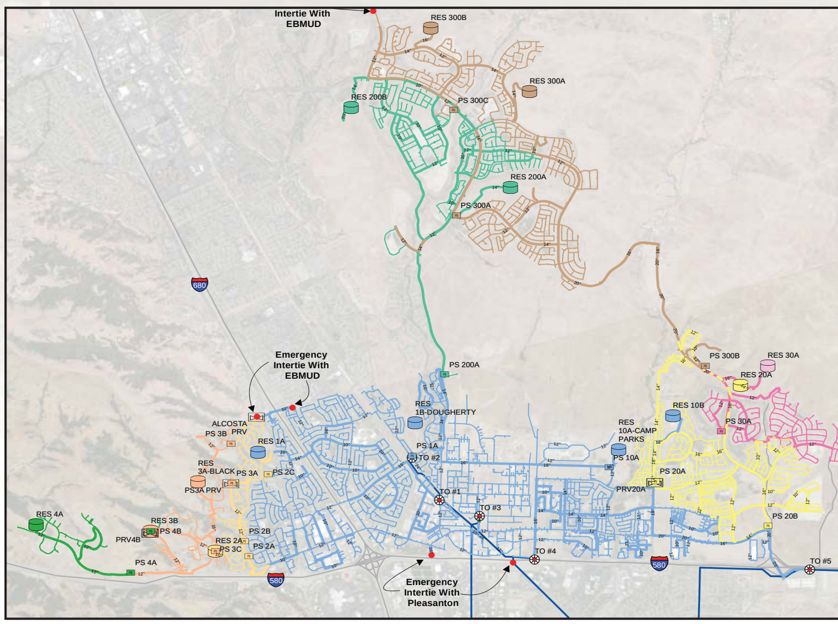

FINAL REPORT
MARCH 2016

DUBLIN SAN RAMON SERVICES DISTRICT

Water System Master Plan

WEST YOST ASSOCIATES

Dublin San Ramon Services District
Water, wastewater, recycled water

Water System Master Plan

Prepared for

Dublin San Ramon Services District

March 2016

WEST YOST ASSOCIATES
Consulting Engineers

406-02-14-38

Elizabeth Drayer, PE

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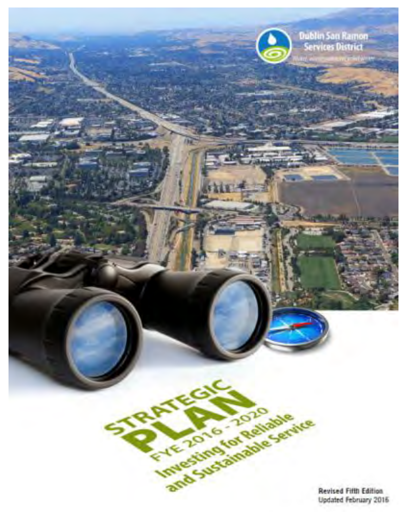
EXECUTIVE SUMMARY

ES.1 OVERVIEW AND NEED FOR WATER SYSTEM MASTER PLAN UPDATE

The Dublin San Ramon Services District (District/DSRSD) Water System Master Plan & Capacity Reserve Fee Study is a comprehensive update of both the District's Water System Master Plan Update dated December 2005 (2005 Water Master Plan) and Development of the District's Water Capacity Reserve Fees dated May 2011 (2011 Capacity Reserve Fee Report). Since the completion of the 2005 Water Master Plan and 2011 Water Connection Fee Report, additional development plans have been completed for East Dublin, West Dublin, the U.S. Army Reserve's Parks Forces Training Area (Parks RFTA), and Dougherty Valley in Contra Costa County. Also, the cities and counties that the District serves have adopted amendments to their general plans and specific plans. These new and updated plans need to be considered when planning future improvements to the District's water system infrastructure.

This Water System Master Plan has been prepared for the District by West Yost Associates in accordance with two key strategic goals of the District's Strategic Plan for Fiscal Years Ending 2016-2020:



- Strategic Goal 1.05: Integrate Master Plans with Fee Setting for Capacity Rights
  - — Master plans for the potable and recycled water, wastewater, and support systems are the critical foundation for much of the District's long-term financial planning.
  - — Master plans will evaluate the District's existing and future infrastructure needs, and the underlying facility assumptions and cost estimates used in the plans will be integrated with determining the capital improvement program (CIP) budget and capacity fees.
  - — To ensure appropriate investment and sound financial planning to support the District's mission well ahead of need, the District will integrate capacity fee studies into the master planning process so that the fees are current, sustainable, and support the needs identified in the plan.
- Strategic Goal 2.04: Define and Implement Essential Projects in a Timely Manner to Meet Community Expectations
  - — Maintaining master plans for key District systems ensures that the District delivers reliable and safe service to current and future customers in a timely manner.
  - — The District will prepare master plans at least every five years and more frequently if significant assumptions in the current plan or capital improvement program change.
  - — Master plans will include recommendations for infrastructure expansion, improvements, and rehabilitation, as well as associated cost estimates and projected schedules.

The Water System Capacity Reserve Fee Study will be prepared by HDR, Inc. (HDR) as a separate, stand-alone document and will be aligned with the recommended capital improvement plan described in this Water System Master Plan.

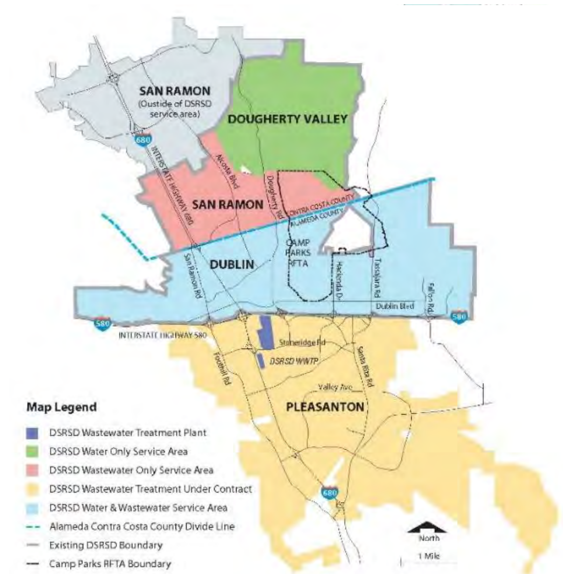
ES.2 WATER SYSTEM MASTER PLAN OBJECTIVES AND TASKS

The update of the District's Water System Master Plan & Capacity Reserve Fee Study will guide the District's remaining future potable water capital improvement projects and establish appropriate capacity reserve fees to fund them. The resulting Water System Master Plan provides a comprehensive road map for the District for future planning for its potable and recycled water system.

Specific objectives and tasks are listed below with references to specific chapters of the Water System Master Plan.

Evaluate and summarize existing key potable and recycled water system facilities	→	*See Chapter 2. Water Service Area and Water System Facilities*
Evaluate, confirm and update, as needed, performance and operational criteria under which the potable and recycled water system will be analyzed and future facilities recommendations will be formulated	→	*See Chapter 4. Water System Planning and Performance Criteria* *For additional information on recycled water planning criteria, refer to "DERWA Model Update and System Evaluation" prepared by Carollo Engineers (included in Appendix F)*
Prepare potable and recycled water demand projections through buildout of the District's service area	→	*See Chapter 3. Existing and Projected Water Demands* *For additional information on recycled water demands, refer to "DERWA Model Update and System Evaluation" prepared by Carollo Engineers (included in Appendix F)*
Update and validate the District's potable and recycled water system hydraulic models	→	*For information on the potable water system model, refer to Potable Water System Model "Modeler's Notebook" prepared by West Yost (provided under separate cover)* *For information on the recycled water system model, refer to "DERWA Model Update and System Evaluation" prepared by Carollo Engineers (included in Appendix F)*
Evaluate existing and future potable and recycled water system conditions to identify the District's future needs	→	*Refer to Chapter 5. Evaluation of Existing Potable Water System and Chapter 6. Evaluation of Future Potable Water System* *For information on the existing and future recycled water system, refer to "DERWA Model Update and System Evaluation" prepared by Carollo Engineers (included in Appendix F)*
Develop a capital improvement program for recommended existing and future potable and recycled water system facilities	→	*Refer to Chapter 7. Recommended Capital Improvement Program*
Establish appropriate capacity reserve fees to fund the recommended capital improvement program	→	*To be prepared as a separate report by HDR.*

ES.3 WATER SERVICE AREA AND POPULATION



DSRSD's current water service area includes the original service area in the City of Dublin in Alameda County, as well as approved development in Eastern Dublin, Western Dublin, and the Dougherty Valley portion of the City of San Ramon in Contra Costa County. DSRSD's potable water service area also includes the Parks RFTA, also referred to as Camp Parks, which officially became part of the water system in 1999; the Federal Bureau of Prison's Federal Correctional Institution at Dublin, and Alameda County's Santa Rita Jail.

Several new development projects are planned within the District's service area, including Wallis Ranch, Moller Ranch and Dublin Crossing. West Yost, along with District staff, coordinated with City of Dublin Planning Department staff to quantify the extent and timing of these and other anticipated future development projects. As development within the District's water service area continues, the District's population is expected to increase to 92,549 by the year 2020 (corresponding to buildout of the Dougherty Valley area) and to approximately 106,610 by the year 2035 (corresponding to buildout of City of Dublin and the overall District water service area).

ES.4 EXISTING AND PROJECTED FUTURE WATER DEMAND

As described in Chapter 3 of this Water System Master Plan, projected future water demands were evaluated based on both future population and future land use projections. It is recommended that the District adopt the land used based potable water demand projection for this Water System Master Plan Update because it incorporates more up-to-date and accurate future land use estimates and unit water use factors, and also accounts for the expected potable water offset from recent (2014) and future planned potable water service conversions to the recycled water system. In addition, with the land use based water demand projection, GIS data can be used to spatially locate projected water demands for the hydraulic evaluation of the future water system.

A summary of existing and projected potable and recycled water demands within the District's water service area is provided in Table ES-1.

Table ES-1. Existing and Projected Potable and Recycled Water Demands

Demand Condition	Potable Water[a]			Recycled Water[b]		
	Existing (2013)[c]	Total 2020 Demand	Total Buildout Demand	Existing (2014)	Total 2020 Demand	Total Buildout Demand
Annual Demand	11,244 af/yr	13,690 af/yr	15,840 af/yr	2,287 af/yr	3,904 af/yr	4,203 af/yr
Average Day	10.0 mgd	12.2 mgd	14.1 mgd	2.0 mgd	3.5 mgd	3.8 mgd
Maximum Day		24.4 mgd	28.2 mgd		8.7 mgd	9.4 mgd
Peak Hour		29.3 mgd	33.8 mgd		26.3 mgd	28.3 mgd

(a) Refer to Chapter 3, Table 3-19.
(b) Refer to Chapter 3, Table 3-26 and also Appendix F "DERWA Model Update and System Evaluation" prepared by Carollo Engineers.
(c) Potable water use for 2014 was not considered to be representative of normal demand conditions because it was significantly lower due to increased conservation efforts in response to the on-going drought and would not be conservative for use in planning.

The District's 2020 average day potable water demands are expected to increase by approximately 22 percent over existing (2013) water demands. The projected 2020 average day demand is 12.2 million gallons per day (mgd), for a total annual demand of 13,690 acre-feet (af). These growth projections are based on near-term development anticipated to occur by 2020. The District's Buildout average day potable water demands are expected to increase by approximately 41 percent over existing water demands. The projected Buildout average day demand is 14.1 mgd, for a total annual demand of 15,840 af, or. These growth projections are long-term projections that assume future development based on Buildout planning projections.

The District's 2020 average day recycled water demands are expected to increase by approximately 70 percent over existing (2014) water demands. The projected 2020 average day demand is 3.5 mgd, for a total annual demand of 3,904 af, These growth projections are based on near-term development anticipated to occur by 2020. The District's Buildout average day recycled water demands are expected to increase by approximately 84 percent over existing water demands. The projected Buildout average day demand is 3.8 mgd, for a total annual demand of 4,203 af. These growth projections are long-term projections that assume future development based on Buildout planning projections.

ES.5 RECOMMENDED POTABLE WATER SYSTEM IMPROVEMENTS

ES.5.1 Existing Potable Water System Needs

Chapter 5 of this Water System Master Plan presents the evaluation of the District's existing potable water distribution system, and its ability to meet recommended potable water system service and performance standards under various existing potable water demand conditions. The chapter includes both system capacity and hydraulic performance evaluations. The system capacity evaluation includes an analysis of pumping and water storage capacity. The hydraulic performance evaluation assesses the existing potable water system's ability to meet recommended service and performance standards under maximum day, maximum day demand plus fire flow, and peak hour demand conditions.

Findings from the evaluation of the existing water distribution system and the recommended improvements needed to eliminate deficiencies are summarized in Table ES-2.

Table ES-2. Existing Potable Water System Findings and Recommendations

System Component	Finding/Recommendation
Pumping Capacity	All service zones were found to have surplus pumping capacity in excess of existing maximum day demand. No pump station mitigation is recommended based on existing demand conditions. There is only one pump station that has an on-site backup generator (PS 4B). To improve pump station reliability during power outages, on-site backup generators are recommended at the following five pump stations: PS 2C, PS 3A, PS 20B, PS 200A and PS 300B. It should be noted that mechanical and/or electrical improvements may be required at these pump stations to accommodate the installation of permanent, on-site backup generators.
Storage Capacity	Zone 2 was found to have a storage capacity deficit of 0.27 MG. As noted previously, the Zone 2 pump stations are equipped with a plug-in adaptor for portable standby generators, and are recommended for installation of permanent on-site generators, providing additional supply reliability for these zones. In the event of fire flow or emergency conditions, the permanent on-site generator could be used to operate the Zone 2 pump station without time delay to bring the portable generator to power up the pump station. In addition, there is a pressure reducing/sustaining valve at PS 3A which could also provide supply reliability for Pressure Zone 2 in the event of fire flow or emergency conditions in Pressure Zone 2; therefore, no additional storage in Pressure Zone 2 is recommended based on existing demand conditions.
Pipelines	Discharge pipelines for PS 20A exceeded the recommended pipeline velocity criteria during a peak hour demand condition. However, no improvements for pipelines exceeding the velocity criteria in the existing potable water system are recommended since the primary criterion (pressure) is met.

Existing water system improvements to address existing system deficiencies should be completed as funding permits.

ES.5.2 Future Potable Water System Needs

Chapter 6 of this Water System Master Plan presents the evaluation of the District's future potable water distribution system, and its ability to meet recommended potable water system service and performance standards under future water demand conditions. Future water demand conditions evaluated included 2020 demand conditions and Buildout (2035) demand conditions as determined in *Chapter 3 Existing and Projected Water Demands*.

West Yost conducted this evaluation using an updated hydraulic model that incorporated improvements to eliminate deficiencies identified in the existing water system evaluation (see *Chapter 5 Evaluation of Existing Potable Water System*). In addition, West Yost also conducted a storage siting evaluation for Pressure Zone 1 and Pressure Zone 20.

The future potable water system evaluation includes both system facility capacity and hydraulic performance evaluations. The system facility capacity evaluation includes an analysis of pumping and water storage capacity. The system performance evaluation assesses the future potable water system's ability to meet recommended planning and design criteria under two conditions: future maximum day demand plus fire flow and peak hour demand conditions. In addition, the future potable water system was further analyzed using an extended period simulation under a maximum day demand condition to evaluate storage turnover.

Findings from the evaluation of the future water distribution system and the recommended improvements needed to eliminate deficiencies are summarized in Table ES-3. Recommended improvements do not include in-tract pipelines that are required for new development and fully funded by the project proponents.

Table ES-3. Future Potable Water System Findings and Recommendations		
System Component	2020 Improvements	Buildout Improvements
Supply Capacity	No recommendations	To provide supply reliability under future maximum day demand, a new Zone 7 turnout (Turnout 6) is recommended south of I-580 at Pimlico Drive. The capacity of this turnout should be equal to 6,000 gpm (8.64 mgd). Requires 2,281 linear feet (LF) of new 20-inch diameter pipeline, of which 205 LF must be installed using jack and bore techniques underneath I-580.
Pumping Capacity	Construct new 1.56 mgd PS 300D at Moller Ranch project site to provide emergency supply to Pressure Zone 300 of the Moller Ranch project (to be entirely developer-funded; not included in recommended CIP)	Under future demand conditions, the District's pump stations in Pressure Zones 1, 20, 30 and 200 have pumping deficiencies. The pumping deficit in Pressure Zone 30 is very small (only 6 gpm) and is therefore not a concern. Pumping deficiencies in Pressure Zones 1, 20 and 200 are larger and could be eliminated by installing larger pumps at PS1A, PS20B and PS200A. However, these improvements are not needed in the near-term and are based on future demand conditions which are subject to change as development plans change and as water use in the District's service area changes. Therefore, these improvements have been deferred in this Water System Master Plan and should be re-evaluated in future updates to this plan.
Storage Capacity	Replace the existing Reservoir 10A with a new 4.1 MG Reservoir 10A at a lower elevation for additional storage capacity in Pressure Zone 1; and Construct a new 1.3 MG Reservoir 20B for additional storage capacity in Pressure Zone 20 (also requires 8,674 LF of 12-inch diameter pipeline to the proposed Reservoir 20B location in the Windemere Development)	No recommendations
Pipelines	Construct new in-tract pipelines for new developments in Eastern Dublin, Moller Ranch and Dougherty Valley (to be entirely developer-funded; not included in recommended CIP)	

The construction of capital improvements for the intermediate (2020) and Buildout (2035) demand conditions should be coordinated with the proposed schedules of new development to ensure that require infrastructure will be in place to serve future customers.

ES.6 RECOMMENDED RECYCLED WATER SYSTEM IMPROVEMENTS

A separate evaluation of the DSRSD-EBMUD Recycled Water Authority (DERWA) recycled water system was conducted by Carollo Engineers in parallel with the preparation of this Water System Master Plan (Carollo's report titled "*DERWA Model Update and System Evaluation"* is provided in Appendix F).

The recycled water hydraulic model was run under year 2020 and buildout recycled water demand conditions to identify areas of low pressure under peak hour demand conditions. The model was also used to identify high velocity and headloss locations. In general, the hydraulic modeling analysis indicates that the District should be able to serve the projected buildout recycled water demands while meeting the established planning criteria. Notable findings from the system analysis are discussed below:

- Low Pressure Areas: There are a few isolated areas in the system that experience low pressures (below 40 psi) during peak hour demand conditions. These areas are primarily driven by the service elevation rather than system headlosses or other hydraulic restrictions. Some customers in these areas have on-site booster pump stations to increase pressures as needed. Others have not cited any low pressure issues. For this reason, no improvements are recommended to address any low pressure conditions in these areas.
- Shaefer Ranch/Western Dublin Area: The District has projected future recycled water demands associated with this area of roughly 208 af/yr, which is located outside of the current recycled water service area in Western Dublin. The estimated service elevation at Shaefer Ranch is roughly 1,000 feet at the highest point. Potable water service for this area is located within the Zone 4 pressure zone, with a maximum hydraulic grade line elevation of 1,130 feet. In order to provide recycled water service to this area, it would need to be boosted from Pressure Zone R1 into a new recycled water pressure zone. The approximate hydraulic grade line elevation difference between the two pressure zones would be on the order of 520 feet. Approximately 22,600 feet of 12-inch diameter main, a new pump station and new storage tank would be required to provide recycled water service to this area. Based on the estimated cost to construct these new facilities (approximately $15 million), the District has determined that providing recycled water service to this area would not be cost-effective given the relatively small demand.

ES.7 SUMMARY OF RECOMMENDATIONS AND ESTIMATED COSTS

The recommended potable water system capital improvement projects are listed in Table ES-4 and shown on Figure ES-1 and summarized below.

The recommended intermediate (2020) potable water system improvements are as follows:

- New Reservoir 10A
  - Replace the existing Reservoir 10A with a new 4.1 MG Reservoir 10A at a lower elevation for additional storage capacity in Pressure Zone 1;
  - Replaces previously recommended CIP for a new Reservoir 1C (CIP No. 08-6203).
- New Reservoir 20B
  - Construct a new 1.3 MG Reservoir 20B near the Windemere Development area and associated 8,674 LF 12-inch diameter pipeline;
  - Updates previously recommended CIP for a new Reservoir 20B (CIP No. 14-W008).
- New Pipelines
  - Approximately 1,700 LF of new 14-inch diameter pipeline from Bollinger Canyon Road south to Reservoir 200B to replace existing pipeline to Reservoir 200B (project is included in District's adopted 2015 CIP as CIP No. 05-6204) (see additional discussion in Chapter 7);
  - Approximately 400 LF of 16-inch diameter Pressure Zone 20 pipeline and 1,700 LF of 20-inch diameter Pressure Zone 30 pipeline on Fallon Road (project is included in District's adopted 2015 CIP as CIP No. 12-W013) (these pipelines have already been installed by the developer but need to be reimbursed by the District) (see additional discussion in Chapter 7).

The recommended Buildout (2035) potable water system improvements are as follows:

- New Turnout 6
  - Construct a new Zone 7 turnout (Turnout 6) south of I-580 at Pimlico Drive; the minimum capacity of the new Turnout 6 should be 6,000 gallons per minute (gpm) (8.6 mgd);
  - Requires installation of 2,281 LF of new 20-inch diameter pipeline, of which 205 LF must be installed using jack and bore techniques underneath I-580;
  - Updates previously recommended CIP for a new Turnout 6 (CIP No. T00-29).

Table ES-4. Summary of Recommended Capital Improvement Projects and Estimated Cost[a]

CIP ID	Improvement Type	Improvement by District or Developer	Reason for Improvement	Improvement Description	Zone	Estimated Construction Cost[b]	Capital Cost (includes mark-ups)[b+A1]
Existing System Improvements (Near-Term Improvements)							
Booster Pump Station Improvements							
CIP Sta 2C	New Generator	District	Emergency/Supply Reliability	On-site backup generator at Station 2C	2	$ 468,000	$ 608,000
CIP Sta 3A	New Generator	District	Emergency/Supply Reliability	On-site backup generator at Station 3A	3	$ 468,000	$ 608,000
CIP Sta 20B	New Generator	District	Emergency/Supply Reliability	On-site backup generator at Station 20B	20	$ 468,000	$ 608,000
CIP Sta 200A	New Generator	District	Emergency/Supply Reliability	On-site backup generator at Station 200A	200	$ 468,000	$ 608,000
CIP Sta 300B	New Generator	District	Emergency/Supply Reliability	On-site backup generator at Station 300B	300	$ 468,000	$ 608,000
						Subtotal	$ 3,040,000
						Existing System Improvement Projects (Near-Term Projects) Total	**$ 3,040,000**
Intermediate Improvements (2020 Improvements)							
Storage Improvements							
CIP Res 10A	New Reservoir	District	Storage Deficiency	Construct new 4.1 MG Reservoir 10A (includes demolition of existing Reservoir 10A)	1	$ 5,920,000	$ 7,636,000
CIP Res 20B	New Reservoir	District	Storage Deficiency	Construct new 1.3 MG storage reservoir (includes 8,674 LF of 12-inch diameter pipeline from Tassajara Road to Reservoir 20B and property purchase)	20	$ 5,999,000	$ 7,753,000
						Subtotal	$ 15,389,000
Pipeline Improvements							
CIP No. 05-6204	New Pipeline	To be installed by Developer and reimbursed by District	Storage Operation	Construct 1,700 feet of 14-inch diameter pipeline from Bollinger Canyon Road south to Reservoir 200B	200	[c]	$ 824,256
CIP No. 12-W013	New Pipeline	Already installed by Developer; to be reimbursed by District	Distribution Improvement	Construct 400 feet of 16-inch diameter Pressure Zone 20 water main and 1,700 feet of 20-inch diameter Pressure Zone 30 water main on Fallon Road	20 & 30	[d]	$ 315,500
						Subtotal	$ 1,139,756
						Intermediate Improvement Projects (2020 Projects) Total	**$ 16,528,756**
Buildout Improvements (2035 Improvements)							
Supply Improvements							
CIP FUT TO6	Supply Reliability	District	Buildout	Construct new Zone 7 Turnout 6 at Pimlico Drive and I-580 including 205-foot Jack and Bore and 2,076 LF of 20-inch diameter pipeline to Dublin Boulevard	1	$ 1,546,000	$ 2,009,000
						Subtotal	$ 2,009,000
						Buildout Improvement Projects Total	**$ 2,009,000**
						Total Capital Improvement Plan	**$ 21,577,756**

[a] Costs shown are based on the October 2015 SF ENR CCI of 11169.

[b] Costs include base construction costs plus 30 percent design and construction contingency, and an additional markup equal to 30 percent for professional services.

[c] Cost shown is based on maximum amount to be reimbursed to the developer by the District.

[d] Cost shown is based on amount to be reimbursed to the developer by the District.

It should be noted that any in-tract pipelines required to be installed as part of new development projects will be fully funded and installed by the project proponents. Therefore, these facilities and corresponding costs are not included.

Existing water system improvements (Near-term Improvements) to address existing system deficiencies should be completed as funding permits. The construction of capital improvements for the intermediate (2020) and Buildout (2035) demand conditions should be coordinated with the proposed schedules of new development to ensure that require infrastructure will be in place to serve future customers.

The total planning-level cost of potable water system improvements to support the District's existing and future water demands is estimated to be $21.6 million (M). Of this amount, approximately $3.0M is required to address existing system deficiencies, and approximately $18.5M is required to support future planned growth ($16.5M for 2020 + $2.0M for Buildout (2035)).

Also, it should be noted that although a parallel evaluation has been performed for the District's recycled water system (see Appendix F), no improvements to the District's recycled water distribution system have been identified.

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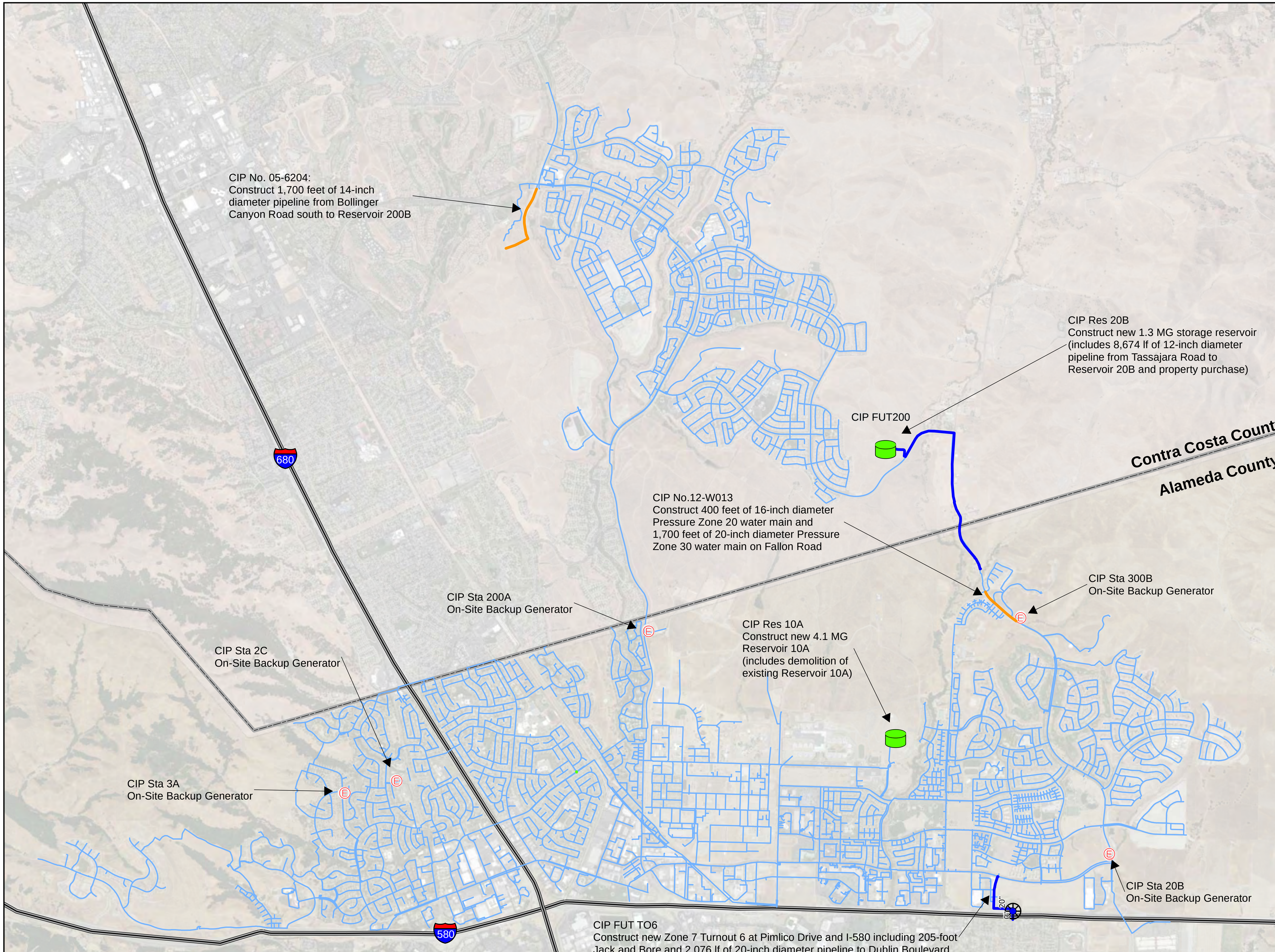
FIGURE ES-1

Dublin San Ramon Services District Water System Master Plan

RECOMMENDED CAPITAL IMPROVEMENT PROGRAM



N

0 1,750 3,500

Scale in Feet

LEGEND

2020 Storage Improvement

On-site Backup Generator

Pipeline Improvements

Near-Term

Buildout

WEST YOST ASSOCIATES
Consulting Engineers

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CHAPTER 1: INTRODUCTION

Chapter Highlights

This Water System Master Plan & Capacity Reserve Fee Study is a comprehensive update of the District's December 2005 Water System Master Plan Update and 2011 Capacity Reserve Fee Study.

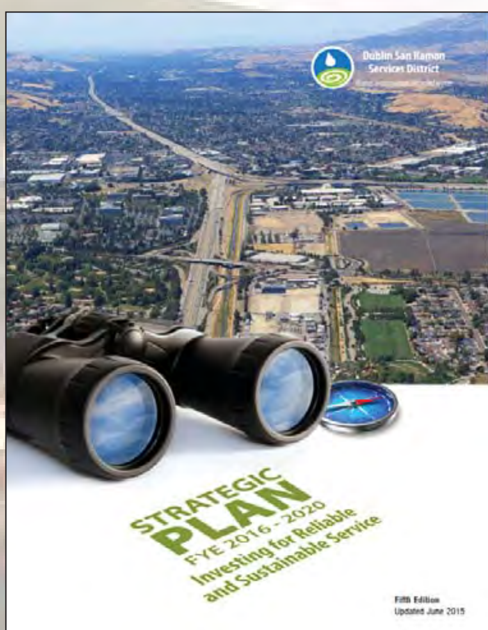
The update of the District's Water System Master Plan and Capacity Reserve Fee will guide the District's remaining future water system capital improvement projects and establish appropriate capacity reserve fees to fund them.

Chapter Contents:

REPORT ORGANIZATION

Chapter 1:	Introduction
Chapter 2:	Water Service Area and Water System Facilities
Chapter 3:	Existing and Projected Water Demands
Chapter 4:	System Planning and Performance Criteria
Chapter 5:	Evaluation of Existing Potable Water System
Chapter 6:	Evaluation of Future Potable Water System
Chapter 7:	Recommended Capital Improvement Program

The Water System Capacity Reserve Fee Study establishing cost based capacity reserve fees for new customers connecting to the District's system will be prepared by HDR, Inc. based on the recommended capital improvement program described in this Water System Master Plan and will be published as a separate, stand alone document.



This Water System Master Plan & Capacity Reserve Fee Study is being conducted in accordance with two key strategic goals of the District's Strategic Plan:

- Goal 1.05: Integrate Master Plans with Fee Setting for Capacity Rights
- Goal 2.04: Define and Implement Essential Projects in a Timely Manner to Meet Community Expectations

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CHAPTER 1
Introduction

1.1 OVERVIEW AND NEED FOR WATER SYSTEM MASTER PLAN UPDATE

The Dublin San Ramon Services District (District/DSRSD) Water System Master Plan & Capacity Reserve Fee Study is a comprehensive update of both the District's Water System Master Plan Update dated December 2005 (2005 Water Master Plan) and Development of the District's Water Capacity Reserve Fees dated May 2011 (2011 Capacity Reserve Fee Report). Since the completion of the 2005 Water Master Plan and 2011 Water Connection Fee Report, additional development plans have been completed for East Dublin, West Dublin, the Parks Reserve Forces Training Area (Parks RFTA) and Dougherty Valley (in Contra Costa County). Also, the cities that the District provides water service to (City of Dublin and City of San Ramon) have adopted amendments to their General Plans and have prepared new Specific Plans for planned new development areas. These new and updated plans need to be considered when planning future improvements to the District's water system infrastructure.

This Water System Master Plan & Capacity Reserve Fee Study has been conducted in accordance with two key strategic goals of the District's 2015 Strategic Plan for Fiscal Years Ending 2016-2020:

- Strategic Goal 1.05: Integrate Master Plans with Fee Setting for Capacity Rights
  - Master plans for the water, wastewater, and support systems are the critical foundation for much of the District's long-term financial planning.
  - Master plans will evaluate the District's existing and future infrastructure needs, and the underlying facility assumptions and cost estimates used in the plans will be integrated with determining the capital improvement program (CIP) budget and capacity fees.
  - To ensure appropriate investment and sound financial planning to support the District's mission well ahead of need, the District will integrate capacity fee studies into the master planning process so that the fees are current, sustainable, and support the needs identified in the plan.
- Strategic Goal 2.04: Define and Implement Essential Projects in a Timely Manner to Meet Community Expectations
  - Maintaining master plans for key District systems ensures that the District delivers reliable and safe service to current and future customers in a timely manner.
  - The District will prepare master plans at least every five years and more frequently if significant assumptions in the current plan or capital improvement program change.
  - Master plans will include recommendations for infrastructure expansion, improvements, and rehabilitation, as well as associated cost estimates and projected schedules.

1.2 WATER SYSTEM MASTER PLAN OBJECTIVES AND TASKS

The update of the District's Water System Master Plan & Capacity Reserve Fee Study will guide the District's remaining future water system capital improvement projects and establish appropriate capacity reserve fees to fund them.

To accomplish these objectives, the following tasks have been performed:

- Evaluate and summarize existing key potable and recycled water system facilities;
- Evaluate, confirm and update, as needed, performance and operational criteria under which the potable and recycled water systems will be analyzed and future facilities recommendations will be formulated;
- Prepare potable and recycled water demand projections through buildout of the District's service area;
- Update and validate the District's potable and recycled water system hydraulic models;
- Evaluate existing and future potable and recycled water system conditions to identify the District's future needs;
- Develop a capital improvement program for recommended existing and future potable and recycled water system facilities; and
- Establish appropriate water system capacity reserve fees to fund the recommended capital improvement program.

The resulting Water System Master Plan provides a comprehensive road map for the District for future planning for its potable and recycled water systems.

1.3 AUTHORIZATION

West Yost Associates (West Yost) was authorized to prepare this Water System Master Plan Update by the District on May 6, 2014. The evaluation of the District's potable water system was conducted by West Yost. The evaluation of the District's recycled water system (included in Appendix F) was conducted under a separate District authorization by Carollo Engineers.

The Water System Capacity Reserve Fee Study will be prepared by HDR, Inc. (HDR) as a separate, stand-alone document and will be aligned with the recommended capital improvement plan described in this Water System Master Plan.

1.4 REPORT ORGANIZATION

This Water System Master Plan is organized into the following chapters:

- Executive Summary
- Chapter 1. Introduction
- Chapter 2. Water Service Area and Water System Facilities
- Chapter 3. Existing and Projected Water Demands
- Chapter 4. Water System Planning and Performance Criteria
- Chapter 5. Evaluation of Existing Potable Water System
- Chapter 6. Evaluation of Future Potable Water System
- Chapter 7. Recommended Capital Improvement Plan

The following appendices to this Water System Master Plan contain additional technical information, assumptions and calculations:

- Appendix A: Potable Water Demand Assumptions
- Appendix B: Summary of Changes in the Key Performance Criteria
- Appendix C: Fire Code Requirements and Fire Flow Information Received from Alameda County Fire Department (ACFD)
- Appendix D: Evaluation of Future Storage Reservoir Locations
- Appendix E: Cost Estimating Assumptions
- Appendix F: DERWA Model Update and System Evaluation

The Water System Capacity Reserve Fee Study establishing cost-based capacity reserve fees for new customers connecting to the District's system will be prepared by HDR, Inc. based on the recommended capital improvement program described in this Water System Master Plan and will be published as a separate, stand-alone document.

A separate Water System Hydraulic Model "Modeler's Notebook" has also been prepared to accompany the delivery of the updated water system hydraulic model to the District. The "Modeler's Notebook" documents the assumptions and details for each of the modeled water system facilities and each of the scenarios included in the hydraulic model. Use of the hydraulic model to evaluate the District's existing and future conditions is described in Chapter 5 and Chapter 6, respectively.

1.5 ACRONYMS AND ABBREVIATIONS

The following acronyms and abbreviations have been used throughout this Water System Master Plan to improve document clarity and readability.

ACFD	Alameda County Fire Department
ADD	Average Day Demand
af	Acre-Feet
AFA	Acre-Feet Annually
AWWA	American Water Works Association
BBID	Byron Bethany Irrigation District
Cal Water	California Water Services Company
CCI	Construction Cost Index
CEQA	California Environmental Quality Act
CII	Industrial and Institutional
CIP	Capital Improvement Program
CUWCC	California Urban Water Conservation Council
DDW	Division of Drinking Water
DERWA	DSRSD-EBMUD Recycled Water Authority
District	Dublin San Ramon Services District
DLD	Dedicated Land Disposal
du/acre or du/ac	Dwelling Unit Per Acre
DWR	State of California Department of Water Resources
EBMUD	East Bay Municipal Utility District
ENR	Engineering News Record
FAR	Floor to Area Ratio
FCI	Federal Correctional Institution
ft/kft	Feet Per Thousand Feet
ft/s	Feet Per Second
GIS	Geographical Information System
gpcd	Gallons Per Capita Per Day
gpd	Gallons Per Day
gpm	Gallons Per Minute
HDPE	High-Density Polyethylene
HDR	HDR, Inc.
HGL	Hydraulic Grade Line
hp	Horsepower
LF	Linear Feet
M	Million
MDD	Maximum Day Demand
MG	Million Gallons
mgd	Million Gallons Per Day
NFPA	National Fire Protection Agency
Parks RFTA or Camp Parks	U.S. Army Reserve Parks Reserve Forces Training Area

PHD	Peak Hour Demand
psi	Pounds Per Square Inch
PVC	Polyvinyl Chloride
SCADA	Supervisory Control and Data Acquisition
SRVFPD	San Ramon Valley Fire Protection District
SRVRWP	San Ramon Valley Recycled Water Project
STWSD	Semitropic Water Storage District
SWP	State Water Project
SWRCB	State Water Resources Control Board
USBR	U.S. Bureau of Reclamation
USEPA	U.S. Environmental Protection Agency
UWMP	Urban Water Management Plan
West Yost	West Yost Associates
WWTP	Wastewater Treatment Plant
Zone 7	Zone 7 Water Agency

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CHAPTER 2: WATER SERVICE AREA AND WATER SYSTEM FACILITIES

Chapter Purpose

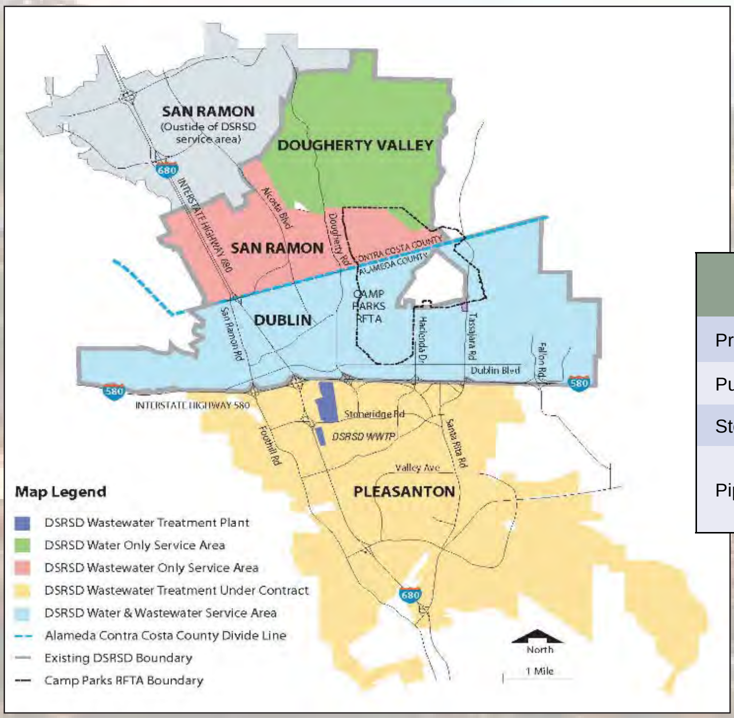
The purpose of this chapter is to describe the District's existing water service area and water system facilities. System information was obtained through the review of previous reports, maps, plans, operating records, and other available data provided to West Yost by the District.

Chapter Highlights

The District provides potable and recycled water service to the City of Dublin (in Alameda County) and the Dougherty Valley area of the City of San Ramon (in Contra Costa County).

Chapter Contents:

	City of Dublin Population	Dougherty Valley Population	Total Water Service Area Population
2015	55,844	26,029	81,873
2020	60,531	32,018 (buildout)	92,549
2025	65,218	32,018	97,236
2030	69,905	32,018	101,923
2035	74,592 (buildout)	32,018	106,610



Facilities	Potable Water System	Recycled Water System
Pressure Zones	8	4
Pump Stations	17	6
Storage Reservoirs	14	4
Pipelines	302 miles ranging from 4-inch to 20-inch in diameter	67 miles ranging from 1-inch to 36-inch in diameter

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CHAPTER 2
Water Service Area and Water System Facilities

The purpose of this chapter is to describe the District's existing water service area and potable and recycled water system facilities. System information was obtained through the review of previous reports, maps, plans, operating records, and other available data provided to West Yost by the District.

2.1 WATER SERVICE AREA

2.1.1 Water Service Area Description

Founded in 1953, the District provides potable and recycled water service to the City of Dublin (in Alameda County) and the Dougherty Valley area of the City of San Ramon (in Contra Costa County), wastewater collection and treatment to Dublin and south San Ramon, and wastewater treatment under contract to the City of Pleasanton. The District's overall service area boundary is shown on Figure 2-1, along with the specific services provided in each area.

DSRSD's water service area (including potable water and recycled water) includes Central Dublin (DSRSD's original service area), as well as approved development in Eastern Dublin, Western Dublin, and Dougherty Valley. DSRSD's water service area also includes the U.S. Army Reserve's Parks Reserve Forces Training Area (Parks RFTA, also referred to as Camp Parks), which became part of the water system in 1999; the Federal Bureau of Prison's Federal Correctional Institution at Dublin (FCI), and Alameda County's Santa Rita Jail.

The District's water service area is divided into five sub-areas to evaluate potential differences in water demands because of differences in projected land use (e.g., higher densities or larger homes) from the older portions of the District's service area. These five sub-areas include Central Dublin, Western Dublin, Eastern Dublin, Dougherty Valley portion of the City of San Ramon, and Parks RFTA.

2.1.2 Water Service Area Population

Historical population for the District's water service area is presented in Table 2-1 and illustrated on Figure 2-2. As shown in Table 2-1, the population of the District's water service area increased from 30,023 people in 2000 to 81,873 people in 2015, representing a 173 percent increase. This large increase in population is primarily the result of new development in Eastern Dublin and Dougherty Valley. As development within the District's water service area continues, the District's population is expected to increase to 92,549 by the year 2020 (corresponding to buildout of the Dougherty Valley area) and to approximately 106,610 by the year 2035 (corresponding to buildout of City of Dublin and the overall District water service area).

Table 2-1. Historical (1990-2015) and Projected (2020-2035) Water Service Area Population

Year	City of Dublin[(a)]	Dougherty Valley[(b)]	Total Population
1990	23,229	0	23,229
1995	24,277	0	24,277
2000	30,023	0	30,023
2005	38,147	7,092	45,239
2010	45,681	22,407	68,088
2015	55,844	26,029	81,873
2020	60,531	32,018 (buildout)	92,549
2025	65,218	32,018	97,236
2030	69,905	32,018	101,923
2035	74,592 (buildout)	32,018	106,610

(a) Historical data from California Department of Finance Website; projected populations based on buildout year of 2035 (linearly interpolated between 2015 population of 55,844 and buildout population of 74,592). 2010 data provided by District via email on March 10, 2015.

(b) Historical data based on information received from the District on September 23, 2015 and February 10, 2016, and from City of San Ramon on February 23, 2016. Projected populations based on data received from District via email on March 10, 2015.

2.1.3 Water Service Area Land Use

The cities of Dublin and San Ramon provided Geographical Information System (GIS) General Plan land use maps for West Yost to review and develop an existing land use map for the District. The resulting existing land use map for the District's water service area is presented on Figure 2-3. The total acreages by General Plan land use designation for the District's water service area in 2014 are summarized in Table 2-2.

As shown in Table 2-2, the District's current water service area is approximately 78.6 percent developed. The District's water service area is approximately 90.1 percent developed in the Dougherty Valley and approximately 74.5 percent developed in the City of Dublin. It should be noted that these estimates for percent developed do not include the planned new development in the Parks RFTA and Dublin Crossings Specific Plan areas because these proposed development areas are not currently vacant and are considered as redevelopment projects (conversion of current Public Lands to proposed new land uses).

Table 2-2. Existing Land Use[(a)]

General Plan Land Use	City of Dublin Acreage[(b)]	Dougherty Valley Acreage[(c)]	Total Acreage
Public / Semi-Public / Open Space			
Parks / Public Recreation	401	88	489
Public Lands	1,409		1,409
Public / Semi-Public	430	133	563
Subtotal	2,240	221	2,461
Commercial / Industrial			
General Commercial	323		323
Retail / Office	38	13	51
Retail / Office and Automotive	39		39
General Commercial / Campus Office	13		13
Campus Office	89		89
Business Park / Industrial	119		119
Business Park / Industrial and Outdoor Storage	57		57
Mixed Use	15	21	37
Mixed Use 2 / Campus Office	11		11
Medium/High-Density Residential and Retail Office	11		11
Subtotal	715	35	750
City of Dublin Residential			
Rural Residential / Agriculture (1 du per 100 Gross Residential Acres)	8		8
Estate Residential (0.01 - 0.8 du/acre)	24		24
Low-Density Single Family (0.5 - 3.8 du/acre)	44		44
Single Family Residential (0.9 - 6.0 du/acre)	1,373		1,373
Medium-Density Residential (6.1 - 14.0 du/acre)	363		363
Medium/High-Density Residential (14.1 - 25.0 du/acre)	119		119
High-Density Residential (>25.1 du/acre)	50		50
Subtotal	1,982		1,982
Dougherty Valley Residential			
Rural Conservation (0.00 - 0.20 du/acre)		913	913
Single Family - Low/Medium-Density (3.0 - 6.0 du/acre)		367	367
Single Family - Medium-Density (6.0 - 14.0 du/acre)		497	497
Multiple Family - High-Density (14.0 - 30.0 du/acre)		59	59
Subtotal		1,836	1,836
Vacant Parcels[(d)]			
Vacant Parcels	1,690	229	1,919
Subtotal	1,690	229	1,919
Total	6,627	2,320	8,947
Percent of Total Vacant	25.5%	9.9%	21.4%

(a) Does not include stream corridor and undeveloped open space acreage.

(b) Developed based on data received from the City of Dublin on 08/26/2014.

(c) Developed based on data received from the City of San Ramon on 08/27/2014.

(d) Does not include Parks RFTA and Dublin Crossing Specific Plan areas as these areas are not currently vacant and are considered redevelopment projects (conversion of current Public Lands).

2.2 POTABLE WATER SYSTEM

2.2.1 Potable Water Supply

The District purchases its potable water supply from the Zone 7 Water Agency (Zone 7) who also serves the City of Pleasanton, City of Livermore, and California Water Services Company (Cal Water). Zone 7 acquires and treats the water supply, then conveys the treated water via transmission lines to the District's service area and other retail customers. Zone 7's conveyance system is illustrated on Figure 2-4.

Zone 7 uses a combination of water supplies and water storage facilities to meet the retailers' water demands, including the District. The combination of water supplies used by Zone 7 includes the following:

- Imported surface water from the State Water Project (SWP);
- Imported surface water transferred from the Byron Bethany Irrigation District (BBID);
- Local surface water runoff captured in Del Valle Reservoir;
- Perennial yield of the Main Basin (allocated to each water retailer based on an Independent Groundwater Pumping Quota; 645 acre-feet per year for the District);
- Local groundwater previously recharged and extracted from the Main Basin;
- Local storage in the Chain-of-Lakes; and
- Non-local groundwater storage in the Semitropic Water Storage District (STWSD).

The availability and reliability of the District's water supplies is evaluated in the District's 2010 Urban Water Management Plan (UWMP), which will next be updated in early 2016.

2.2.2 Potable Water Facilities

The District's potable water distribution system facilities are shown on Figure 2-5 and are color-coded to indicate the District's pressure zones. Figure 2-6 shows the District's potable water facilities based on their hydraulic grade line (HGL). The District's existing water system facilities are discussed in more detail below. The evaluation of facility capacities and their ability to meet existing and future water demands is described in *Chapter 5 Existing Potable Water System Evaluation* and *Chapter 6 Future Potable Water System Evaluation*, respectively.

2.2.2.1 Potable Water Turnouts

Water purchased by the District from Zone 7 is delivered through five water supply turnout facilities. The turnouts are described as follows:

- Turnout 1:
  - Constructed in 1976
  - Located at the intersection of Dougherty Road and the abandoned Southern Pacific Railroad right-of-way
- Turnout 2:
  - Constructed in 1985
  - Located at the intersection of Amador Valley Boulevard and Stagecoach Road
- Turnout 3:
  - Operated by the District since 1995
  - Located near Evans Boulevard, between 2nd and 3rd Streets, in Parks RFTA
  - Planned to be removed in the future as development in its vicinity occurs
- Turnout 4:
  - Constructed in 1999
  - Located at Arnold Road and Altamirano Avenue
- Turnout 5:
  - Completed in late 2005
  - Located west of Livermore Outlets Drive in the parking lot near Interstate 580

All of the turnouts have Zone 7-owned and DSRSD-owned flow meters that record water purchases by the District. Turnouts 1, 2, 4 and 5 are operated continuously under normal conditions (Turnout 3 is only operated for emergency conditions or low pressure in Pressure Zone 1). Turnouts 1, 2 and 4 have fluoridation facilities co-located at the turnout site. Turnout 5 does not have fluoridation facilities at the turnout site; instead, water from Turnout 5 is conveyed by the District to Pump Station 20B, where there is a fluoridation facility.

Table 2-3 summarizes the District's existing turnout facilities. As shown, the District's current total turnout capacity is 31.68 million gallons per day (mgd). Locations of the turnouts are shown on Figures 2-4 and 2-5.

Table 2-3. Potable Water Supply Turnouts

Turnout	Operation Status	Pressure Zone	Elevation, feet msl	Average Hydraulic Grade Line, feet[a]	Maximum Design Capacity	
					gpm	mgd
1	Normal Condition	1	340	529	5,000	7.20
2	Normal Condition	1	339	493	5,500	7.92
3[b]	Emergency Condition	1	340	479	500	0.72
4	Normal Condition	1	340	552	5,000	7.20
5	Normal Condition	1	368	543	6,000[c]	8.64
				Total	22,000	31.68

(a) Average hydraulic grade line for each turnout is based on pressure setting at each Pressure Reducing Station.
(b) Turnout 3 only operates during low pressure in Pressure Zone 1 and is planned to be removed in the future as development in its vicinity occurs.
(c) The actual capacity of Turnout 5 ranges between 5,200 to 5,300 gpm.
msl = mean sea level

2.2.2.2 Emergency Water Supply Interties

The District has emergency supply agreements in place with its neighboring water purveyors (East Bay Municipal Utilities District (EBMUD), the City of Pleasanton and the City of Livermore) that allow water to enter, or be transferred from, its water system in the event of a major system failure. The District currently has two emergency supply connection points with the City of Pleasanton, one emergency supply connection point with the City of Livermore, and three emergency supply connection points with EBMUD. The locations of the interties are shown on Figure 2-5. The interties are described as follows:

- City of Pleasanton Interties:
  - Two Locations:
    - Eastern Dublin Bay Area Rapid Transit (BART) Station; and
    - Eastern property line of the Dublin Sports Grounds.
  - Per the emergency supply contract between DSRSD and City of Pleasanton, the quantity of supply depends on the availability of supply from the supplying agency.
  - The emergency connections are flanged connections located in below-grade vaults. The District maintains the piping required to make the emergency connections if and when needed.
- City of Livermore Intertie:
  - One Location:
    - East of the El Charro Road exit off of Interstate I-580.
  - Per the emergency supply contract between DSRSD and City of Livermore, the quantity of supply depends on the availability of supply from the supplying agency.
  - During an emergency condition, adjacent pipe stub-outs to each purveyor are connected to interim, above-grade piping and pumps for transferring water.

- EBMUD Interties:
  - Three Locations:
    - Intersections of Davona Drive and Alcosta Boulevard in Dublin;
    - Intersection of Southwick Way and Alcosta Boulevard in Dublin; and
    - At Dougherty Road, south of Red Willow Road.
  - Per the emergency supply contract between DSRSD and EBMUD, the maximum quantity is 2,500 gpm (3.6 mgd).
  - During an emergency condition, adjacent pipe stub-outs to each purveyor are connected to interim, above-grade piping and pumps for transferring water.

2.2.2.3 Potable Water Pressure Zones

There are eight main pressure zones within the District's potable water distribution system. Water purchased from Zone 7, the District's sole potable water supplier, enters the District's water distribution system through Zone 7 turnouts into the District's Pressure Zone 1 which is located in Central Dublin, and is then distributed into the District's other pressure zones. The locations of the District's eight pressure zones are shown on Figure 2-7, and a summary of these pressure zones with their key characteristics is provided in Table 2-4.

Table 2-4. Potable Water Pressure Zones

Pressure Zone	Range of Service Elevations, feet msl[a]	HGL of Reservoir[b], feet msl	Water Supply Source(s)
1	0 – 390	520.5	Zone 7 Turnouts
2	390 – 520	644.7	Pressure Zone 1
3	520 – 740	838.5	Pressure Zone 2
4	740 – 1,000	1,130.0	Pressure Zone 3
20	390 – 622	695.0	Pressure Zone 1
30	580 – 798	886.4	Pressure Zone 20
200	390 – 607	694.3	Pressure Zone 1
300	580 – 777	880.0[c]	Pressure Zones 20 and 200

(a) Based on elevations assigned in the hydraulic model.
(b) Assumed as the overflow elevation of each reservoir.
(c) Based on Reservoir 300A overflow elevation.

2.2.2.4 Potable Water Storage Reservoirs

The District currently operates fourteen potable water storage reservoirs as shown on Figure 2-5. The District has a total storage capacity of approximately 27.1 million gallons (MG). The storage reservoirs provide storage capacity for the District to meet diurnal demand fluctuations, supply demands during emergency and power outage conditions, and fire flow requirements. A summary of the existing reservoirs with their key characteristics is provided in Table 2-5.

2.2.2.5 Potable Water Pump Stations

The District currently operates seventeen potable water pump stations shown on Figure 2-5. The pump stations transfer water from the District's Zone 7 turnouts to the District's various pressure zones and storage reservoirs. The District operates the pump stations based on the water levels in the storage reservoirs to which they pump. A summary of the existing pump stations with their key characteristics is provided in Table 2-6.

Table 2-5. Potable Water Storage Facilities[a]

Storage Facility ID	Pressure Zone	Construction Year	Reservoir Type	Bottom Elevation, feet msl	Diameter, feet	Height [b], feet	Capacity, MG	
							Total	Operational Maximum[c]
Res 1A	1	1960	Welded Steel	491.5	110	29.0	2.00	2.00
Res 1B[d]	1	1983	Welded Steel	491.5	150	31.0	2.35	2.35
Res 2A	2		Welded Steel	615.5	65	29.2	0.72	0.72
Res 3A	3	1985	Welded Steel	816	70	22.5	0.65	0.65
Res 3B	3	1996	Welded Steel	815.5	50	23.0	0.34	0.34
Res 4A	4	2006	Welded Steel	1101	64	29.0	0.70	0.70
Res 10A	10	1940s	Buried Concrete - Trapezoidal	525	-	13.0	3.00	3.00
Res 10B	10	2001	Buried Concrete	496.5	145	24.0	3.00	3.00
Res 20A	20	2001	Welded Steel	670	150	25.0	3.30	3.30
Res 30A	30	2001	Welded Steel	860	85	26.4	1.12	1.12
Res 200A	200	2000	Welded Steel	670.3	135	24.0	2.60	2.60
Res 200B	200		Concrete	670.3	93	24.0	1.20	1.20
Res 300A	300	2002	Welded Steel	855.5	130	24.5	2.30	2.30
Res 300B	300	2003	Concrete	857	120	22.5	1.70	1.70
						Total Capacity	24.98	24.98

(a) Source file: Potable Daily Report-2014-05-28 050150.xls and Rebuilt-DSRSD_HydraulicModel_V9_5_Draft.mxd.
(b) Height measured to reservoir overflow.
(c) Maximum reservoir capacities was calculated from overflow levels.
(d) Reservoir 1B is also known as Dougherty Reservoir and is a shared facility between Zone 7 and DSRSD. 1.175 MG of working storage is owned by DSRSD and 1.175 MG of working storage is leased by DSRSD from Zone 7 through 4/18/2033 per Supplemental Zone 7/DSRSD Agreement dated 2/20/1990. The remaining 1.35 MG is reserved for emergency storage that is available to either Zone 7 or DSRSD.

Table 2-6. Potable Water Pump Stations[(a)]									
Pump Station ID	Source Pressure Zone	Service Pressure Zone	Ground Surface Elevation[(b)], msl	Type of Pump	Pump No.	Horsepower	Nominal Pump Capacity, gpm	Nominal Pump Capacity, mgd	Rated Total Dynamic Head, feet
1A	1	1	350	Vertical Turbine	1	20	1200	1.73	46.00
					2	20	1200	1.73	46.00
					3	20	1200	1.73	46.00
2A	1	2	407	In-line Centrifugal	1	20	300	0.43	160.00
					2	20	300	0.43	160.00
2B	1	2	402	In-line Centrifugal	1	20	300	0.43	160.00
					2	20	300	0.43	160.00
2C	1	2	390	Horizontal Split Case	1	30	500	0.72	180.00
					2	30	500	0.72	180.00
					3	30	500	0.72	180.00
3A	2	3	502	Vertical Turbine	1	20	200	0.29	250.00
					2	20	200	0.29	250.00
					3	20	200	0.29	250.00
3B	2	3	535	Horizontal End Suction	1	20	125	0.18	235.00
					2	20	125	0.18	235.00
					3	20	125	0.18	235.00
3C	3	3	618	In-line Centrifugal	1	40	300	0.43	240.00
					2	40	300	0.43	240.00
					3	40	300	0.43	240.00
4A	3	4	772	Vertical Turbine	1	50	400	0.58	310.00
					2	50	400	0.58	310.00
					3	50	400	0.58	310.00
4B	3	4	815	Vertical Turbine	1	40	200	0.29	300.00
					2	40	200	0.29	300.00
10A	1	10	431.5	Horizontal Split Case	1	15	1050	1.51	40.00
					2	15	1050	1.51	40.00
					3	15	1050	1.51	40.00
20A	1	20	396	Vertical Turbine	1	75	750	1.08	216.00
					2	75	750	1.08	216.00
					3	75	750	1.08	216.00
20B	1	20	376	Horizontal Split Case	1	75	1083	1.56	185.00
					2	75	1083	1.56	185.00
					3	75	1083	1.56	185.00
					4	75	1083	1.56	185.00
30A	20	30	556	Horizontal Split Case	1	40	400	0.58	230.00
					2	40	400	0.58	230.00
					3	40	400	0.58	230.00
200A	1	200	407	Horizontal Split Case	1	100	930	1.34	235.00
					2	100	930	1.34	235.00
					3	100	930	1.34	235.00
					4	100	930	1.34	235.00
300A	200	300	510	Horizontal Split Case	1	75	868	1.25	208.00
					2	75	868	1.25	208.00
					3	75	868	1.25	208.00
300B	20	300	530	Vertical Turbine	1	100	1250	1.80	235.00
					2	100	1250	1.80	235.00
					3	100	1250	1.80	235.00
300C	200	300	543.8	Horizontal Split Case	1	75	650	0.94	220.00
					2	75	650	0.94	220.00
					3	75	650	0.94	220.00

[(a)] Source file: Development of Operational Model Technical Memorandum No. 1 Report and Rebuilt-DSRSD_HydraulicModel_V9_5_Draft.mxd.
[(b)] Elevation was obtained from Rebuilt-DSRSD_HydraulicModel_V9_5_Draft.mxd.

2.2.2.6 Potable Water Distribution Pipelines

There are approximately 302 miles of distribution pipelines in the District's potable water system that range in size from 4-inch to 20-inch in diameter. Approximately 74 percent of the potable water pipelines consist of polyvinyl chloride (PVC) pipe, and a majority of the pipelines are 8-inch in diameter.

2.3 RECYCLED WATER SYSTEM

2.3.1 Recycled Water Supply

Starting in 1995, DSRSD and EBMUD began working on the San Ramon Valley Recycled Water Project (SRVRWP), a joint project operated through the DSRSD-EBMUD Recycled Water Authority (DERWA) to provide recycled water service to landscape irrigation customers in the San Ramon Valley and adjacent areas. The SRVRWP was specifically developed to provide recycled water that met Title 22 disinfected tertiary recycled water requirements to landscape irrigation customers of EBMUD and DSRSD, including the City of San Ramon, City of Dublin, Dougherty Valley, Town of Danville, and Town of Blackhawk areas of Alameda and Contra Costa Counties. The recycled water deliveries began in early 2006 after the completion of the first phase of the program. The DERWA recycled water system has three components owned by three different agencies:

- DERWA owns the Pump Stations R1 (at the DSRSD Wastewater Treatment Plant), R200B, and R200A, as well as Reservoirs R100 and R200;
- EBMUD owns and operates the recycled water distribution pipeline system contained within its service area, and will have two pump stations and a reservoir (future facilities); and
- DSRSD owns and operates the recycled water treatment facilities at its Wastewater Treatment Plant that treat wastewater from Dublin, South San Ramon and Pleasanton, and the recycled water distribution pipeline system within its service area, along with three pump stations (R300A, R300B, and R20) and two reservoirs (R20 and R300).

In addition, the City of Pleasanton began using recycled water from the recycled water treatment facilities in 2014, and will be expanding its use in the future. The City of Pleasanton ties into the DERWA system near the corner of the DSRSD Dedicated Land Disposal (DLD) site adjacent to Stoneridge Drive near the wastewater treatment plant (WWTP).

2.3.2 Recycled Water Facilities

Figure 2-8 provides an overall schematic diagram of the DERWA recycled water system showing the existing and future recycled water system facilities in the District's service area and the EBMUD service area. The key existing water system facilities are discussed in more detail below. The evaluation of facility capacities and their ability to meet existing and future water demands is described in Carollo Engineers' November 2015 Report titled "DERWA Model Update and System Evaluation", a copy of which is included in Appendix F.

2.3.2.1 Recycled Water Pressure Zones

There are four pressure zones in the District's recycled water distribution system, and they are presented on Figure 2-8. These pressure zones include Pressure Zones R1, R20, R200 and R300. Pressure Zones R1 and R20 serve the Parks RFTA, Central Dublin, and Eastern Dublin sub areas, while Pressure Zones R200 and R300 serve the Dougherty Valley sub area.

Pressure Zone R300 contains two separate service areas in Dougherty Valley. The southeastern portion of Pressure Zone R300 is served by Pump Station R300A and Reservoir R300A, and the northwestern portion of Pressure Zone R300 is served by Pump Station R300B.

Pressure Zones R1 and R200 also serve the southern and central portions of the City of San Ramon, located within EBMUD's service area. Table 2-7 provides a summary of these pressure zones with their key characteristics.

Table 2-7. Recycled Water Pressure Zones

Pressure Zone	Range of Service Elevations, feet msl[a]	HGL of Reservoir[b] or Pump Station, feet msl	Water Supply Source(s)
R1	320 – 507	632.5	Recycled Water Treatment Facility at DSRSD WWTP
R20	450 – 660	790.5	Pressure Zone R1
R200	442 – 634	734.5	Pressure Zone R1
R300 (R300A) R300 (R300B)[c]	514 – 736 600 – 814	806.3 974.0	Pressure Zone R200

[a] Based on elevations assigned in the hydraulic model.
[b] Assumed as the overflow elevation of each reservoir.
[c] HGL for Pressure Zone R300B is based on Pump Station R300B. This pressure zone is served directly from Pump Station R300B.

2.3.2.2 Recycled Water Storage Reservoirs

The DERWA recycled water distribution system includes four recycled water storage tanks. These four tanks are R100, R20, R200, and R300. The DERWA recycled water distribution system has a total recycled water storage capacity of approximately 10.9 MG. Tanks R20 and R300 are used exclusively by DSRSD. The locations of the four recycled water storage tanks are illustrated on Figure 2-8, while Figure 2-9 presents an HGL of the system, including the recycled water storage tanks. Table 2-8 presents summary of the existing recycled water storage tanks with their key characteristics.

Table 2-8. Recycled Water Storage Facilities[a]

Storage Facility ID	Pressure Zone	Construction Year	Reservoir Type	Bottom Elevation, feet msl	Diameter, feet	Height [b], feet	Capacity, MG	
							Total	Operational Maximum[c]
Res R100	R1	2005	Concrete	598	150	34.5	4.5	4.5
Res R20 [d]	R20	2003	Concrete	760	91	30.5	1.5	1.5
Res R200	R200	2005	Below ground reinforced concrete	700	150	34.5	4.5	4.5
Res R300 [d]	R300	2000	Steel	790	69	16.25	0.45	0.45
						Total Capacity	10.95	10.95

[a] Source: DERWA Recycled Water Model and Operations Plan Update - Phase 2 Technical Memorandum No. 2 - Hydraulic Model Documentation and Calibration, Final, September 2010.
[b] Height measured to reservoir overflow.
[c] Maximum reservoir capacities as calculated from overflow levels.
[d] Tanks R20 and R300 are used exclusively by DSRSD.

2.3.2.3 Recycled Water Pump Stations

There are six recycled water pump stations that serve the DERWA recycled water service area. These six pump stations are Pump Stations R1, R20, R200A, R200B, R300A, and R300B which are presented in Table 2-9 with their key characteristics. Pump Stations R20, R300A and R300B are used exclusively by DSRSD. The locations of the six recycled water pump stations are illustrated on Figure 2-8. Figure 2-9 presents a HGL of the system, including the pump stations.

Table 2-9. Recycled Water Pump Stations[a]

Pump Station ID	Source Pressure Zone	Service Pressure Zone	Ground Surface Elevation, msl	Pump No.	Horsepower	Design Flow, gpm	Design Flow, mgd	Design Head, feet
R1	WWTP	R1	331.5	1	450	3,370	4.85	350
				2	450	3,370	4.85	350
				3	450	3,370	4.85	350
R20[b]	R1	R20	480	1	125	1,200	1.73	225
				2	125	1,200	1.73	225
				3	125	1,200	1.73	225
R200A	R1	R200	430	1	100	1,300	1.87	180
				2	100	1,300	1.87	180
				3	100	1,300	1.87	180
R200B	R1	R200	460	1	125	2,000	2.88	180
				2	125	2,000	2.88	180
				3	125	2,000	2.88	180
R300A [b]	R200	R300A	520	1	40	625	0.90	132
				2	40	625	0.90	132
R300B [b]	R200	R300B	660	1	2	26	0.04	173
				2	2	26	0.04	173
				3	30	365	0.53	181
				4	30	365	0.53	181
				5	30	365	0.53	181

(a) Source: DERWA Recycled Water Model and Operations Plan Update - Phase 2 Technical Memorandum No. 2 - Hydraulic Model Documentation and Calibration, Final, September 2010.
(b) Pump stations R20, R300A and R300B are used exclusively by DSRSD.

2.3.2.4 Recycled Water Distribution Pipelines

The total length of pipelines in the recycled water system is approximately 67.2 miles, having diameters ranging from 1 to 36 inches in diameter. Out of this total length, 16.8 miles (24.9 percent) of the recycled water pipelines are considered part of the DERWA backbone. 2.8 miles (4.2 percent) are exclusively EBMUD facilities, and the remaining 47.6 miles (70.8 percent) are exclusively District facilities. Roughly two-thirds of the recycled water pipelines consist of PVC pipeline, and a majority of the recycled pipelines are 8-inches in diameter. Figure 2-8 illustrates the layout of the District’s recycled water distribution pipeline system.

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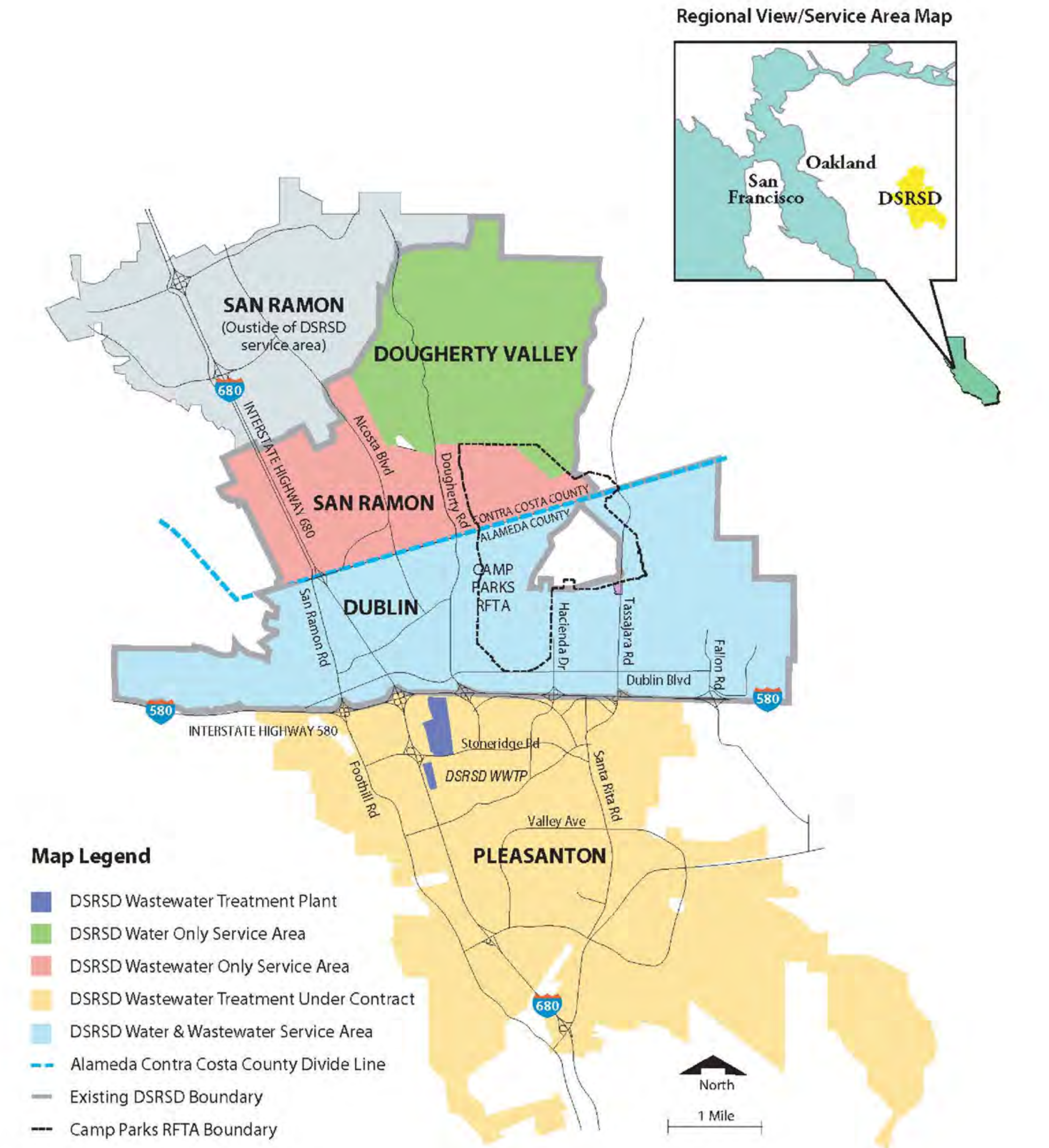

FIGURE 2-1

Dublin San Ramon Services District Water System Master Plan

DSRSD SERVICE AREA

Notes
1. Source: DSRSD website November 2015.

LEGEND

WEST YOST ASSOCIATES
Consulting Engineers

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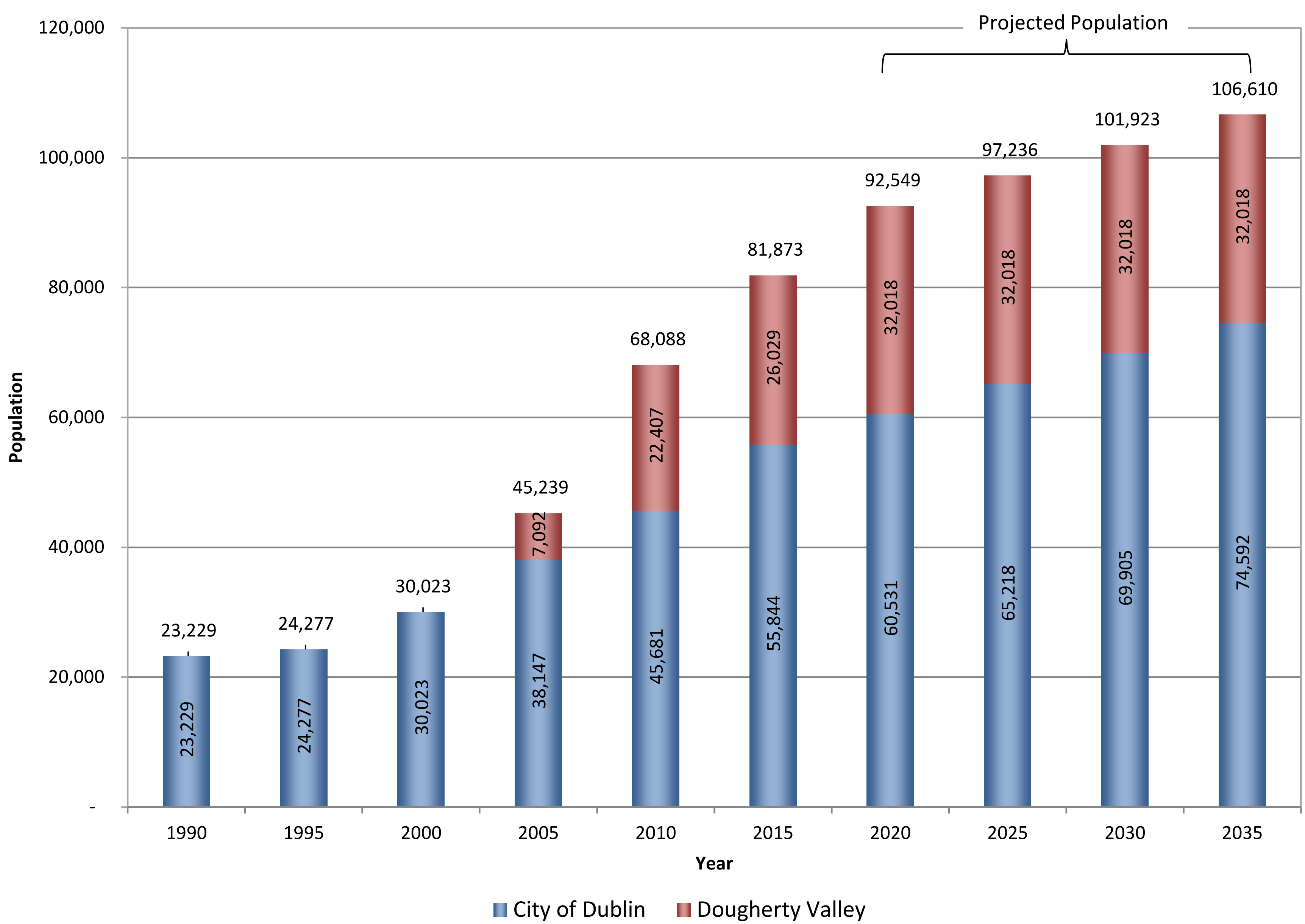
Figure 2-2. Historical and Projected Water Service Area Population



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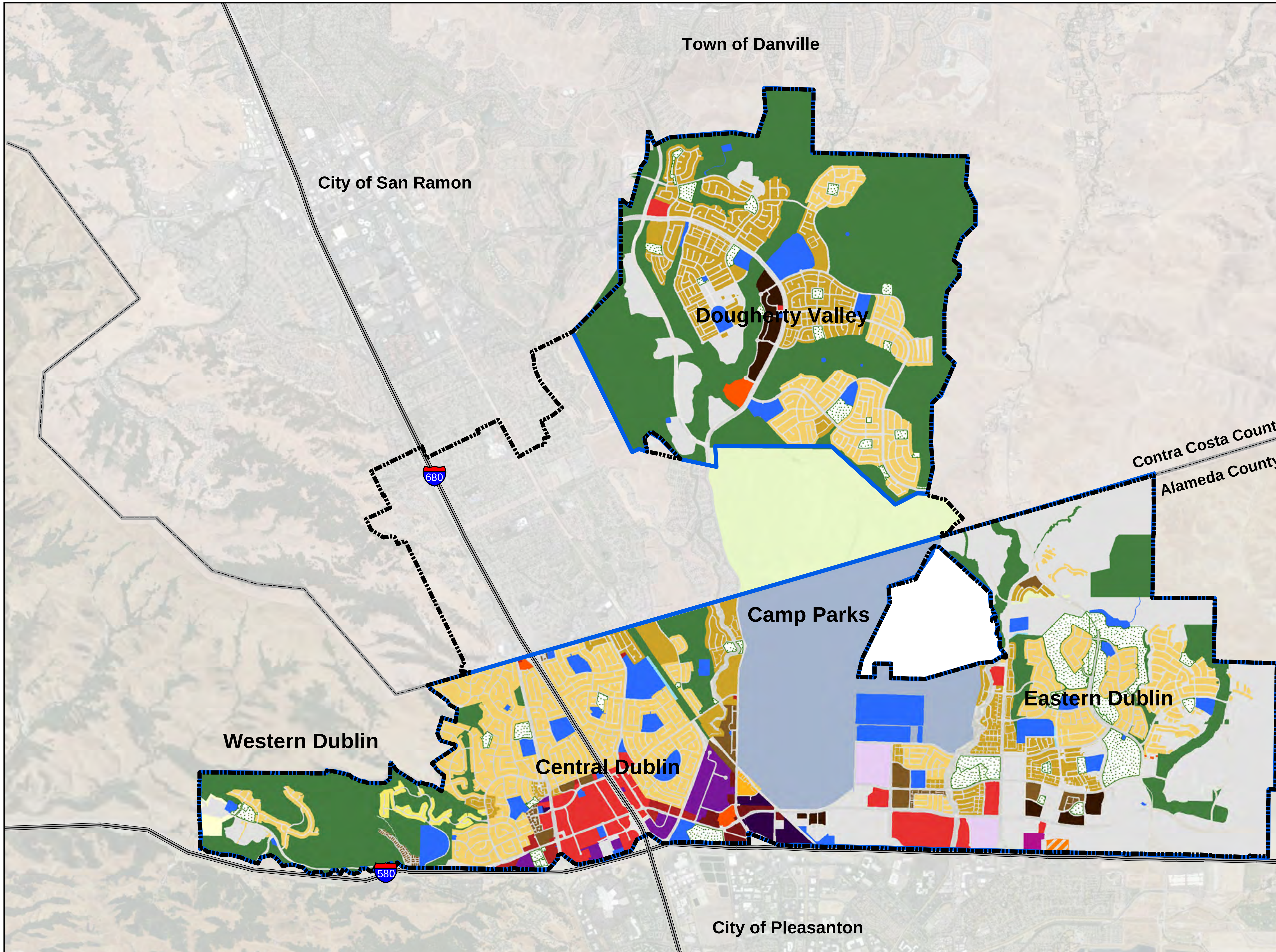

FIGURE 2-3

Dublin San Ramon Services District Water System Master Plan

EXISTING LAND USE

N

0 2,000 4,000

Scale in Feet

Note:
1. Buildout land use designations for vacant parcels are shown on Figure 3-4.

LEGEND

Vacant
- Vacant Parcel

Public/Semi-Public/Open Space
- Parks / Public Recreation
- Open Space
- Stream Corridor
- Public Lands
- Public / Semi-Public

Commercial / Industrial
- General Commercial
- Retail / Office
- Retail / Office and Automotive
- General Commercial / Campus Office
- Campus Office
- Business Park / Industrial
- Business Park / Industrial and Outdoor Storage
- Mixed Use
- Mixed Use 2 / Campus Office
- Medium/High-Density Residential and Retail Office

City of Dublin Residential
- Rural Residential / Agriculture (1 du per 100 Acres)
- Estate Residential (0.01 - 0.8 du/acre)
- Low-Density Single Family (0.5 - 3.8 du/acre)
- Single Family Residential (0.9 - 6.0 du/acre)
- Medium-Density Residential (6.1 - 14.0 du/acre)
- Medium/High-Density Residential (14.1 - 25.0 du/acre)
- High-Density Residential (>25.1 du/acre)

Dougherty Valley Residential
- Rural Conservation Area (0.00-0.20 du/acre)
- Single Family - Low/Medium-Density (3.0 - 6.0 du/acre)
- Single Family - Medium-Density (6.0 - 14.0 du/acre)
- Multiple Family - High-Density (14.0 - 30.0 du/acre)

- Water Service Area
- DSRSD Service Boundary
- Interstate Highway
- County Line

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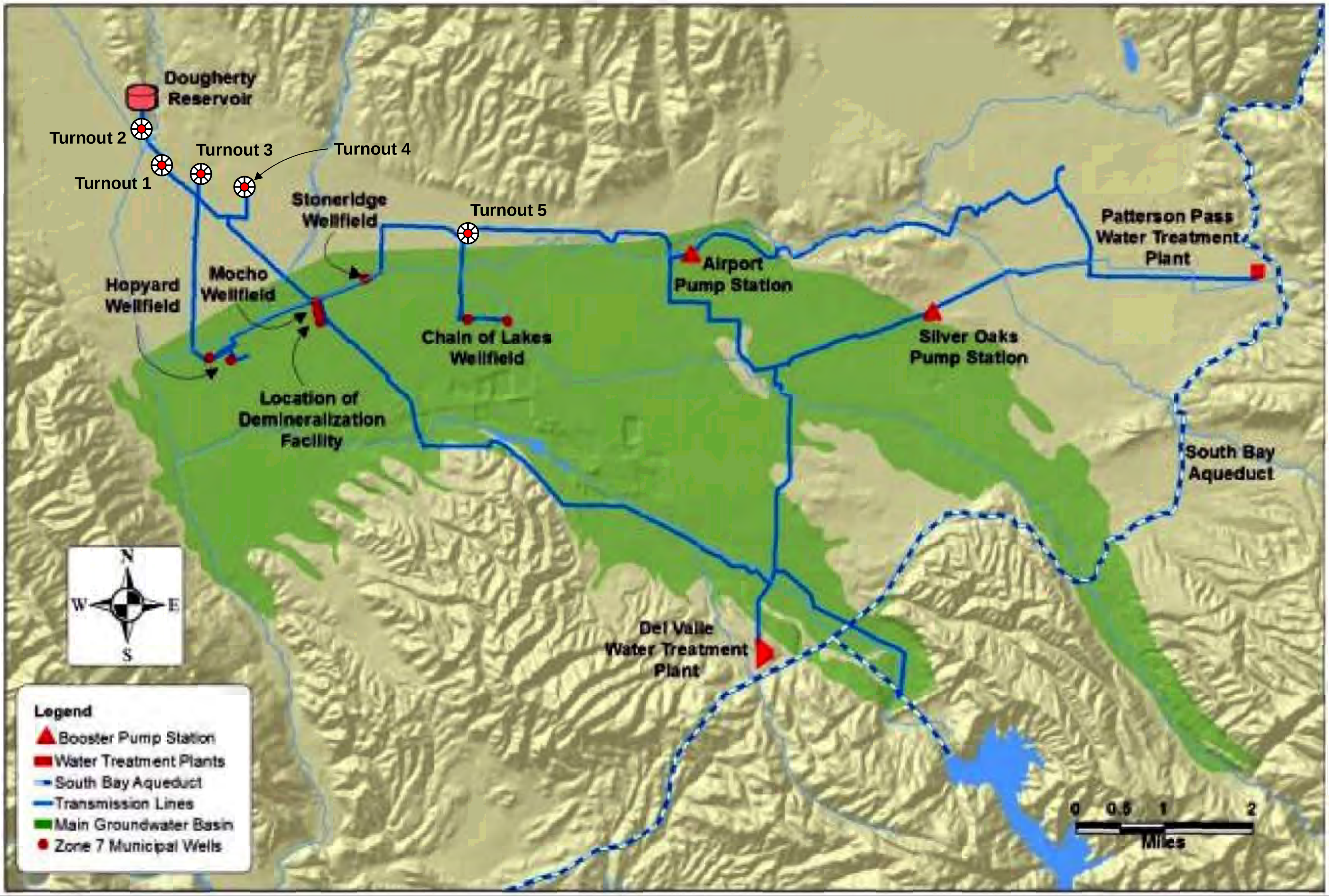

Notes
1. Source: http://www.zone7water.com/images/pdf_docs/water_supply/2010_uwmp-complete.pdf. Figure 2-4, 2010 Urban Water Management Plant, December 2010.

LEGEND

Zone 7 Turnout to Serve DSRSD

FIGURE 2-4

Dublin San Ramon Services District
Water System Master Plan

ZONE 7 SYSTEM

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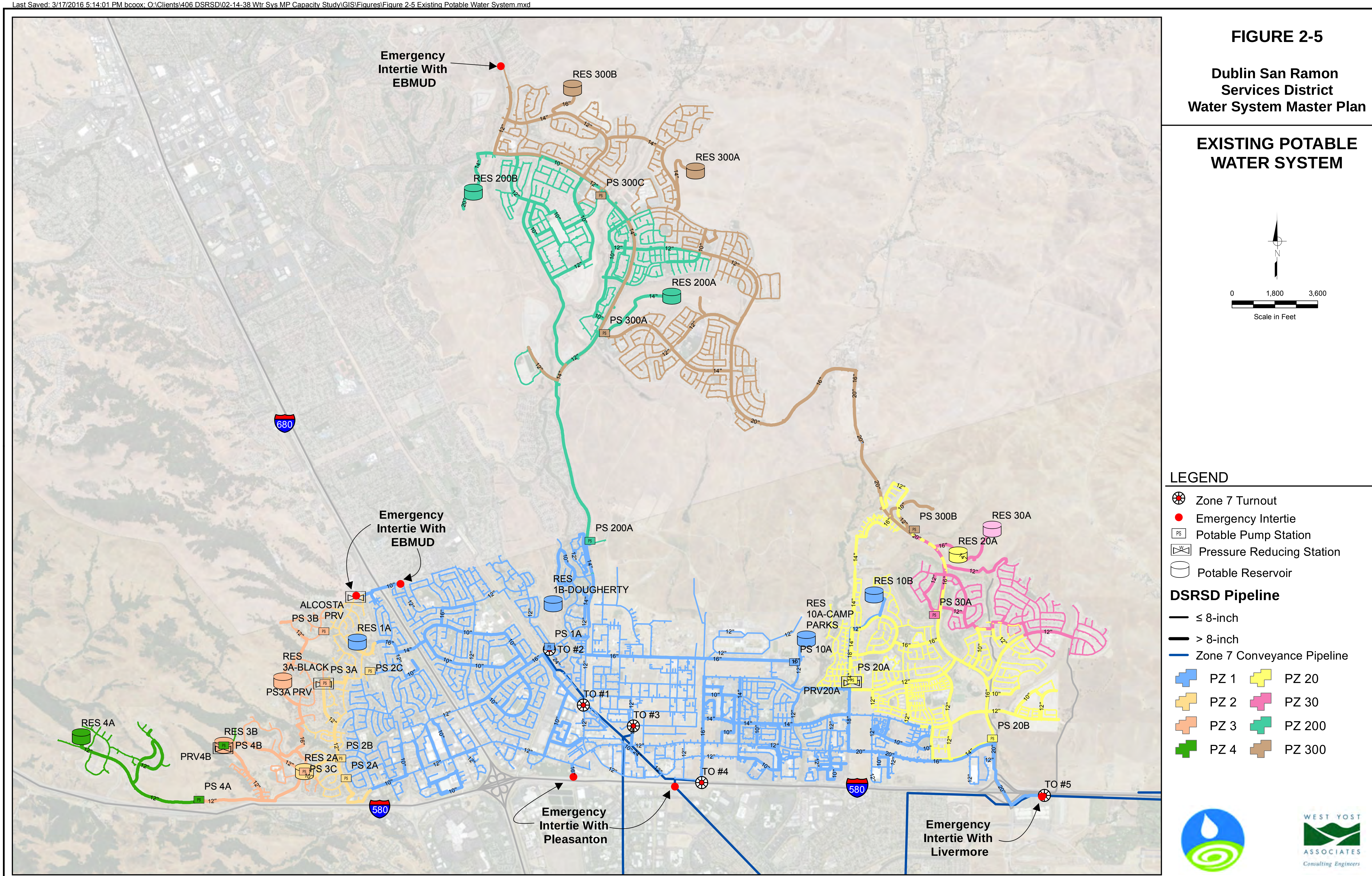
Last Saved: 3/17/2016 5:14:01 PM bcoox; O:\Clients\406 DSRSD\02-14-38 Wtr Sys MP Capacity Study\GIS\Figures\Figure 2-5 Existing Potable Water System.mxd



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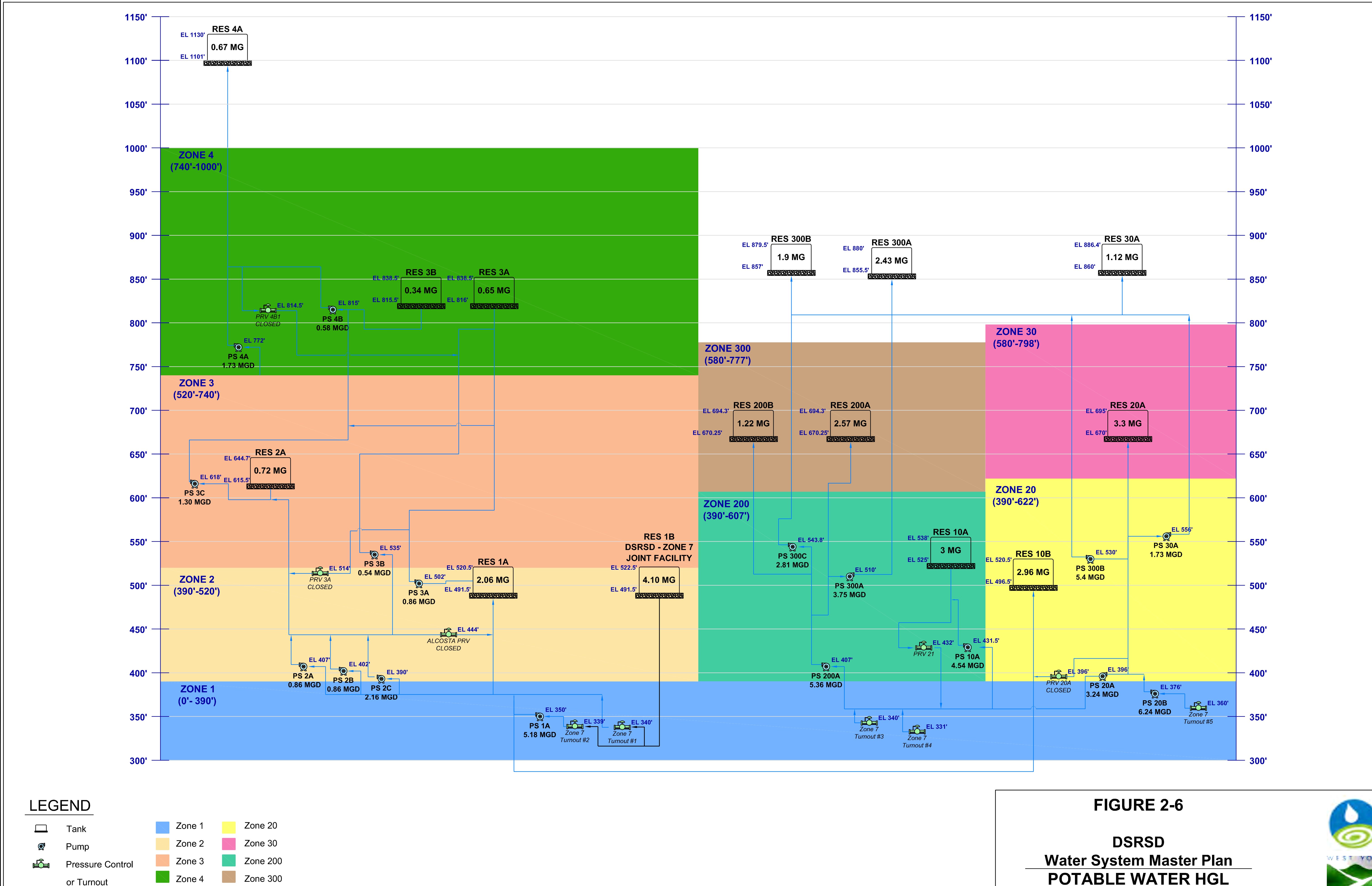

FIGURE 2-6

DSRSD
Water System Master Plan
POTABLE WATER HGL

WEST YOST ASSOCIATES

O:\Clients\406 DSRSD\02-14-38 Wtr Sys MP Capacity Study\CAD\Figures\Figure 2-6 Potable HGL.dwg 9-02-15 06:30:44 PM isuroso

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Last Saved: 3/17/2016 5:17:01 PM bcoox; O:\Clients\406 DSRSD\02-14-38 Wtr Sys MP Capacity Study\GIS\Figures\Figure 2-7 Potable Water Pressure Zones.mxd

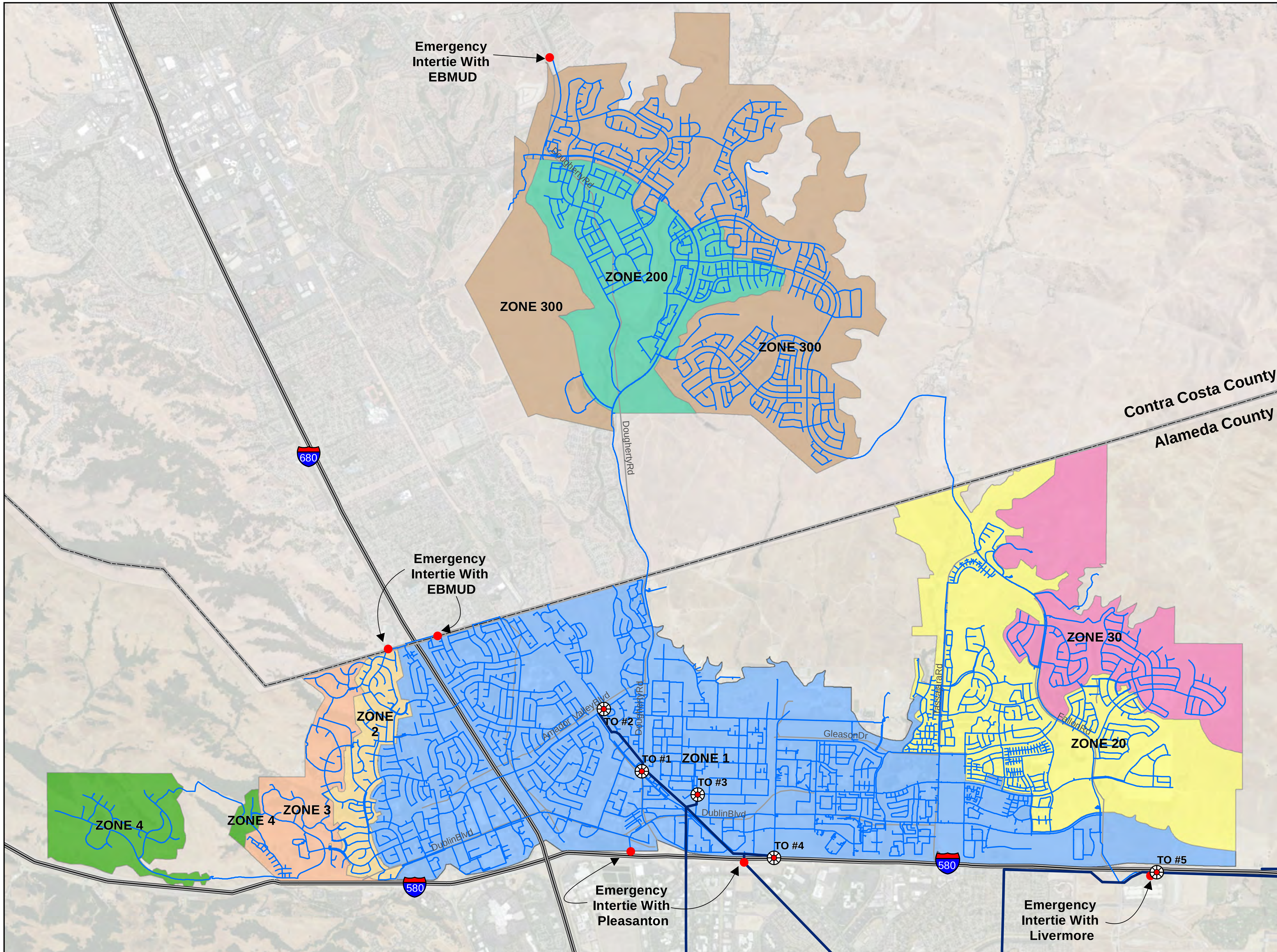

FIGURE 2-7

Dublin San Ramon Services District Water System Master Plan

POTABLE WATER PRESSURE ZONES

0 1,800 3,600
Scale in Feet

LEGEND

- Zone 7 Turnout
- Emergency Intertie
- Zone 7 Conveyance Pipeline
- Potable Distribution Pipeline
- Zone 1
- Zone 2
- Zone 3
- Zone 4
- Zone 20
- Zone 30
- Zone 200
- Zone 300

WEST YOST ASSOCIATES
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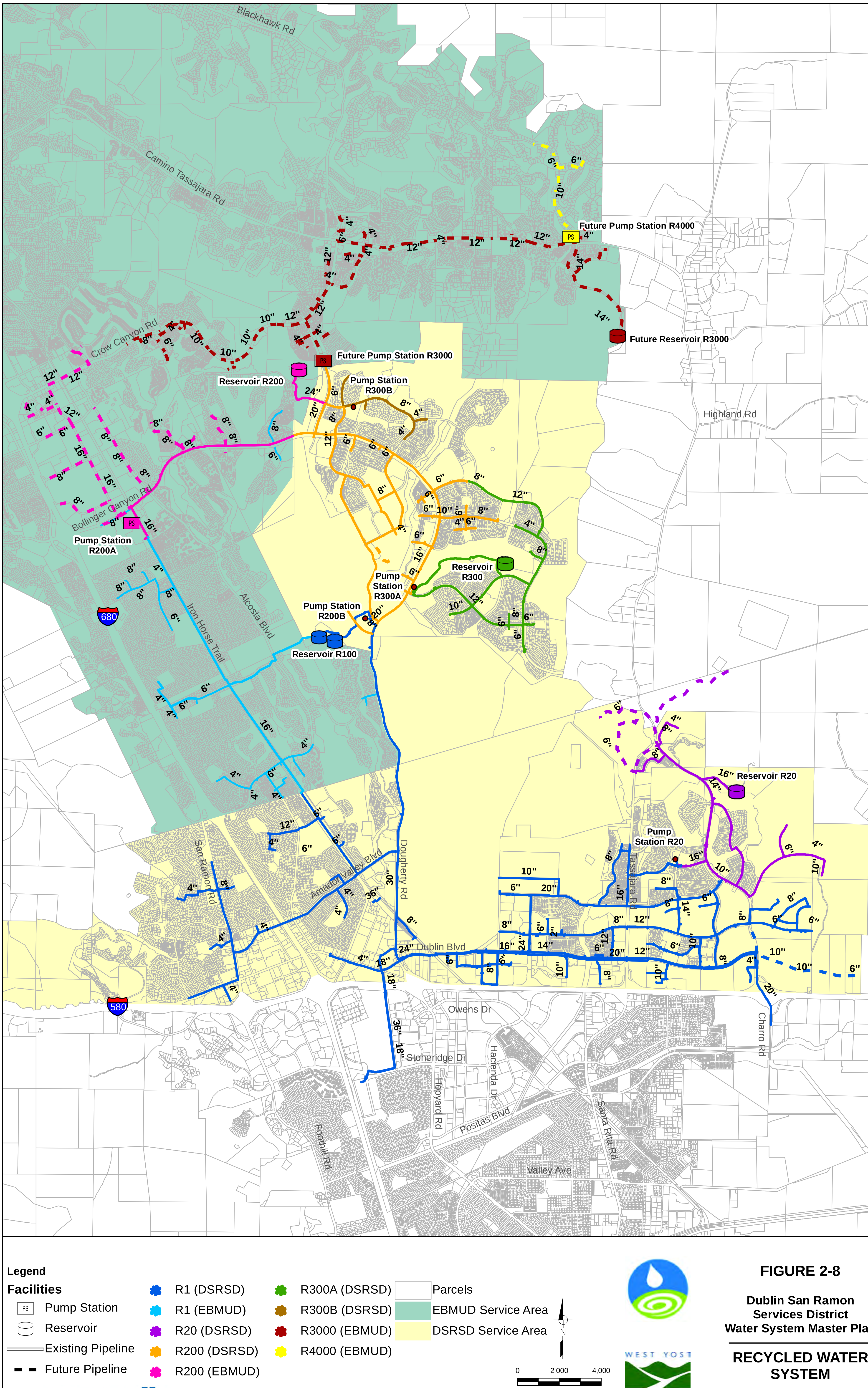

FIGURE 2-8

Dublin San Ramon Services District Water System Master Plan

RECYCLED WATER SYSTEM

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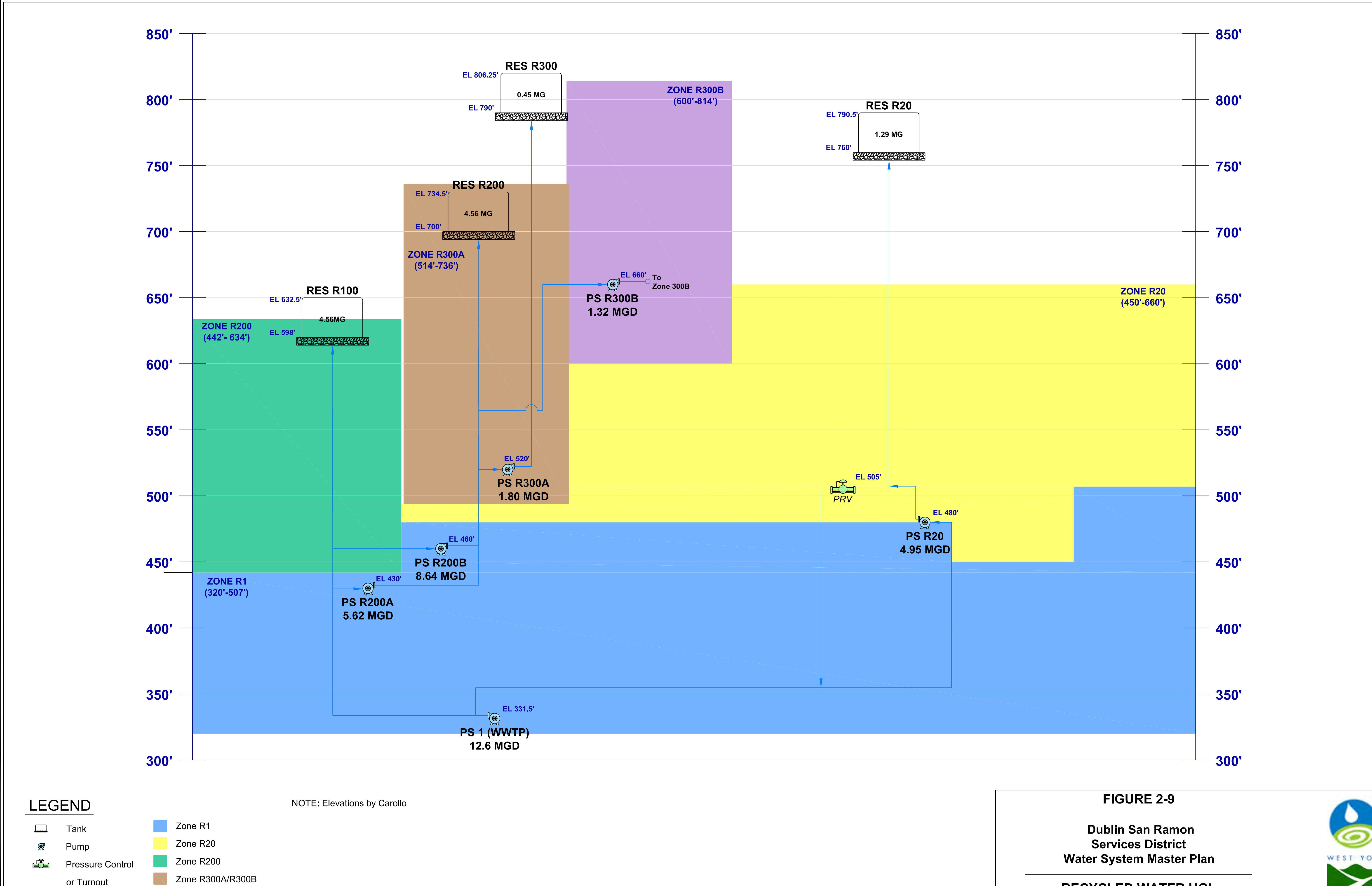

FIGURE 2-9

Dublin San Ramon
Services District
Water System Master Plan

RECYCLED WATER HGL

WEST YOST ASSOCIATES

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CHAPTER 3: EXISTING & PROJECTED WATER DEMANDS

Chapter Contents:

Chapter Purpose

The purpose of this chapter is to present the current and projected water demands within the District's water service area.

Chapter Highlights

Potable and recycled water demands have been projected for the District's water service area based on planned projected new development within the City of Dublin and Dougherty Valley area of the City of San Ramon. Unit water use factors and peaking factors were reviewed and refined based on historical water consumption data and recent water conservation trends and were used to develop future demand projections.

This chapter focuses primarily on the District's potable water demands. A separate analysis of recycled water demands, which included an evaluation of the overall DERWA system, was conducted by Carollo Engineers; a copy of Carollo's report is included in Appendix F.

Key Tables in this Chapter

- Table 3-8. Adopted Peaking Factors for the Potable Water System (see page 3-10)
- Table 3-16. Recommended Unit Water Demand Factors for the Potable Water System (see page 3-20)
- Table 3-18. Summary of Recent and Planned Potable Water Service Conversions to Recycled Water (see page 3-22)
- Table 3-21. Summary of Recommended Potable Water Demand Projection (see page 3-24)
- Table 3-24. Adopted Peaking Factors for the Recycled Water System (see page 3-27)
- Table 3-26. Summary of Recycled Water Demand Projections in DSRSD's Water Service Area (see page 3-28)

Demand Condition	Potable Water Demand		Recycled Water Demand	
	2020	Buildout	2020	Buildout
Annual	13,690 af	15,840 af	3,904 af	4,033 af
Average Day	12.2 mgd	14.1 mgd	3.5 mgd	3.8 mgd
Max Day	24.4 mgd	28.2 mgd	8.7 mgd	9.4 mgd
Peak Hour	29.3 mgd	33.8 mgd	26.3 mgd	28.3 mgd

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CHAPTER 3
Existing and Projected Water Demands

The purpose of this chapter is to present the current and projected water demands within the District's water service area. Accurate and detailed water demand estimates are required to develop and calibrate the potable and recycled water system hydraulic models, help identify deficiencies in the existing potable and recycled water systems, and assist in the assessment of future system capacities to identify future CIPs. The following sections of this chapter describe the data and methodology utilized to determine the District's water demands for the potable and recycled water systems.

3.1 POTABLE WATER DEMANDS

3.1.1 Historical Potable Water Use

3.1.1.1 Potable Water Purchased

Annual water purchased from Zone 7 for the District's water service area between 2005 and 2015 is presented in Table 3-1. As shown in Table 3-1, the total potable water purchased has increased from 9,626 acre-feet (af) in 2005 to 11,244 af in 2013, representing a 17 percent increase in water purchased from Zone 7 over the last nine years.[1] However, it should be noted that water purchased from Zone 7 decreased in 2008 through 2011 and then increased in 2012 and 2013, with 2013 water use back above the 2007 level. This more recent, lower, water use (including data for 2014 and 2015) is not representative of normal water use characteristics for the District as it has been significantly affected by on-going drought conditions. Table 3-1 also indicates that the average day potable water demand has averaged 8.4 mgd over the last five years.

[1] 2014 and 2015 were not selected for comparison due to the significant drop in water purchased as a result of prolonged drought conditions and water use limitations imposed under DSRSD's Community Drought Declaration in 2014.

Table 3-1. Historical Annual Potable Water Purchased from Zone 7

Year	Million Gallons	Acre-feet	Average Day Demand, mgd
2005	3,137	9,626	8.6
2006	3,202	9,825	8.8
2007	3,547	10,885	9.7
2008	3,505	10,757	9.6
2009	3,154	9,679	8.6
2010	3,018	9,262	8.3
2011	3,117	9,565	8.5
2012	3,345	10,264	9.2
2013	3,664	11,244	10.0
2014	2,786	8,549	7.6
2015	2,433	7,466	6.7
Average Annual Daily Demand (2005-2015)			8.7
Average Annual Daily Demand Over Last Five Years (2011-2015)			8.4

Source: *Standard Water Audit - 12 Dec 2013.xls* and *Standard Water Audit - 12 Dec 2014.xls* received from District.

3.1.1.2 Potable Water Consumption

The District tracks its potable water consumption through customer meter records. Table 3-2 summarizes the District's historical annual potable water consumption by customer type. The predominant water use in the District is by residential customers, which accounts on average for approximately 61 percent of the total annual potable water consumption.

Table 3-2. Historical Annual Metered Potable Water Consumption by Customer Type, MG[a,b]

Customer Type	Year								
	2006	2007	2008	2009	2010	2011	2012	2013	2014
Residential									
Single Family	1,471	1,540	1,619	1,545	1,494	1,515	1,686	1,774	1,475
Multi-Family	117	144	173	183	191	196	207	239	250
Town House	9	10	10	10	11	11	13	12	11
Condominium	62	62	65	65	64	66	70	71	174
Subtotal Residential	1,659	1,756	1,866	1,803	1,760	1,790	1,975	2,096	1,910
Non-Residential									
Commercial	610	760	615	483	459	467	485	487	313
FCI[c]	84	99	101	88	86	81	81	79	77
Alameda County[d]	199	192	214	133	109	107	104	116	120
Irrigation	453	486	537	471	444	449	498	525	303
Subtotal Non-Residential	1,347	1,537	1,467	1,176	1,098	1,104	1,169	1,207	813
Total	3,006	3,293	3,333	2,980	2,859	2,894	3,144	3,303	2,723
Percent Residential	55%	53%	56%	61%	62%	62%	63%	63%	70%
Percent Non-Residential	45%	47%	44%	39%	38%	38%	37%	37%	30%

(a) Data for 2005 was not available.
(b) Source: *2013 consumption SUMMARY (rev 093014).xls* received from District. 2014 data received in March 2015.
(c) Federal Correctional Institution
(d) Santa Rita Jail

3.1.1.2.1 Per Capita Water Use

Historical per capita water use for the District's water service area between 2005 and 2015 is presented in Table 3-3. It should be noted that per capita water use is calculated based on the District's total water purchased and includes both residential and non-residential water use and system losses. As shown in Table 3-3, the District's per capita water use has decreased from 190 gallons per capita per day (gpcd) in 2005 to 134 gpcd in 2013[2]; representing an approximate 30 percent decrease in per capita water use.

Table 3-3. Historical Per Capita Potable Water Use

Year	Population Served			Potable Water Purchased, MG(c)	Per Capita Water Use, gpcd(d)
	City of Dublin(a)	Dougherty Valley(b)	Total		
2005	38,147	7,092	45,239	3,137	190
2006	39,868	13,898	53,766	3,202	163
2007	41,309	16,268	57,577	3,547	169
2008	44,321	18,137	62,458	3,505	153
2009	45,104	19,927	65,031	3,154	133
2010	45,681	22,407	68,088	3,018	121
2011	46,202	23,150	69,352	3,117	123
2012	46,771	23,572	70,343	3,345	130
2013	50,049	25,039	75,088	3,664	134
2014	53,430	25,527	78,957	2,786	97
2015	55,844	26,029	81,873	2,433	81
Average Per Capita Water Use (2005-2015)					136
Average Per Capita Water Use (not including 2014 and 2015)					146

(a) Source: 2005-2010 from California Department of Finance E-4 Population estimates. 2011-2015 from California Department of Finance E-5 Population estimates.
(b) Source: Data received from Contra Costa County and City of San Ramon for number of residential units in Dougherty Valley and from City of San Ramon for average number of people per residential unit (3.32).
(c) Refer to Table 3-1.
(d) Includes both residential and non-residential water use and system losses.

An illustrative comparison of the historical population served, potable water purchased, and per capita water use within the District's water service area is shown on Figure 3-1. The District's annual population served, potable water purchased, and per capita water use has varied historically due to various factors such as growth, changes in the economy, drought, etc.

[2] 2014 and 2015 were not selected for comparison due to the significant drop in per capita water use as a result of prolonged drought conditions and water use limitations imposed under DSRSD's Community Drought Declaration in 2014.

3.1.1.2.2 Large Water User Accounts

The District also maintains records on potable water consumption for the largest water use accounts in their water service area. Accounting for large water users separately from other potable water demands is important because the water demands from these large potable water use customers are unique, and can dramatically affect water system performance. Actual potable water demands for the top 20 large water use accounts in 2013 were obtained from meter records provided by the District and are presented in Table 3-4.

Table 3-4. Top 20 Potable Water Use Accounts in 2013[(a)]

Name on Account	Address	Meter Type	Water Demand, gpm
Alameda County G.S.A	5325 Broder Boulevard	Water	220.2
FCI Dublin	FDC Loop at 8th Street	Water	81.7
FCI Dublin	FCI Rear Gate	Water	53.7
Ulferts Center Inc.	4288 (West Building) Dublin Boulevard	Water	23.8
The Terraces at Dublin Ranch	3360 Maguire Way	Water	21.9
Elan @ Dublin Station	5501 Demarcus Boulevard	Water	20.7
Dublin Unified School District	8151 Village Parkway	Water	19.1
The Terraces at Dublin Ranch	3290 Maguire Way	Water	18.7
Discovery Builders	9595 Dublin Boulevard	Irrigation	16.5
Trevi Partners DBA Radisson	6680 Regional Street	Water	16.0
Cotton Wood Apartments	6555 Cotton Wood Circle	Irrigation[(b)]	15.6
Shea Properties #7157	6450 Dougherty Road	Irrigation	12.6
Welcome Market Inc.	7333 Regional Street	Water	12.3
Cotton Wood Apartments	6558 Cotton Wood Circle	Water	12.0
Dublin Unified School District	7997 Vomac Road	Irrigation[(b)]	11.7
Dublin Unified School District	7500 Amarillo Road	Water	11.1
Dublin 9-10B LLC	Dublin SPGS	Water	10.8
Dublin Ranch Golf Course	Golf Course Irrigation	Irrigation[(c)]	10.7
Dublin Unified School District	3601 Kohnen Way	Water	10.6
Archstone Community	Southside Central Parkway	Irrigation[(c)]	10.6

(a) Source: *top_20(100114).xlsx* received from District.
(b) The District has plans to convert this potable water account to recycled water.
(c) Potable water account has been converted to recycled water.

3.1.1.3 Water Losses

Water losses are the difference between the quantity of water supplied (purchased) and the quantity of water authorized for consumption. There are two broad categories of water losses: apparent losses and real losses. Apparent losses are the non-physical losses that occur due to unauthorized consumption (water theft), metering inaccuracies and systematic data handling errors. In other words, apparent losses are the volume of water that is consumed, but not properly measured, accounted or paid for and results in lost revenue and distortions in customer water consumption patterns. Real losses are the physical losses that occur due to leaks, breaks and storage overflows.

District staff calculates and tracks water losses in the potable water system by using the American Water Works Association (AWWA) standard water audit format, which accounts for all authorized potable water consumption. Authorized water consumption includes all water use that may be billed or unbilled, metered or unmetered (e.g., water use from registered customers, firefighting, street cleaning, flushing, etc.). Historical annual water loss estimates provided by the District are summarized in Table 3-5. In the last nine years, the system-wide water losses have ranged from 3.8 percent to 6.6 percent, with an average of 5.1 percent. The average water loss factor for the last five years has been 5.2 percent.

West Yost recommends the use of an anticipated water loss factor of 6 percent for planning purposes in this Water System Master Plan because this factor accounts for some of the variability between the more recent historical annual water losses, which ranged from 3.8 to 6.6 percent. The recommended system-wide water loss factor is slightly higher than the water loss factor used in the 2010 UWMP (i.e., 5 percent) as it includes more recent data, which indicates that water losses have increased in the potable water system.

Table 3-5. Water Losses in the Potable Water System[a,b]

Year	Percent of Total Water Purchased, %
2005	1.8[c]
2006	1.7[c]
2007	4.0
2008	4.6
2009	4.8
2010	6.6
2011	3.8
2012	5.7
2013	6.0
2014	5.0
2015	5.4
Average Water Losses (2007-2015)	5.1
Average Water Losses Over Last Five Years (2011-2015)	5.2

[a] Source: 2005-2010 – 2010 UWMP, 2011-2013 – *Standard Water Audit - 12 Dec 2013.xls*, 2014 – *Standard Water Audit – 12 Dec 2014.xls* , and 2015 – *Standard Water Audit – 10 October 2015 with 2015 calendar year.xls* received from District.
[b] Accounts for all authorized potable water consumption.
[c] Water losses shown for 2005 and 2006 are unusually low and may be the result of data handling errors associated with the District's switch to a new billing system (Eden) in 2005.

3.1.2 Potable Water Peaking Factors

Water system facilities are generally sized to meet peak demand periods. The peaking conditions of most concern for facility sizing are typically maximum month demand, maximum day demand with fire flow and peak hour demand. Peak water use is typically expressed as a ratio, or peaking factor, dividing the peak water use by the average daily water use. These peaking factors are then used to calculate maximum month, maximum day and peak hour water use conditions.

3.1.2.1 Maximum Month

Figure 3-2 presents the District's historical monthly total water purchases between 2005 and 2013 and indicates that the District's peak potable water use typically occurs in July or August, which corresponds with the high temperatures and minimal rainfall that is experienced in the District during those summer months. Table 3-6 summarizes the total water purchased during the maximum month between 2005 and 2013 and includes the calculated maximum month peaking factors. In the past nine years, the maximum month peaking factor has ranged from 1.3 to 1.6, with an average of 1.5. West Yost recommends a maximum month peaking factor of 1.5 for planning purposes, consistent with the District's 2005 Water Master Plan Update.

Table 3-6. Summary of Maximum Month Peaking Factors for the Potable Water System[a]

Year	Maximum Month	Maximum Month Water Purchased, mgd	Average Day Demand, mgd[b]	Average Day to Maximum Month Peaking Factor
2005	August	14.0	8.6	1.6
2006	July	14.1	8.8	1.6
2007	July	14.0	9.7	1.4
2008	July	13.1	9.6	1.4
2009	July	12.2	8.6	1.4
2010	July	12.3	8.3	1.5
2011	August	12.2	8.5	1.4
2012	August	13.1	9.2	1.4
2013	July	13.4	10.0	1.3
Average Maximum Month Peaking Factor				1.5

(a) Source: Standard Water Audit - 12 Dec 2013.xls received from District.
(b) Refer to Table 3-1.

3.1.2.2 Maximum Day

Table 3-7 summarizes the maximum day demand between 2005 and 2013 and includes the calculated maximum day peaking factors. In the past nine years, the maximum day peaking factor has ranged from 1.3 to 2.4, with an average of 1.9. West Yost recommends a slightly more conservative maximum day peaking factor of 2.0 for planning purposes as it is also consistent with the District's 2005 Water Master Plan Update.

Table 3-7. Summary of Maximum Day Peaking Factors for the Potable Water System[a]

Year	Maximum Day	Maximum Day Water Demand, mgd	Average Day Demand, mgd[b]	Average Day to Maximum Day Peaking Factor
2005	July 27	20.9	8.6	2.4
2006	July 24	17.6	8.8	2.0
2007	June 29	17.7	9.7	1.8
2008	September 2	16.6	9.6	1.7
2009	August 17	16.9	8.6	2.0
2010	July 6	15.1	8.3	1.8
2011	September 19	15.3	8.5	1.8
2012	August 10	16.3	9.2	1.8
2013[c]	July 13	13.4	10.0	1.3
Average Maximum Day Peaking Factor				1.9

(a) Source: *Max day and avg day demand 2005-2013.xlsx* received from District for 2005-2013.
(b) Refer to Table 3-1.
(c) Source: Based on SCADA data received for model verification.

3.1.2.3 Peak Hour

Based on hourly Supervisory Control and Data Acquisition (SCADA) system data received for the District's potable water system facilities operations during July 13, 2013, it was determined that the peak hour peaking factor is 2.4 times the average day demand.[3] This updated peak hour peaking factor is significantly lower than the adopted peak hour peaking factor of 3.8 from the 2005 Water Master Plan Update. However, 2003 data from the 2005 Water Master Plan Update indicated that the peak hour peaking factor was equal to 2.5 times the average day demand, but at that time it was believed that the significantly lower factor could be a result of errors in SCADA or from increased recycled water use. Because more recent (2013) SCADA data supports a lower peak hour peaking factor similar to the 2003 data, it is recommended that a peak hour peaking factor of 2.4 times the average day demand be adopted for this Water System Master Plan.

[3] Based on July 13, 2013 peak hour flow of 11,398 gpm with an average maximum day flow of 9,329 gpm. This factor (1.2) was multiplied by the recommended maximum day peaking factor of 2.0 times the average day demand to calculate the peak hour peaking factor (1.2 x 2.0 = 2.4 times the average day demand).

3.1.2.4 Summary of Recommended Peaking Factors for the Potable Water System

Table 3-8 summarizes the maximum month, maximum day, and peak hour peaking factors that will be used for evaluations in this Water System Master Plan.

Table 3-8. Adopted Peaking Factors for the Potable Water System

Demand Condition	Peaking Factor
Average Day During Maximum Month	1.5 times average day demand
Maximum Day	2.0 times average day demand
Peak Hour	2.4 times average day demand

3.1.3 Projected Potable Water Demand

Potable water demands were projected for the 2020 and the City of Dublin General Plan buildout (2035) timeframes for the District's water service area using both a per capita water use (population based) method and a unit water demand method based on land use type. The specific steps used in the development of these two projection methods and the results are discussed below. Included in the discussion below is a summary on the water conservation targets required to comply with the Water Conservation Act of 2009 (Senate Bill x7-7, or SBx7-7), which requires urban water purveyors to reduce their per capita water use by 20 percent by 2020.

3.1.3.1 Compliance with the Water Conservation Act of 2009

In February 2008, Governor Arnold Schwarzenegger called for a statewide 20 percent reduction in per capita water use by 2020, and asked state and local agencies to develop a more aggressive plan of water conservation to achieve the goal. A team of state and federal agencies (the 20x2020 Agency Team) consisting of the California Department of Water Resources (DWR), State Water Resources Control Board (SWRCB), California Energy Commission, Public Utilities Commission, Department of Public Health, Air Resources Board, CALFED Program, U.S. Bureau of Reclamation (USBR), and the California Urban Water Conservation Council (CUWCC) was formed to develop a statewide implementation plan for achieving this goal.

On November 10, 2009, Governor Arnold Schwarzenegger signed SBx7-7, one of several bills passed as part of a comprehensive set of new Delta and water policy legislation. SBx7-7 requires a 20 percent reduction in statewide urban per capita water usage by 2020 and establishes various methodologies for urban water suppliers to establish their interim (2015) and final (2020) per capita water use targets.

Four methodologies are identified in SBx7-7 for establishing per capita water use targets:

Method 1: A 20 percent reduction from historical baseline per capita water use based on a 10-year running average per capita water use ending between December 31, 2004 and December 31, 2010.

Method 2: Per capita water use based on 55 gpcd water use for indoor residential water use, landscape irrigation use based on water efficiency equivalent to the standards of the Model Water Efficient Landscape Ordinance, and a 10 percent reduction from baseline commercial, industrial and institutional (CII) water use.

Method 3: 95 percent of the hydrologic region targets established for per capita water use based on the State's 20x2020 Water Conservation Plan.

Method 4: An approach that considers the water conservation potential from (1) indoor residential savings, (2) metering savings, (3) CII savings, and (4) landscape and water loss savings.

An agency can choose to use any of the four methods to develop their water use targets. As part of the District's 2010 UWMP, the District adopted Method 1 and the corresponding per capita water use targets of 183 gpcd for 2015 and 163 gpcd for 2020. It should be noted that the District's current per capita water use is lower than both the 2015 (interim) and 2020 (final) SBx7-7 per capita water use targets. The District will be confirming their SBx7-7 per capita water use targets and compliance with the 2015 target in the 2015 UWMP, which is due to DWR by July 1, 2016.

3.1.3.2 Population Based Projection

Table 3-9 provides the projected potable water demand based on the District's population projections and SBx7-7 per capita water use targets.

Table 3-9. Projected Potable Water Demands Based on Population and SBx7-7 Water Use Targets

Year	Population[(a)]	SB7-7 Per Capita Water Use Target, gpcd	Projected Water Demand, mgd
2015	81,873	183[(b)]	15.0
2020	92,549	163[(c)]	15.1
2025	97,236	163[(c)]	15.8
2030	101,923	163[(c)]	16.6
2035	106,610	163[(c)]	17.4

(a) Refer to Table 2-1.
(b) Based on 2010 UWMP interim (2015) SBx7-7 per capita water use target.
(c) Based on 2010 UWMP final (2020) SBx7-7 per capita water use target.

Because per capita based water demand projections uniformly distribute water use over the entire water service area, they do not account for water use variations from different land uses and spatial locations. Therefore, population based water use projections are useful for estimating overall potable water use, but potable water demands projected from land use data are desired for the development of the hydraulic model because potable water demands in the hydraulic model are typically allocated based on specific land use designation and location. The following sections explain the methodology used to develop the land use based potable water demand projections.

3.1.3.3 Land Use Based Projection Methodology

Land use based potable water demand projections were developed using land use based unit potable water demand factors and an estimate of vacant land based on data from general and specific land use plans. The methodology used to develop land use based unit potable water demand factors and the resultant potable water demand projection is discussed in the following sections.

3.1.3.3.1 Unit Potable Water Demand Factors

To develop updated unit potable water demand factors, District staff provided West Yost with the following data:

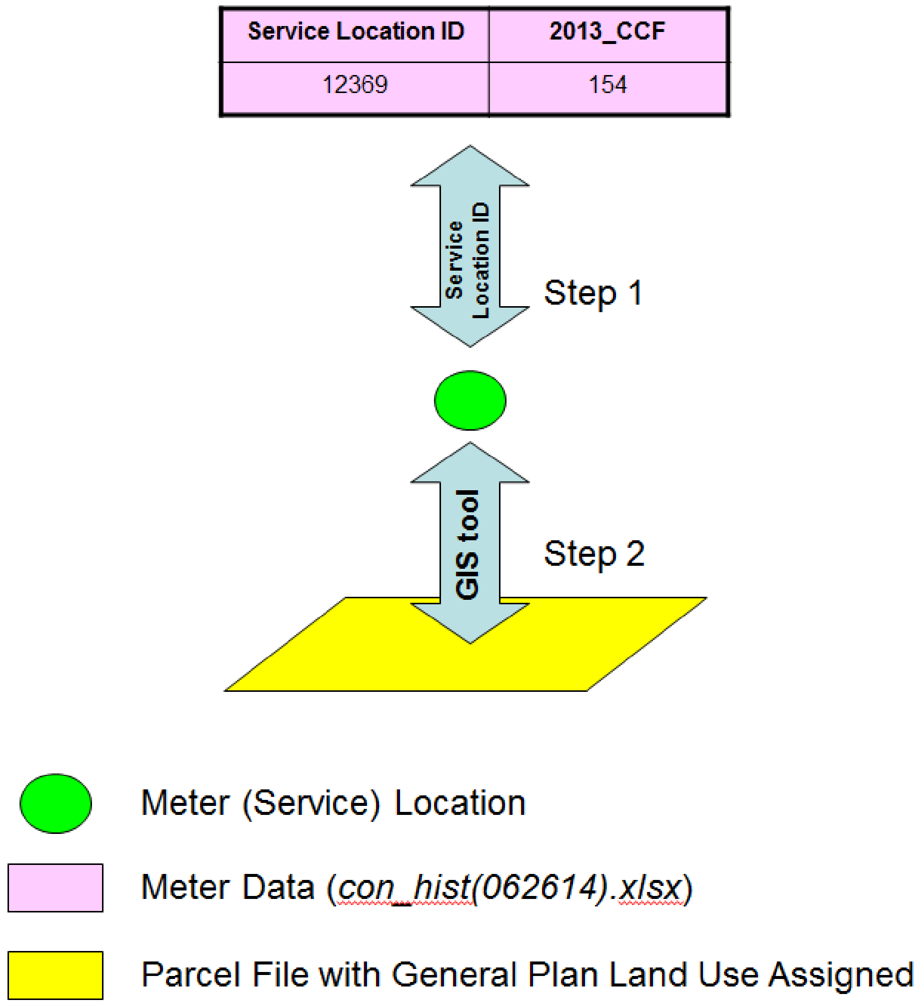
- 2013 potable water meter records with Service Location IDs;
- Spatially-located potable water meter locations with Service IDs;
- Parcel data in GIS format; and
- General Plan land use maps in GIS format[4].

General Plan land use designations were previously assigned to the parcel file using GIS tools in order to determine the existing developed and vacant acreage within the District's service area (refer to Table 2-2).

The 2013 potable water meter records were first linked to the spatially-located potable water meter locations by using the Service Location ID (Step 1). The spatially-located potable water meter locations were then assigned the closest General Plan land use designation based on their location using GIS analysis tools (Step 2). This process provided the means to then calculate the potable water use factor for each General Plan land use designation by using the total water use data from the potable water meter records for each General Plan land use designation and dividing that by the corresponding existing developed acreage (Table 2-2). Figure 3-3 illustrates the methodology used to link the spatially-located potable water meter records to the General Plan land use designations.

[4] Provided by the City of Dublin and City of San Ramon.

Figure 3-3. Illustration of Methodology for Linking Water Meter Records to General Plan Land Use Parcels File



Approximately 94 percent of the 2013 water consumption was used to develop the updated unit water demand factors. Although some of the existing potable water use records are missing from this evaluation, a significant portion (94 percent) of the existing potable water use was captured and used to develop the potable unit water demand factors, which is suitable for a planning level study. Of the potable water meter records that could not be linked to the spatially-located potable water meter locations, one possible explanation for this discrepancy may be that the spatially-located potable water meter locations file is older and does not contain all the 2013 Service Location IDs.

The following sections provide a discussion of the development of residential and non-residential unit potable water demand factors using the linked data described above.

3.1.3.3.1.1 Residential Unit Potable Water Demand Factors

Calculation of the residential unit potable water demand factors required the use of the average dwelling unit density assumptions (du/acre or du/ac) to convert the calculated unit water demand factors from gallons/acre/day to gallons/unit/day. Table 3-10 summarizes the average dwelling unit density used to calculate the residential unit water demand factors. It should be noted that the Low Density Residential average dwelling unit density for the City of Dublin was adjusted slightly higher based on the more recent data available from Single Family Residential meters.

Table 3-10. Summary of Average Dwelling Unit Density[a]

Land Use Designation	Average Dwelling Unit Density, du/gross acre
City of Dublin Residential	
Rural/Estate	0.01
Low Density	4.7[b]
Medium Density	10
Medium-High Density	20
High Density	35
City of San Ramon Residential	
Low Density	5.7
Low-Medium Density	6.9
Medium Density	9.1
Medium-High	12.4
High Density	31.6

[a] Data obtained from Table B-1 in the 2005 Water Master Plan Update.
[b] Adjusted from 4 dwelling units per gross acre to 4.7 to reflect more recent data from Single Family Residential meters.

The potable water meter records with General Plan land use designations were then used along with the average dwelling unit density as shown in Table 3-10 to calculate residential unit potable water demand factors (gallons/unit/day) by taking the total annual water demand by land use designation and dividing by the calculated total average dwelling units. Table 3-11 summarizes the new residential unit water demand factors calculated from the 2013 potable water meter data. It should be noted that unit potable water demand factors were calculated for most of the residential land uses, but they could not be developed for all of the residential land uses (e.g., Rural/Estate) due to insufficient water meter data. However, most of the District's primary residential land uses consist of either Low Density or Medium Density units; therefore, these calculated factors are representative of most of the residential water uses that occur in the District.

Table 3-11. Calculated Residential Unit Potable Water Demand Factors[(a)]

Land Use Designation	2013 Water Use Linked, gpd	Existing Net Acreage[(b)]	Existing Gross Acreage[(c)]	Average Dwelling Units[(d)]	Unit Water Demand Factor, gpd/du
City of Dublin Residential					
Low Density[(e)]	2,485,308	1,373	1,538	7,228	344
Medium Density	1,033,591	363	407	4,069	254
Medium-High Density	422,615	119	133	2,668	158
High Density	265,931	50	56	1,949	136
City of San Ramon Residential					
Low-Medium Density	860,276	367	411	2,839	303
Medium Density	1,192,543	497	556	5,061	236
High Density	186,861	59	66	2,073	90

(a) Factors account for recycled water use.
(b) Refer to Table 2-2.
(c) Net acreage increased by 12 percent to include streets (i.e., gross acreage).
(d) Refer to Table 3-10.
(e) Includes Low Density and Single Family Residential land uses.

3.1.3.3.1.2 Non-Residential Unit Potable Water Demand Factors

Calculation of the non-residential unit potable water demand factors required the use of average floor to area ratio (FAR) assumptions to convert the calculated unit water demand factors from gallons/acre/day to gallons/ft^2/day. Table 3-12 summarizes the average FAR used to calculate the non-residential unit water demand factors and also includes assumptions for Public and Open Space land uses.

Table 3-12. Summary of Average FAR and Other Land Use Assumptions[(a)]

Land Use Designation	Assumption
Average FAR	FAR
Commercial Retail	0.25
Commercial Office	0.25
Business Park	0.28
Mixed Use	0.25
Public / Semi-Public	0.25
Other	people/acre
Elementary School	37
Junior High/Middle School	37
High School	37
City Park/Community Center	30
Golf Course	0.6[(b)]

(a) Data obtained from Table B-1 in the 2005 Water Master Plan Update.
(b) Value was not provided in the 2005 Water Master Plan Update. Estimated based on the average potable water use from the Clubhouse and Maintenance Building (approximately 1,230 gpd), adopted unit water demand factor (12 gpd/golfer), and General Plan golf course acreage (180 acres).

The potable water meter records with General Plan land use designations were then used along with the assumptions shown in Table 3-12 to calculate non-residential unit potable water demand factors by taking the total annual water demand by land use designation; dividing that by the associated total existing acreage; and then dividing that calculated total by the average FAR or people/acre assumptions.

Table 3-13 summarizes the new non-residential unit water demand factors calculated from the 2013 potable water meter data. It should be noted that unit potable water demand factors were calculated for most of the non-residential land uses, but they could not be developed for all of the non-residential land uses (e.g., Public/Semi-Public) due to insufficient water meter data. However, most of the District's primary non-residential land uses are either Commercial or Business Park; therefore, these calculated factors are representative of most of the non-residential water uses that occur in the District.

Table 3-13. Calculated Non-Residential Unit Potable Water Demand Factors[(a)]

Land Use Designation	2013 Water Use Linked, gpd	Existing Acreage[(b)]	Average FAR[(c)]	Unit Water Demand Factor, gpd/ft^2
Commercial				
Commercial Retail[(d)]	631,231	426	0.25	0.14
Commercial Office[(e)]	86,706	89	0.25	0.09
Industrial				
Business Park[(f)]	130,398	176	0.28	0.06
Mixed Use				
Mixed Use[(g)]	75,721	26	0.25	0.27

(a) Factors account for recycled water use.
(b) Refer to Table 2-2.
(c) Refer to Table 3-12.
(d) Includes General Commercial, Retail/Office, Retail/Office and Automotive, and General Commercial/Campus Office land uses.
(e) Includes Campus Office land use.
(f) Includes Business Park/Industrial, and Business Park/Industrial and Outdoor Storage land uses.
(g) Includes Mixed Use, and Medium/High Density Residential and Retail Office land uses.

3.1.3.3.1.3 Recommended Unit Water Demand Factors for the Potable Water System

Table 3-14 presents a comparison of the updated unit potable water demand factors with previously developed factors from the 2005 Water Mater Plan Update and with factors that have been used more recently by District staff. Unit potable water demand factors that are recommended for adjustment based on more recent data are presented in the last column of Table 3-14 with bold text. A discussion of key findings from this comparison including the rationale for adjustments in the unit potable water demand factors is provided in Table 3-15.

Table 3-14. Comparison of Unit Potable Water Demand Factors[a]

Land Use Designation	Unit	Previous Unit Water Demand Factor (*without recycled water use*)	Previous Unit Water Demand Factor (*with recycled water use*)	Unit Water Demand Factor Currently Used by DSRSD Staff[b]	Updated Unit Water Demand Factor[c]	Recommended Unit Water Demand Factor[d]
City of Dublin Residential						
Low Density	gpd/du	393	393	350	344	**350**
Medium Density	gpd/du	225	200	180	254	**255**
Medium-High Density	gpd/du	157	130	120	158	**160**
High Density	gpd/du	138	125	115	136	**135**
City of San Ramon Residential						
Low-Medium Density	gpd/du	330	330	300	303	**300**
Medium Density	gpd/du	225	200	180	236	**255**
High Density	gpd/du	138	125	115	90	**135**
Commercial						
Commercial Retail	gpd/ft^2	0.10	0.10	0.10	0.14	**0.14**
Commercial Office	gpd/ft^2	0.10	0.10	0.10	0.09	0.10
Industrial						
Business Park	gpd/ft^2	0.10	0.10	0.10	0.06	**0.06**
Mixed Use						
Mixed Use	gpd/ft^2	--[e]	--[e]	--[e]	0.27	**0.27**

[a] Previous unit water demand factors are from the 2005 Water Master Plan Update.
[b] Based on data in the following file: *Potable Demand 2014F - Timing Update in Dublin Budget Res Pop Spreadsheets -Mar 2014.xlsx*.
[c] Factors were developed based on 2013 water meter data and account for recycled water use. However, some factors still contain some irrigation water use from meters that are not served by the recycled water system.
[d] Factors that are recommended to be adjusted from the 2005 Water Master Plan Update factors are in bold text.
[e] A Mixed Use factor was not developed in the 2005 Water Master Plan Update nor has it been used in recent DSRSD evaluations.

Table 3-15. Summary of Key Findings and Recommendations for Updated Unit Potable Water Demand Factors

Land Use Designation	Findings and Recommendations
City of Dublin Residential	
Low Density	• Adjust factor lower based on recent meter data to match factor currently used by District staff.
Medium Density	• Water use for this land use designation based on recent meter data indicates actual water use is higher (~13 percent) than previous assumptions. • Further review indicated the following findings: – Some areas with Medium Density land use designation are developed at a lower dwelling unit density – There is a possibility that some Medium Density dwelling units have a higher number of people per dwelling unit • Adjust factor higher to match more recent meter data.
Medium-High Density	• It appears that water use was not reduced with the introduction of recycled water. • Adjust factor higher to match more recent meter data.
High Density	• It appears that water use was not reduced with the introduction of recycled water. • Adjust factor higher to match more recent meter data.
City of San Ramon Residential	
Low-Medium Density	• Adjust factor lower based on recent meter data to match the factor currently used by District staff.
Medium Density	• Water use for this land use designation based on recent meter data indicates actual water use is higher (~5 percent) than previous assumptions. • Set factor to match City of Dublin Medium Density Residential factor to reduce confusion. This would provide a more conservative water demand estimate.
High Density	• Updated factor is significantly lower than previous assumptions. • Set factor to match City of Dublin High Density Residential factor to reduce confusion. This would provide a more conservative water demand estimate.
Commercial	
Commercial Retail	• Retail water use was found to be at a higher rate than Office water use. • Adjust factor higher to match recent meter data.
Commercial Office	• Updated factor is very similar to previously adopted factor. • No adjustment recommended.
Industrial	
Business Park	• Industrial water use was found to be at a lower rate than Office water use. • Adjust factor lower to match recent meter data.
Mixed Use	
Mixed Use	• New factor developed for areas with combined residential and non-residential land uses.

It is assumed that recycled water will be used extensively for exterior landscaping in the future because the District's recycled water supply system infrastructure is mostly constructed and operational. Therefore, the recommended unit potable water demand factors assume that recycled water would be used. Table 3-16 summarizes the recommended unit potable water demand factors.

Table 3-16. Recommended Unit Water Demand Factors for the Potable Water System[a]

Land Use Designation	Unit for Interior Use	Interior Use	Exterior Use, gpd/acre[b]
Residential			
Rural[c]	gpd/du	730	--
Low Density	gpd/du	350	--
Low-Medium Density	gpd/du	300	--
Medium Density	gpd/du	255	--
Medium-High Density	gpd/du	160	--
High Density	gpd/du	135	--
Commercial			
Commercial Retail	gpd/ft^2	0.14	267.8
Commercial Office	gpd/ft^2	0.10	267.8
Industrial			
Business Park	gpd/ft^2	0.06	267.8
Mixed Use			
Mixed Use	gpd/ft^2	0.27	267.8
Public			
Public/Semi-Public[c]	gpd/ft^2	0.05	267.8
Elementary School[c]	gpd/student	10	267.8
Middle School[c]	gpd/student	15	267.8
High School[c]	gpd/student	20	267.8
Open Space			
Neighborhood Park[c]	gpd/acre	125	--
Community Center[c]	gpd/visitor	8	--
Golf Course[c]	gpd/golfer	12	--

(a) Factors account for recycled water use and are mostly based on the factors from the 2005 Water Master Plan Update with adjustments as presented in Table 3-14.
(b) Assumes extensive use of recycled water for exterior landscaping and minimal potable water use on non-residential land uses equal to 10 percent of the exterior landscaping water demand of 3.0 af/acre/yr (0.3 af/acre/yr = 267.8 gpd/acre).
(c) Based on factors from the 2005 Water Master Plan Update.

3.1.3.3.2 Demand Projection for New Development

The projected location and timing of future potable water demands were developed based on discussions with District staff and the City of Dublin and City of San Ramon Planning staff. Figure 3-4 illustrates the locations of projects identified for future development. Projects that were not specifically identified by District staff and City Planning staff were assumed to occur by buildout (2020 for Dougherty Valley and 2035 for City of Dublin).

Using the recommended unit water demand factors presented in Table 3-16 and an anticipated water loss factor of 6 percent, West Yost projected the District's additional potable water demand for each of the District's sub-areas for the 2020 and Buildout (2035) timeframes as shown in Table 3-17. It is projected that an additional 5,567 af of potable water supply will be required to support Buildout water demands. Detailed potable water demand projections by development project are provided in Appendix A.

Table 3-17. Projected Additional Potable Water Demand Based on Land Use Data[a,b]

Sub-Area	2020		Buildout[c]	
	Additional Potable Water Demand, af	Additional Potable Water Demand, mgd	Additional Potable Water Demand, af	Additional Potable Water Demand, mgd
Camp Parks	807	0.72	1,098	0.98
Central Dublin	426	0.38	986	0.88
Dougherty Valley	560	0.50	560	0.50
Eastern Dublin	1,501	1.34	2,789	2.49
Western Dublin	123	0.11	134	0.12
Total	3,417	3.1	5,567	5.0

(a) Detailed potable water demand projections by development project are provided in Appendix A.
(b) Projections include anticipated system-wide water loss of 6 percent.
(c) Includes projected 2020 potable water demands.

3.1.3.3.3 Potable Water Offset

Since the introduction of recycled water supply to the District's water service area, many of the District's irrigation services, which have historically used potable water, have been converted to the recycled water system to help offset potable water use. However, there are some remaining potable water irrigation services that will need to be converted to recycled water supply when the recycled water system is expanded to serve additional areas.

A list of existing customer accounts which have recently converted, or are planned to be converted, to recycled water is provided in Appendix A. Table 3-18 summarizes the recent (2014) and future planned potable water service conversions and includes the associated potable water offset. This associated potable water offset will need to be accounted for and subtracted from the future potable water demand projections. Based on discussions with District staff, it was determined that future planned potable water service conversions are expected to occur by 2020.

Table 3-18. Summary of Recent and Planned Potable Water Service Conversions to Recycled Water[a]

Timeframe	Potable Water Offset[b]	
	af	mgd
Recent (2014) Conversions	223	0.20
Planned (2020) Conversions[c]	748	0.67
Total	971	0.87

(a) Based on data provided by District staff in October 2014 and March 2015. See Appendix A for a list of customer accounts which have recently converted, or are planned to be converted, to recycled water.
(b) Based on water use from 2013 meter records.
(c) Potable Water Offset for Planned (2020) Conversions is subject to change based on actual conversions that take place,

3.1.3.3.4 Land Use Based Projection

To develop the total land use based water demand projection for the potable water system, projected potable water demands from new development were first added to the baseline water demand of 10 mgd, which is equal to the District's average day potable water purchased in 2013, and the total potable water offset was then subtracted. It should be noted that more recent water use data from 2014 was not used because it was significantly lower due to increased conservation efforts in response to the on-going drought and would not be conservative for use in planning. Table 3-19 presents the projected potable water demand at 2020 and Buildout (2035).

Table 3-19. Projected Total Potable Water Demand Based on Land Use Data[a]

Demand Condition	2020		Buildout[b]	
	af	mgd	af	mgd
Baseline (2013)[c]	11,244	10.0	11,244	10.0
Future Development[d]	3,417	3.1	5,567	5.0
Potable Water Offset[e]	(971)	(0.9)	(971)	(0.9)
Total	13,690	12.2	15,840	14.1

(a) Includes anticipated system-wide water loss of 6 percent.
(b) Includes projected 2020 potable water demands.
(c) Refer to Table 3-1.
(d) Refer to Table 3-17.
(e) Refer to Table 3-18.

3.1.3.4 Comparison of Potable Water Demand Projections

Figure 3-5 provides a comparison of both the updated population and land use based potable water demand projections developed for this Water System Master Plan. Based on the historical water use in the District, the land use based potable water demand projection (blue dashed line) appears to be a more accurate representation of future growth and water supply needs for the District because it was developed based on: (1) actual projects that have been identified by District and City staff; and (2) updated unit potable water demand factors.

The population based potable water demand projections (orange and green dotted lines) may overstate future water supply requirements because it is based on projected population and SBx7-7 per capita water use targets, which are higher than what the District is currently experiencing (the average per capita water use from 2005-2013 is 146 gpcd compared to the SBx7-7 final water use target of 163 gpcd). If the more recent 2013 per capita water use of 134 gpcd was applied to the projected population (black dotted line) then the projected potable water demand is very similar to the land use based projection. This finding further indicates that the land used based potable water demand projection is representative of future potable water demands as it can be correlated with projected population growth.

Table 3-20 provides a comparison of the projected buildout potable water demands using both the land use and population based methodologies described above with previous studies.

Table 3-20. Comparison of Potable Water Demand Projections

Year of Study	Study Name	Basis for Projection	Projected Buildout Year	Projected Average Day Water Demand, mgd
2005	Water Master Plan Update	Land Use	2020	15.2
2010	Urban Water Management Plan	Population and SBx7-7 Targets	2035	16.5
2016	Water System Master Plan	Population and SBx7-7 Targets	2035	17.4[a]
		Land Use	2035	14.1[b]

(a) Refer to Table 3-9.
(b) Refer to Table 3-19.

The comparison presented in Table 3-20 indicates the following:

- The land use based potable water demand projection has decreased by approximately 1 mgd when compared to the 2005 Water Master Plan Update (it should be noted that this new land use based buildout potable water demand projection accounts for an estimated potable water offset of 0.9 mgd);
- The population based potable water demand projection is similar to the projection presented in the 2010 Urban Water Management Plan because they both utilize SBx7-7 per capita water use targets to estimate demands; however, as discussed above, if the actual (lower) 2013 per capita water use was used to project potable water demands then the population based potable water demand projection will decrease and closely match the land use based potable water demand projection; and
- There appears to be a decrease in the updated Buildout potable water demand projection as it is refined with more recent land use planning data.

3.1.3.5 Recommended Potable Water Demand Projection

It is recommended that the District adopt the land used based potable water demand projection for this Water System Master Plan Update because it incorporates more up-to-date and accurate future land use estimates and unit water use factors, and also accounts for the expected potable water offset from recent (2014) and future planned potable water service conversions to the recycled water system. In addition, with the land use based water demand projection, GIS data can be used to spatially locate projected potable water demands for the hydraulic evaluation of the future potable water system. This would provide a more accurate future potable water system demand allocation into the District's hydraulic model. Therefore, the land use based potable water demand projection method described above will be used to predict the District's total water supply requirement and also to update the District's hydraulic model. The projected future potable water demands are summarized in Table 3-21.

Table 3-21. Summary of Recommended Potable Water Demand Projection

Demand Condition	Total 2020 Water Demand	Total Buildout Water Demand
Annual Demand	13,690 af	15,840 af
Average Day[a]	12.2 mgd	14.1 mgd
Average Day During Maximum Month[b]	18.3 mgd	21.2 mgd
Maximum Day[c]	24.4 mgd	28.2 mgd
Peak Hour[d]	29.3 mgd	33.8 mgd

[a] Refer to Table 3-19.
[b] Peaking factor of 1.5 times average day.
[c] Peaking factor of 2.0 times average day.
[d] Peaking factor of 2.4 times average day.

3.2 RECYCLED WATER DEMANDS

As discussed in *Chapter 2 Water Service Area and Water System Facilities*, the District serves recycled water to customers in the City of Dublin and the Dougherty Valley area of San Ramon.

The DERWA system provides recycled water for use in the District's water service area, as well as for EBMUD and City of Pleasanton. In 2014, the District accounted for approximately 75 percent of the total system demand on an annual basis, while EBMUD accounted for about 23 percent of the total system demand and the City of Pleasanton accounted for the remaining 2 percent of the total system demands.

The following sections summarize the historical, current and projected recycled water demands within the District's water service area.

3.2.1 Historical Recycled Water Use

Table 3-22 presents the historical annual recycled water consumption for the District's water service area between 2006 and 2015.

Table 3-22. Historical Annual Metered Recycled Water Consumption[a,b]

Year	Million Gallons	Acre-feet	Average Day Demand, mgd
2006	305	937	0.84
2007	632	1,941	1.73
2008	627	1,923	1.72
2009	598	1,836	1.64
2010	552	1,695	1.51
2011	624	1,916	1.71
2012	678	2,080	1.86
2013	770	2,362	2.11
2014	824	2,528	2.26
2015	840	2,579	2.30
		Average	1.8
		Average Over Last Five Years (2011-2015)	2.0

(a) Includes recycled water use in DSRSD's service area only; does not include recycled water use in City of Pleasanton or in EBMUD's service area. DSRSD data only includes demand in the recycled water distribution system and does not include water from recycled water fill stations at the treatment plant.

(b) Source: RW Standard Water Audit – 12 December 2015.xls provided by DSRSD.

Recycled water demands for the twenty highest recycled water users in the District's service area in 2013 are presented in Table 3-23.

Table 3-23. Top 20 Recycled Water Meters in 2013

Name on Account	Address	Water Demand, gpm
Dublin Ranch Golf Course	5900 Signal Hill Drive	80.0
Dublin Ranch Golf Course	5900 Signal Hill Drive	67.0
City of Dublin	6800 Dublin Boulevard	41.4
City of Dublin	Emerald Glen Park	36.3
City of San Ramon	5261 Sherwood Way	22.9
City of Dublin	4605 Lockhart Street	22.8
Goodfellow Top Grade Construction	Construction Meter	18.7
City of Dublin	4605 Lockhart Street	17.1
Dublin Corporate Center	4140 Dublin Boulevard	15.2
Dublin Ranch Business Park	Dublin Boulevard and Grafton Street	14.5
City of Dublin	Alamo Creek Park	13.9
Dublin Unified School District	3601 Kohnen Way	13.3
San Ramon Valley Unified School District	Dougherty Valley High School	13.2
Bit Holdings Sixty-Three Inc.	Hacienda Crossings and Toyota Drive	13.0
San Ramon Valley Unified School District	Dougherty Valley High School	12.7
City of San Ramon	Windemere Parkway and Bethany Road	12.3
City of Dublin	Ted Fairfield Park	12.1
Verona Owners Association at Dublin Ranch	3005 Gleason Drive	12.0
Dublin Unified School District	6817 York Drive	12.0
Bit Holdings Sixty-Three Inc.	Dublin Boulevard and Toyota Drive	11.8

Source: *top_20(100114).xlsx* provided by DSRSD.

3.2.2 Recycled Water Peaking Factors

Recycled water demands vary on an annual, daily, and seasonal basis. Peaking conditions that are of particular significance to hydraulic analysis are the average day demand (ADD), maximum day demand (MDD), and peak hour demand (PHD). Each of these demands conditions is described below:

- **Average Day Demand.** The ADD is the total annual recycled water demand in a year divided by the number of days in that year.
- **Maximum Day Demand.** The MDD is the greatest water demand during a 24-hour period of the year.

- **Peak Hour Demand.** The PHD is the highest water demand during any one-hour period of the year.

Table 3-24 summarizes the maximum day and peak hour peaking factors that were developed and used for the *DERWA Model Update and System Evaluation* (see Appendix F).

Table 3-24. Adopted Peaking Factors for the Recycled Water System[(a)]

Demand Condition	Peaking Factor
Maximum Day	2.5 times average day demand
Peak Hour	7.55 times average day demand

(a) Source: *DERWA Model Update and System Evaluation*, prepared by Carollo Engineers, March 2016 (see Appendix F).

Table 3-25 provides a summary of the District's existing (2014) recycled water demands under various demand conditions.

Table 3-25. Existing (2014) Recycled Water Demand in DSRSD's Water Service Area

Demand Condition	Af	gpm	mgd
Average Day Demand[(a,b)]	2,528	1,567	2.26
Maximum Day Demand[(c)]	--	3,918	5.65
Peak Hour Demand[(d)]	--	11,832	17.06

(a) Source: RW Standard Water Audit – 12 December 2015.xls provided by DSRSD. It should be noted that this 2014 demand number is slightly different than the 2014 demand number used in the *DERWA Model Update and System Evaluation*, prepared by Carollo Engineers, March 2016 (see Appendix F).

(b) Includes recycled water use in DSRSD's service area only; does not include recycled water use in EBMUD service area or in City of Pleasanton. DSRSD data only includes demand in the recycled water distribution system and does not include water from recycled water fill stations at the treatment plant.

(c) Assumes maximum day peaking factor of 2.5 times average day (see Table 3-24).

(d) Assumes peak hour peaking factor of 7.55 times average day (see Table 3-24).

3.2.3 Projected Recycled Water Demand

As part of the *DERWA Model Update and System Evaluation*, future recycled water demand projections were developed for two future demand scenarios (a 2020 demand scenario and a Buildout scenario) by determining incremental recycled water demands for the period from 2015 to 2020 and for the period from 2020 to buildout. Assumed future recycled water demands by project/development area within the District's water service area are provided in Tables A and B of Carollo Engineers' report (see Appendix F). Based on these projected incremental recycled water demands, projected future recycled water demands for 2020 and Buildout have been estimated and are presented in Table 3-26.

Table 3-26. Summary of Recycled Water Demand Projections in DSRSD's Water Service Area[a,b]

Demand Condition	Total 2020 Water Demand	Total Buildout Water Demand
Annual Demand	3,904 af	4,203 af
Average Day	3.5 mgd	3.8 mgd
Maximum Day[b]	8.7 mgd	9.4 mgd
Peak Hour[c]	26.3 mgd	28.3 mgd

(a) Source: *DERWA Model Update and System Evaluation*, prepared by Carollo Engineers, March 2016.
(b) DSRSD service area only; does not include recycled water demands in EBMUD service area or in City of Pleasanton.
(c) Assumes maximum day peaking factor of 2.5 times average day.
(d) Assumes peak hour peaking factor of 7.55 times average day.

These projected recycled water demands are shown on Figure 3-6 and are compared with the previously projected recycled water demands as presented in the District's 2010 UWMP. As shown, the current projections are very similar to the 2010 UWMP projections.

Figure 3-1. Per Capita Water Use, Production, and Population

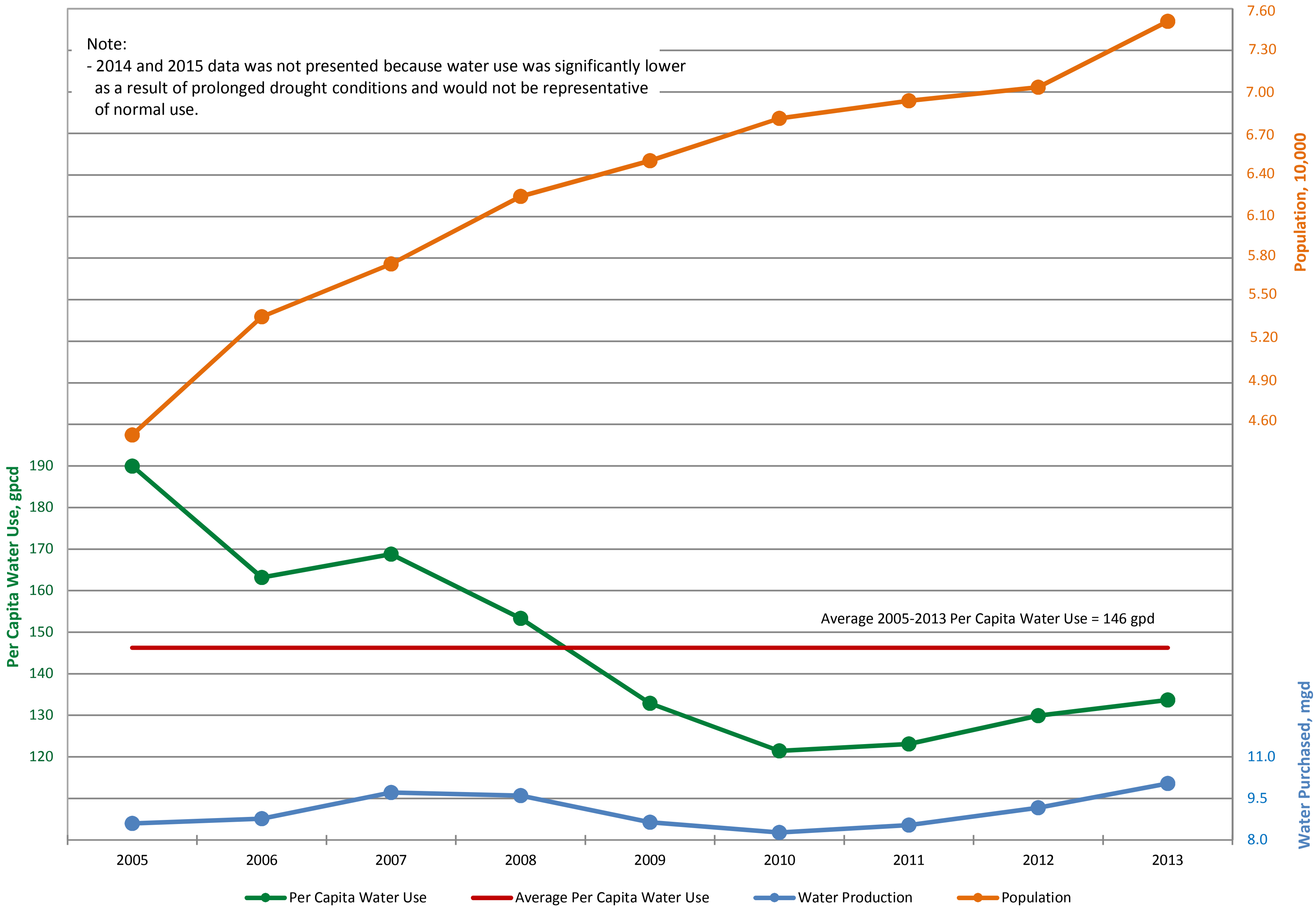


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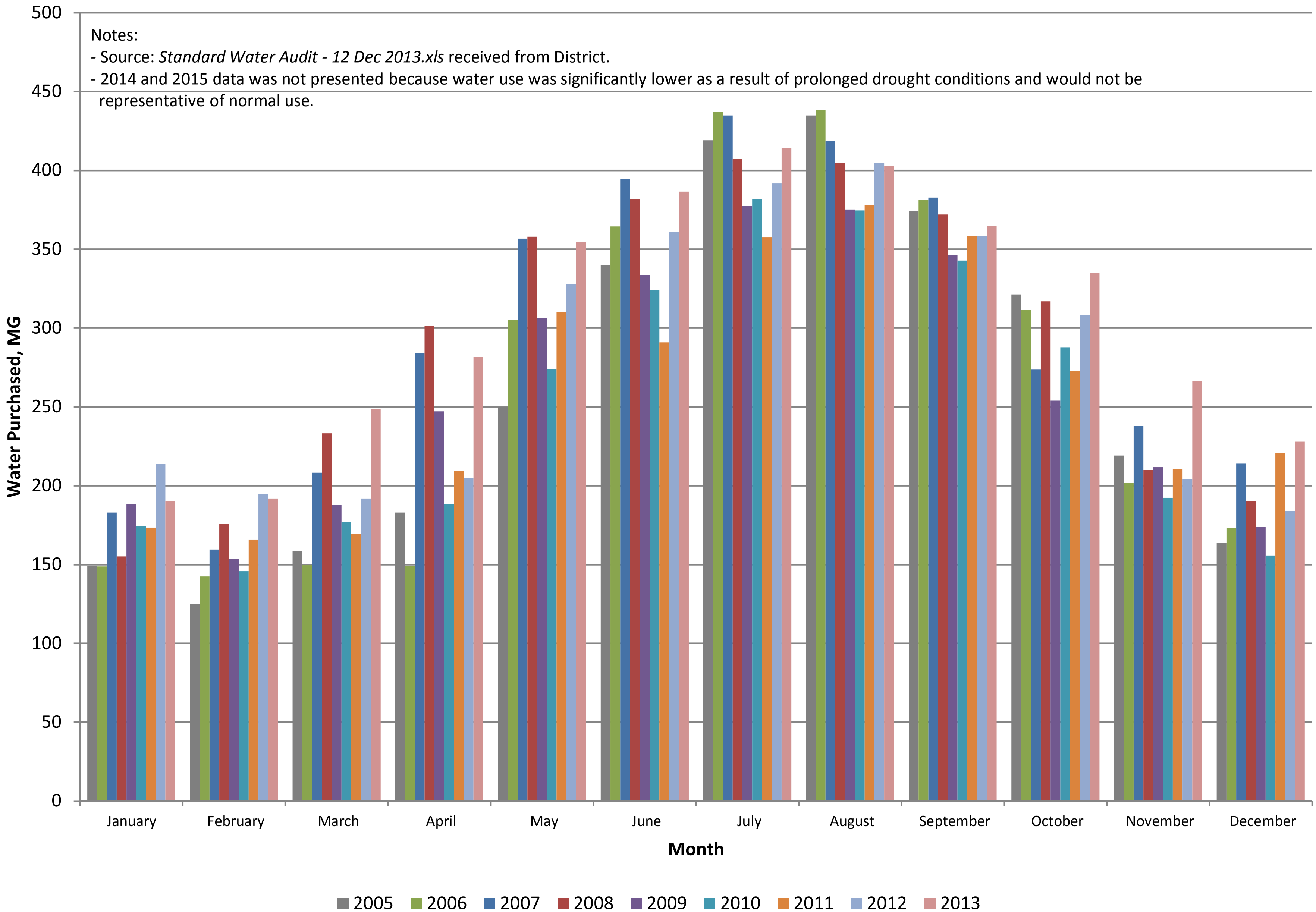
Figure 3-2. Historical Monthly Potable Water Purchased from Zone 7



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Last Saved: 11/16/2015 10:49:12 AM bcoox; O:\Clients\406 DSRSD\02-14-38 Wtr Sys MP Capacity Study\GIS\Figures\Figure 3-4 Future Dev Projects.mxd

Site No.	Planning Area	Name
1	Camp Parks	Parks RFTA
2	Camp Parks	Dublin Crossing
3	Central Dublin	Downtown Dublin -- Retail
4	Central Dublin	Downtown Dublin -- Transit
5	Central Dublin	Downtown Dublin -- Village
6	Central Dublin	Dublin Village
7	Central Dublin	Ramma Market and Cuisine
8	Central Dublin	Sierra Business Center
9	Eastern Dublin	Chevrolet Detail Area
10	Eastern Dublin	Fallon Gateway
11	Eastern Dublin	Promenade
12	Eastern Dublin	East County Hall of Justice
13	Eastern Dublin	Gateway Medical Center
14	Eastern Dublin	The Green
15	Eastern Dublin	Grafton Plaza
16	Central Dublin	Valley Christian Center
17	Central Dublin	Valero Service Station
18	Central Dublin	Dublin Preschool
19	Central Dublin	Fountainhead Montessori
20	Eastern Dublin	Persimmon Place
21	Central Dublin	Challenge Butter
22	Eastern Dublin	The Groves
23	Eastern Dublin	Sorrento -- Ravello
24	Eastern Dublin	Sorrento -- Lucca
25	Eastern Dublin	Wallis Ranch
26	Eastern Dublin	Silvera Ranch -- Phase 3
27	Central Dublin	Tralee
28	Eastern Dublin	Moller Ranch
29	Eastern Dublin	Chateau
30	Eastern Dublin	Dublin Station -- Esprit (E-1)
31	Eastern Dublin	Dublin Station -- Avalon II
32	Eastern Dublin	Tassajara Highlands
33	Eastern Dublin	Nielsen
34	Eastern Dublin	Dublin Ranch North (Redgewick)
35	Eastern Dublin	Jordan Ranch -- Windwood
36	Western Dublin	Schaefer Ranch
37	Central Dublin	Eden Housing -- Veteran's Project
38	Central Dublin	Crown Chevy
39	Western Dublin	Schaefer Ranch GPA
40	Eastern Dublin	Positano -- The Ridge
41	Eastern Dublin	Positano -- The Heights
42	Eastern Dublin	Positano -- Verona Estates
43	Eastern Dublin	Positano -- Veneto
44	Central Dublin	Bayrock
45	Central Dublin	Ares/Prologis
46	Eastern Dublin	Lazy Dog Restaurant
47	Eastern Dublin	Jordan Ranch -- Capri
48	Eastern Dublin	Jordan Ranch -- Trio
49	Central Dublin	Heritage Park
50	Eastern Dublin	Jordan Ranch -- Neighborhood 6
51	Eastern Dublin	Dublin Station -- Site A-1
52	Eastern Dublin	Lennar Homes -- Sub Area 3
53	Eastern Dublin	Jordan Ranch -- Ardmore
54	Dougherty Valley	Gale Ranch -- Avanti
55	Dougherty Valley	Gale Ranch -- Fiorella
56	Dougherty Valley	Gale Ranch -- Iriana
57	Dougherty Valley	Gale Ranch -- Avanti Heights
58	Dougherty Valley	Gale Ranch -- Andorra
59	Dougherty Valley	Gale Ranch -- Fiorella II
60	Dougherty Valley	Gale Ranch -- Fiorella II (9297)
61	Dougherty Valley	Gale Ranch -- Romana
62	Dougherty Valley	Gale Ranch -- Posante
63	Dougherty Valley	Gale Ranch -- Cantera
64	Dougherty Valley	Gale Ranch -- Amarante
65	Dougherty Valley	Gale Ranch -- Romana II
66	Dougherty Valley	Gale Ranch -- Tri-Plexes/C2
67	Dougherty Valley	Gale Ranch -- 9301
68	Dougherty Valley	Rancho San Ramon
69	Dougherty Valley	Community Center
70	Dougherty Valley	Village Center -- North
71	Dougherty Valley	Village Center -- South
72	Dougherty Valley	School/Park
73	Eastern Dublin	Kaiser
74	Eastern Dublin	DiManto
75	Eastern Dublin	Grafton Station Area A
76	Eastern Dublin	Site 15A
77	Eastern Dublin	Moura-Tipper
78	Eastern Dublin	Ashton at Dublin Station (A-3)
79	Eastern Dublin	Fallon Village -- Croak
80	Eastern Dublin	Fallon Village -- Chen
81	Eastern Dublin	Fallon Village -- Anderson
82	Eastern Dublin	Fallon Village -- Righetti
83	Eastern Dublin	Fallon Village -- Monte Vista
84	Eastern Dublin	Fallon Village -- Branaugh
85	Eastern Dublin	EBJ Partners L.P.
86	Eastern Dublin	Pleasanton Ranch Investments
87	Eastern Dublin	Dublin Station -- Site D-1
88	Eastern Dublin	Dublin Station -- Site D-2
89	Eastern Dublin	Dublin Station -- Site E-2
90	Eastern Dublin	East Dublin
91	Eastern Dublin	Zimmer-Raley
92	Eastern Dublin	Dublin Ranch
93	Eastern Dublin	Dublin Ranch
94	Eastern Dublin	Jordan--Mixed Use
95	Eastern Dublin	Jordan--Park 1
96	Eastern Dublin	Jordan--Park 2
97	Eastern Dublin	Jordan--Residential 1
98	Eastern Dublin	Jordan--Residential 2
99	Eastern Dublin	Jordan--Elementary School
100	Eastern Dublin	Jordan--Semi-Public
101	Eastern Dublin	Jordan--Residential 3
102	Eastern Dublin	Fallon Enterprises--Residential 1
103	Eastern Dublin	Fallon Enterprises--Residential 2
104	Eastern Dublin	Braddock & Logan--Residential 1
105	Eastern Dublin	Braddock & Logan--Residential 2
106	Eastern Dublin	Braddock & Logan--Residential 3
107	Eastern Dublin	Dublin Ranch--Commercial 1
108	Eastern Dublin	Dublin Ranch--Commercial 2
109	Eastern Dublin	Dublin Ranch--Commercial 3
110	Central Dublin	Central Dublin--Infill 1
111	Western Dublin	Schafer Ranch--Residential 1
112	Western Dublin	Schafer Ranch--Residential 2

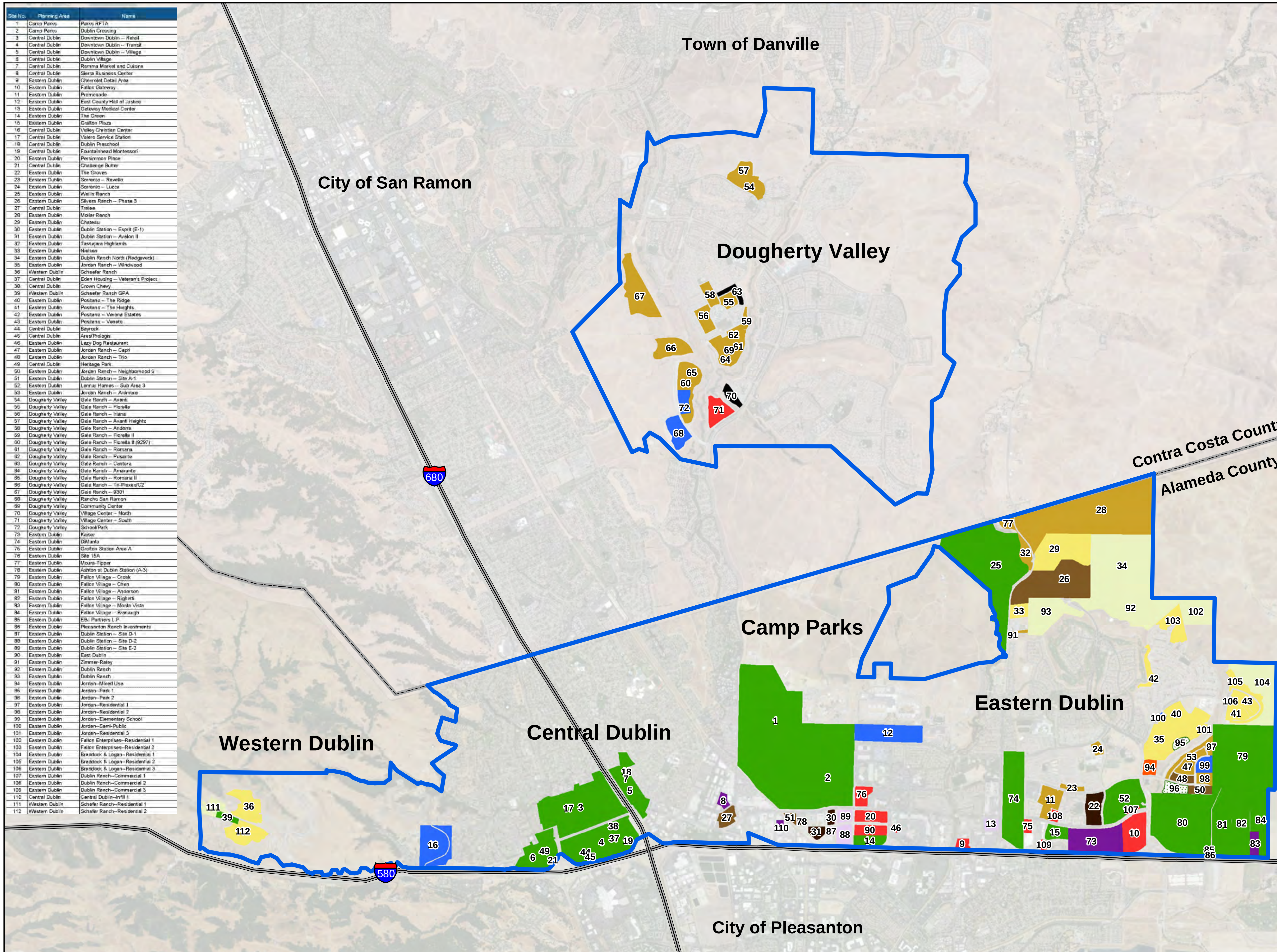

FIGURE 3-4

Dublin San Ramon Services District Water System Master Plan

FUTURE DEVELOPMENT PROJECT LOCATIONS

N

0 2,000 4,000

Scale in Feet

Note:
1. Refer to Appendix A for additional details for each development project.

LEGEND

Multiple Land Uses
- See Appendix A for details

Public/Semi-Public/Open Space
- Parks / Public Recreation
- Public / Semi-Public

Commercial / Industrial
- General Commercial
- Campus Office
- Business Park / Industrial
- Mixed Use

City of Dublin Residential
- Rural Residential / Agriculture (1 du per 100 Acres)
- Low-Density Single Family (0.5 - 3.8 du/acre)
- Medium-Density Residential (6.1 - 14.0 du/acre)
- Medium/High-Density Residential (14.1 - 25.0 du/acre)
- High-Density Residential (>25.1 du/acre)

Dougherty Valley Residential
- Single Family - Medium-Density (6.0 - 14.0 du/acre)
- Multiple Family - High-Density (14.0 - 30.0 du/acre)

- Water Service Area
- Interstate Highway
- County Line

WEST YOST ASSOCIATES
Consulting Engineers

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Figure 3-5. Average Day Potable Water Demand Projections

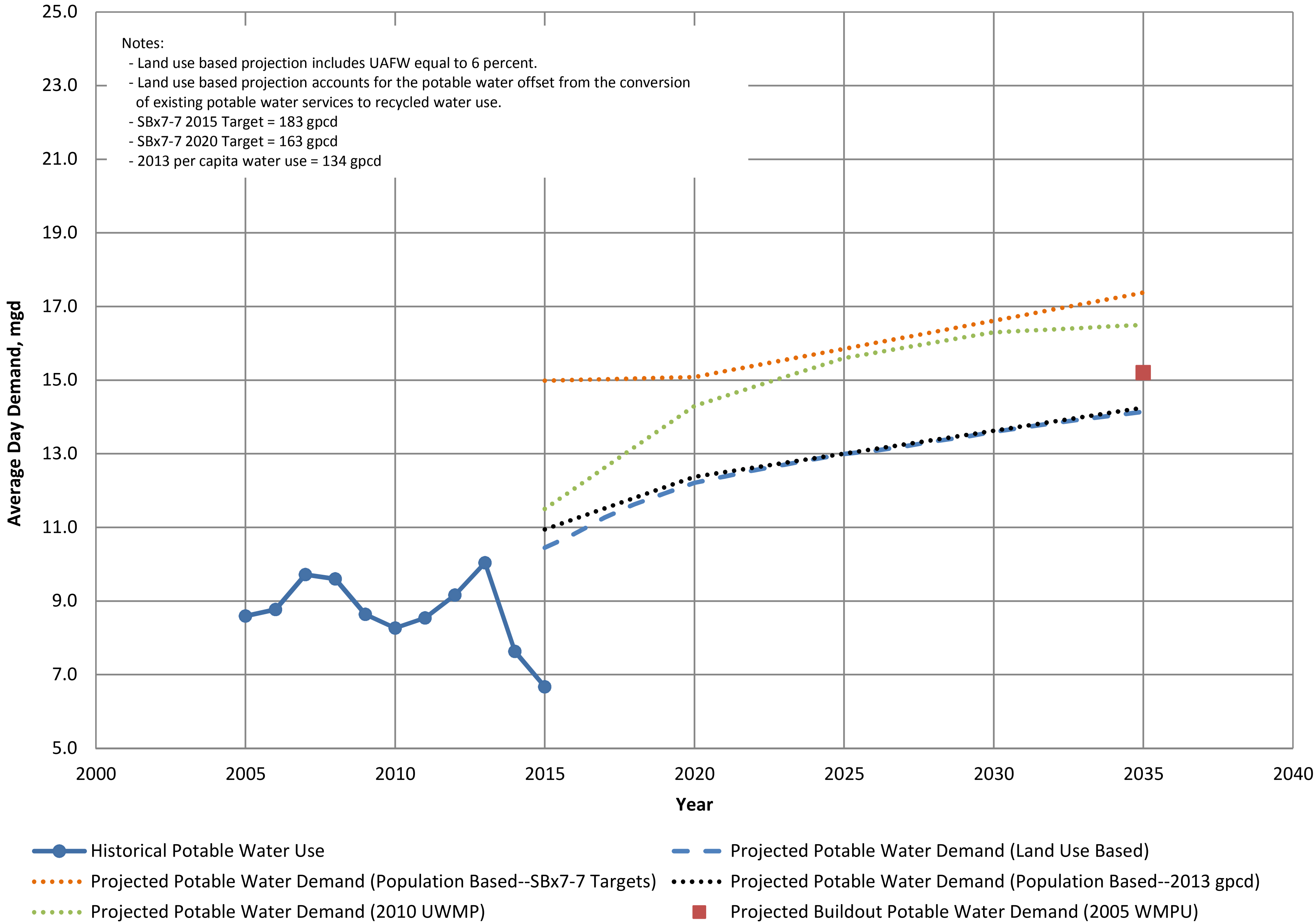

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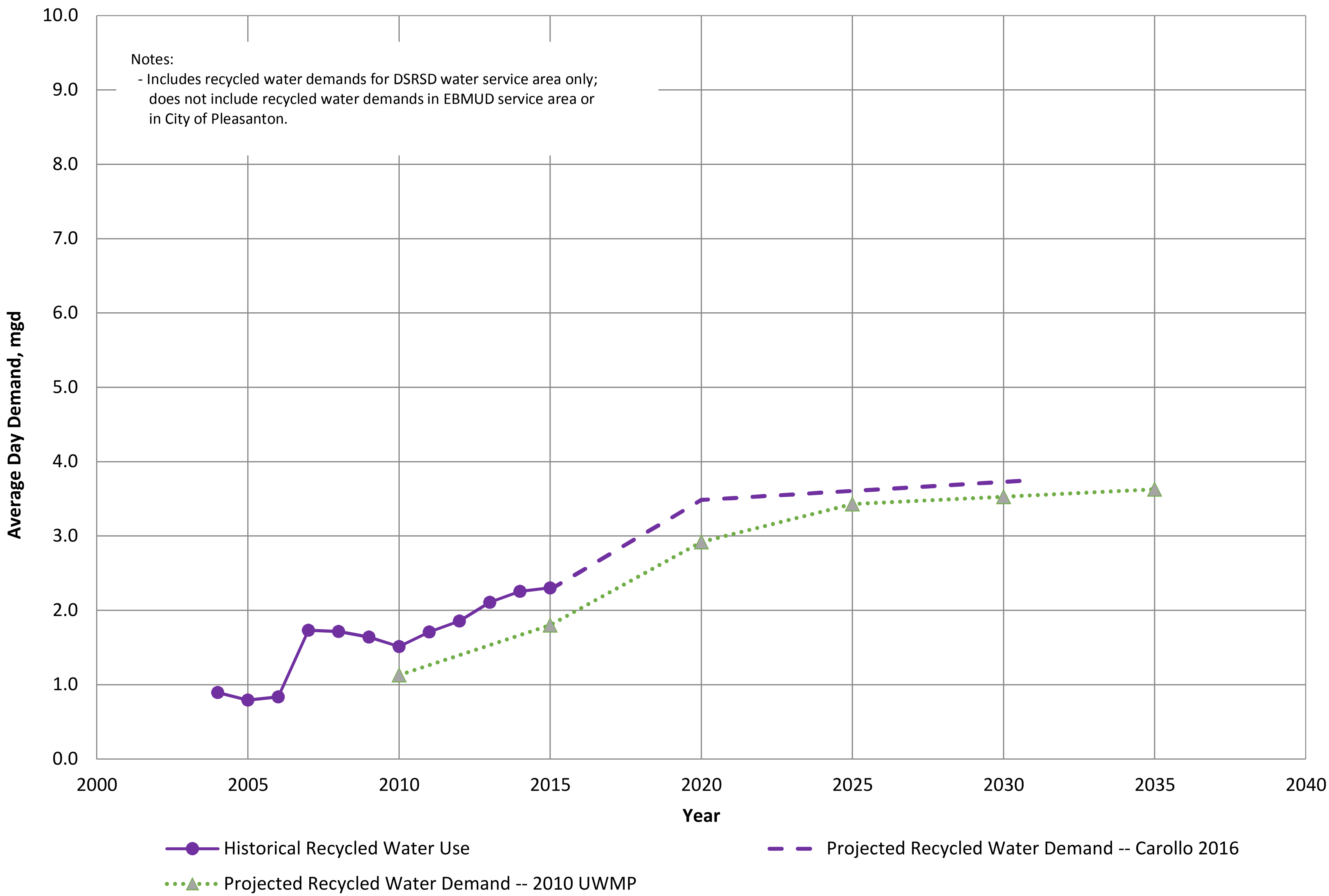
Figure 3-6. Average Day Recycled Water Demand Projections



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CHAPTER 4: SYSTEM PLANNING AND PERFORMANCE CRITERIA

Chapter Contents:

Chapter Purpose

The purpose of this chapter is to define the recommended water system planning and performance criteria to be used for evaluating the required capacity and performance of the District's potable and recycled water systems.

Chapter Highlights

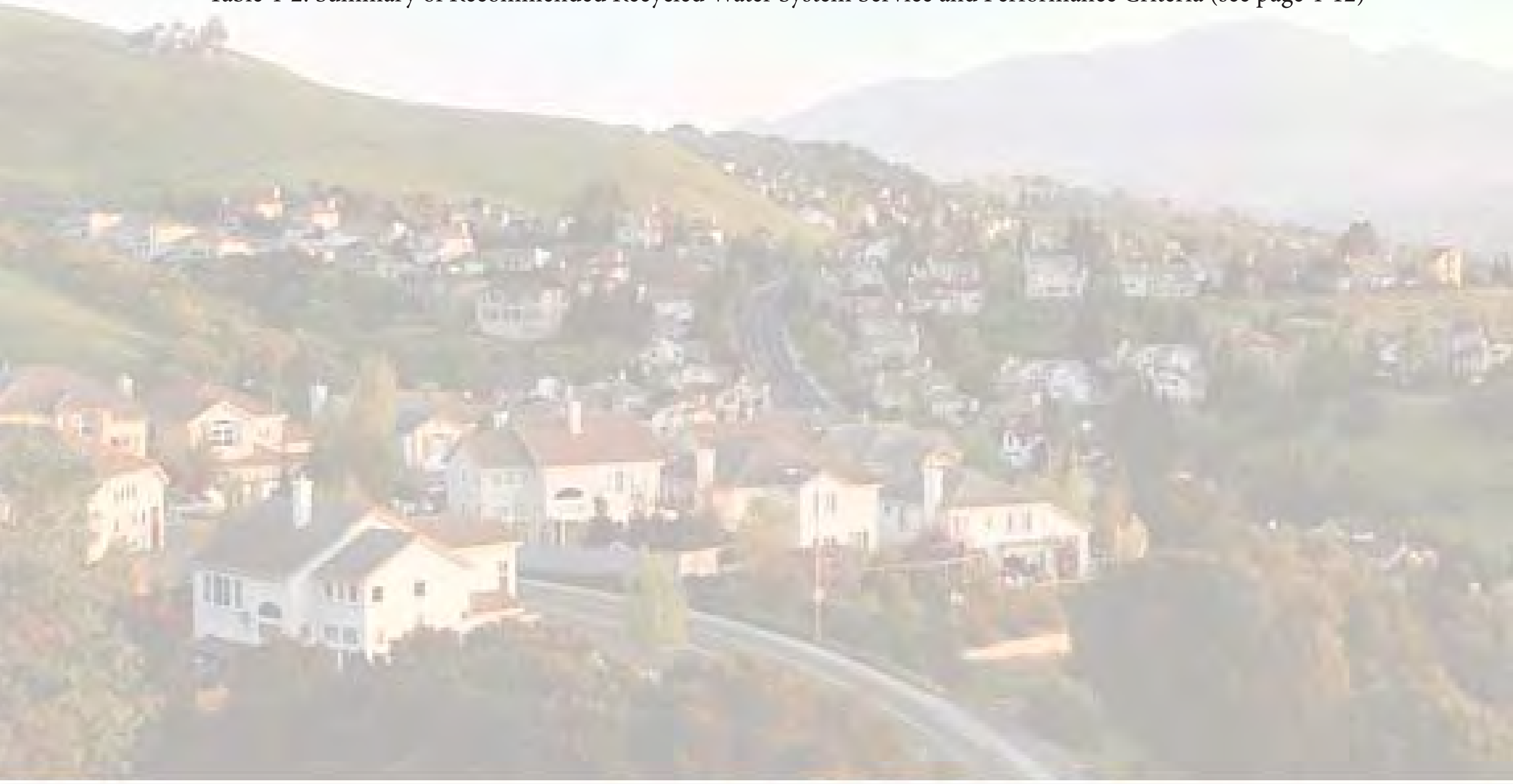
This chapter provides planning and performance criteria for the sizing and evaluation of potable and recycled water facilities, including:

- Pump Station Capacity
- Reservoir Storage Capacity
- Water Transmission and Distribution Pipeline Planning Criteria
    - Pressure Criteria
    - Velocity Criteria
    - Head Loss Criteria

Also see Appendix F for additional information on planning and performance criteria for the recycled water system.

Key Tables in this Chapter

- Table 4-1. Summary of Recommended Potable Water System Service and Performance Criteria (see page 4-3)
- Table 4-2. Summary of Recommended Recycled Water System Service and Performance Criteria (see page 4-12)



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CHAPTER 4
Water System Planning and Performance Criteria

The purpose of this chapter is to define the recommended water system planning and performance criteria to be used for evaluating the required capacity and performance of the District's potable and recycled water systems.

4.1 PLANNING VS. OPERATIONAL CRITERIA

The system planning and performance criteria described in this chapter are used to evaluate the District's existing water system facilities and plan for future water system facilities. However, it should be noted that additional specific operational criteria have been adopted and are being utilized by District operations staff to meet specific seasonal and other low demand conditions.

An example of such operational criteria is the volume of water being maintained in various District potable water storage reservoirs during low demand conditions. The total capacity of the District's storage reservoirs are, for the most part, established based on buildout conditions. Because the District's service area is not yet built out, actual demands are lower than buildout demand conditions, and particularly during the winter months and during the current drought conditions, the required storage volume will be less than the constructed storage capacity. Therefore, specific operational criteria have been adopted by the District to optimize the use of available storage facilities by carefully managing the volume of water in storage to minimize the water quality issues associated with low water turnover in the tank. These operational criteria are specific to current operational conditions and are different than the system planning and performance criteria described in this Water System Master Plan and do not relate to the sizing of new water system facilities to serve buildout conditions, and are therefore not described in this Water System Master Plan.

4.2 POTABLE WATER SYSTEM CRITERIA

Key water system planning and performance criteria from the District's 2005 Water Master Plan have been incorporated into this chapter as applicable. However, some of the previous standards have been slightly modified for this Water System Master Plan to reflect either more recent standards or to address specific District concerns. Key criteria that have changed since the 2005 Water Master Plan are listed below and further discussed in Appendix B:

- Fire flow requirements for Single Family Residential with sprinkler systems;
- Potable water pipeline velocity criteria for transmission and distribution mains;
- Potable water pipeline head loss criteria under fire flow conditions;
- Potable water backup power criteria at pumping facilities; and
- Potable water storage reservoir levels at the start of hydraulic evaluation for normal operating conditions and fire flow conditions.

4.2.1 System Reliability and Water Quality

Potable water system reliability is achieved through a number of system features including:

- Appropriately sized storage facilities;
- Redundant or “firm” pumping and transmission facilities; and
- Alternate power supplies.

Reliability and water quality are also improved by designing looped water distribution pipeline system configurations and avoiding dead-end distribution mains whenever possible. Looping pipeline configurations provide increased reliability for the District’s potable water supply system, and reduce the potential for stagnant water and associated problems of poor taste, possible odor, and low disinfectant residuals. In addition, proper valve placement allows for water system isolation to maintain reliable and flexible system operation under normal and abnormal operating conditions.

As a water purveyor, the District is responsible for ensuring that the applicable water quality standards and regulations are met at all times. The U.S. Environmental Protection Agency (USEPA) and the California SWRCB[1] Division of Drinking Water (DDW) are the agencies responsible for establishing water quality standards for drinking water. USEPA and the SWRCB prescribe regulations that limit the amount of certain constituents and contaminants in water provided by a public water system.

Potable water system facilities located within the District service area should meet the recommended water system service and performance standards (e.g., minimum and maximum system pressures) discussed in the following sections and as summarized in Table 4-1.

[1] As of July 1, 2014, the administration of the State of California Drinking Water Program has transferred from the State of California Department of Public Health (CDPH) to the California State Water Resources Control Board.

Table 4-1. Summary of Recommended Potable Water System Service and Performance Standards

Component	Criteria	Note(s)
POTABLE WATER SYSTEM PERFORMANCE		
Fire Flow Requirements [a, b, c, d]		
Single Family Residential (non-sprinklered)	2,000 gpm @ 2 hours	These are general requirements for master planning purposes, and may not be indicative of requirements for specific developments or buildings. Existing and proposed development should be evaluated on a case-by-case basis. When the construction type of buildings in a new project is known, the Appendix B - 2013 California Fire Code, Table B105.1, shall be used to determine the fire flow requirement. Table B105-1 is included in Appendix A. Two simultaneous fire flows are required by ACFD per pressure zone to evaluate the District's delivery system under maximum day demand conditions.
Single Family Residential (sprinklered)	1,000 gpm @ 2 hours	
Multi-Family Residential	2,500 gpm @ 2 hours	
Commercial	2,500 gpm @ 2 hours	
Institutional	4,000 gpm @ 4 hours	
Industrial / Business Park	4,500 gpm @ 4 hours	
School	4,000 gpm @ 4 hours	
Peak Supply Capacity		
Normal Operating Conditions	Provide firm supply capacity equal to maximum day demand; meet peak hour demand from a combination of supply sources and storage.	Although storage varies daily and seasonally, for conservative planning purposes, it is assumed that storage reservoirs are 75 percent full at the start of hydraulic evaluations.
Fire Flow Conditions	Meet maximum day demand plus fire flow from a combination of supply sources and storage.	Although storage varies daily and seasonally, for conservative planning purposes, it is assumed that storage reservoirs are 50 percent full at the start of hydraulic evaluations.
Distribution System Pressures		
Minimum Pressure - Normal Operating Conditions	*Average Day Demand:* 50 psi at customer service connection *Maximum Day Demand:* 40 psi at customer service connection *Peak Hour Demand:* 40 psi at customer service connection	
Maximum Pressure[e]	200 psi	Per Plumbing Code, new services with pressure greater than 80 psi require an individual pressure regulating device.
Minimum Pressure - Fire Flow Conditions	20 psi	
FACILITIES SIZING		
Zone 7 Turnout Capacity		
Turnout Capacity	Equal to 1.1 multiplied by the maximum day demand	
Pumping Facility Capacity		
Pumping Capacity	Firm pumping capacity equal to maximum day demand in pressure zone	Firm pumping capacity defined as the total capacity of all operational pumps minus the capacity of the largest pumping unit. Pumps located in lower pressure zones must deliver the largest demand requirement for all pressure zones located above them.
Backup Power	Equal to the firm capacity of the pumping facility.	On-site generator for critical stations.[f] Plug-in portable generator for less critical stations.
Water Storage Capacity		
Operational Storage	25 percent of the maximum day demand	
Fire Storage	Fire flow demand for the most severe fire recommended in the pressure zone multiplied by the recommended duration	
Emergency Storage	50 percent of the maximum day demand	
Total Water Storage Capacity	Operational Storage + Fire Storage + Emergency Storage	
Water Transmission and Distribution Pipelines		
Minimum Pipeline Diameter	8-inch diameter (upon review and approval by District staff, 6-inch diameter in small cul-de-sacs and dead-ends with no fire flow requirements or hydrants)	Locate new distribution pipelines within designated utility corridors wherever possible.
Maximum Velocity in Transmission Pipelines greater than 12-inch diameter - Normal Operating Conditions	5 ft/s	Criteria based on requirements for new development. Existing distribution mains will be evaluated on case-by-case basis. Evaluation will include age, material type, velocity, head loss, and pressure.
Maximum Velocity in Distribution Pipelines for 12-inch diameter or less - Normal Operating Conditions	8 ft/s	
Maximum Velocity - Fire Flow Conditions	10 ft/s	
Maximum Head Loss - Fire Flow Conditions	10 ft/1,000 ft	
Hazen Williams "C" Factor	120 for Cement Lined Ductive Iron 130 for Polyvinyl Chloride 150 for HDPE 120-140 for Transite (AC) Pipe	For consistency in hydraulic modeling.
Pipeline Material	*Less than or equal to 12-inch:* Polyvinyl Chloride or Ductile Iron *Greater than 12-inch:* Ductile Iron or HDPE	For consistency in hydraulic modeling.

[a] Construction type and fire flow calculation area are not generally known during the development of a master plan. Therefore, fire flow requirements are based on recommended fire flow standards. Recommended fire flow standards do not include Type V-B construction.
[b] Unique projects or projects with alternate materials may require higher fire flows and should be reviewed by the Fire Marshal on a case-by-case basis (e.g., proposed commercial/industrial areas and schools).
[c] Fire flows to be supplied at a minimum residual system pressure of 20 psi.
[d] Average spacing between fire hydrants shall be between 200 to 500 feet as determined by the recommended fire flow requirements and shall not exceed values listed in Table C105.1 of the 2013 California Fire Code.
[e] District does not have an adopted maximum allowable pressure. For conservative planning purposes, the maximum allowable pressure assigned for evaluation in this Water System Master Plan is 200 psi.
[f] A booster pump station is defined as critical if it provides service to pressure zone(s) without sufficient fire or emergency storage or meets the following criteria:

- The largest facility that provides water to a particular pressure zone;
- A facility that provides the sole source of water to a single or multiple pressure zones and/or service areas; or
- A facility that provides water from a supply turnout.

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4.2.2 Operational Conditions

Maximum day demand, maximum day demand plus fire flow, and peak hour demand conditions are used to assess the adequacy of the District's potable water system facilities and transmission/distribution pipelines during high demand periods. The following sections discuss the assumptions and recommended performance standards for different operating conditions.

4.2.2.1 Maximum Day and Peak Hour Demand -- Normal Operation

Generally, in accordance with California Title 22 requirements and typical potable water system demand criteria, the District's potable water system should have the capability to meet a maximum day demand condition without using storage. For pressure zones with storage, peak hour demand will be assumed to be met from a combination of supply sources (i.e., water supplied from Zone 7 and delivered via pump stations, and water stored in storage tanks). Although the quantity of water storage varies daily and seasonally, for conservative hydraulic modeling purposes, it is assumed that storage reservoirs are 75 percent full at the start of the hydraulic evaluation for planning purposes during a peak hour demand condition.

Evaluations of maximum day demand and peak hour demand conditions will be conducted assuming the largest pump unit at each pump station is in standby mode (i.e., firm pumping capacity). However, in pressure zones served by more than one pump station, only the largest pump serving the zone will be assumed to be out of service. This assumption ensures the reliability and flexibility of the District's potable water system to provide sufficient supply.

4.2.2.2 Fire Flow Conditions

This Water System Master Plan evaluates available fire flows (to assess distribution system adequacy under current and future water demand conditions) by using general land use categories that represent different types of development. Therefore, the fire flow requirements set forth in this Water System Master Plan are intended only for general planning purposes, and may not be reflective of the actual fire flow requirements required by a specific development's size and construction type in accordance with the California Fire Code requirements (see Appendix C), and will not identify specific existing non-conforming developments.

The recommended requirements for the Water System Master Plan fire flow evaluation are based on general land use designations and guidelines from the ACFD and the San Ramon Valley Fire Protection District (SRVFPD). The ACFD has authority over the portions of the District's potable service area that are within the City of Dublin, and the SRVFPD has authority over the portions of the District's potable service area that are within the City of San Ramon (Dougherty Valley).

Minimum fire flow requirements (in gallons per minute (gpm)) and their expected duration are summarized below and also presented in Table 4-1:

- Single Family Residential: 1,000 gpm for 2 hours
- Multi-Family Residential: 2,500 gpm for 2 hours
- Commercial: 2,500 gpm for 2 hours
- Institutional: 4,000 gpm for 4 hours
- Industrial/Business Park: 4,500 gpm for 4 hours
- School: 4,000 gpm for 4 hours

Fire flows may be reduced by up to 50 percent, but in no case to less than 1,000 gpm for single family residential projects or 1,500 gpm for other type building projects, with the installation of an approved National Fire Protection Agency (NFPA) 13 or 13R fire sprinkler system.

As described further in Chapter 5, during the review of fire flow storage requirements for the District's potable water system, the District met with the ACFD to discuss specific parcels in Pressures Zones 2, 3 and 20 that require higher fire flow. The land use types for these parcels include commercial, light industrial/manufacturing, school, and community center/semi-public. The fire storage requirements for these pressure zones are considered large considering the land use within these pressure zones is primarily single family residential. Therefore, fire flow assumptions for several specific parcels were provided to the ACFD Fire Marshal for review. The Fire Marshal provided the District with detailed fire flow requirements for buildings located on those specific parcels. Appendix C provides information received from the Fire Marshal. Based on the Fire Marshal's comments, the required fire flow for the buildings could be reduced by 75 percent, in accordance to the 2013 California Fire Code, because each building has a sprinkler system.

The fire flow applicable for each pressure zone will be based on the highest fire flow requirement designated in that pressure zone of the District's potable water service area, which will be determined based on land uses as defined in the applicable General Plan (City of Dublin or City of San Ramon).

Fire flows are to be met concurrently with a maximum day demand condition while maintaining a minimum residual system pressure of 20 pounds per square inch (psi) in the District's potable water system. These fire flow requirements will be used for the evaluation of the District's potable water system under existing and future water demand conditions. The recommended fire flow criteria are used to determine the appropriate sizing of pipelines to meet current requirements and to guide proper sizing for proposed new pipelines.

Per typical industry standards, the District's potable water system should have the capability to meet a demand condition equal to the occurrence of a maximum day demand concurrent with a single fire flow event while meeting the recommended transmission and distribution pipeline sizing system performance standards discussed under Section 4.2.5. However, as assumed for the 2005 Water Master Plan, two simultaneous fires (one for residential land use and one for commercial land use) per pressure zone are required by the ACFD to evaluate the District's transmission and distribution system under the maximum day demand condition. Also, because most of the land use in Central Dublin is commercial, two simultaneous commercial land use fire events are required to be evaluated for the Central Dublin Pressure Zone.

Additionally, the recommended fire flows and their expected duration are used to establish the required fire flow storage. As assumed for the 2005 Water Master Plan, the ACFD allows the District to assume a single fire flow event for calculating storage requirements (see Section 4.2.4.2 for additional discussion). In pressure zones with storage, maximum day demand plus fire flow will be met by a combination of supply capacity and storage. For planning purposes, it is assumed that storage reservoirs are 50 percent full at the start of the hydraulic evaluation. Assumptions regarding firm pumping capacity will also apply during a maximum day plus fire flow demand condition.

4.2.3 Pumping Capacity

Sufficient water system pumping capacity should be provided to meet the following conditions within the potable water system:

- A maximum day demand with pump stations assumed to operate at firm pumping capacity; and
- Pump stations located in lower pressure zones must deliver the maximum day demand of all pressure zones hydraulically above them.

Pump stations defined as critical[2] should also be equipped with an on-site, backup power generator. Less critical pump stations should be equipped with a plug-in adapter to allow for interconnection to a portable generator, which should be brought to the site by District staff as needed during a prolonged power outage.

4.2.4 Reservoir Storage Capacity

The total treated water storage capacity requirement will be calculated based on the sum of the following three components:

- Operational Storage: Volume of water necessary to meet diurnal peaks observed throughout the day, equal to 25 percent of the maximum day demand;
- Fire Storage: Volume of water necessary to supply a single fire flow event; and
- Emergency Storage: Volume of water necessary to provide emergency supply, assumed to be equivalent to 50 percent of the maximum day demand.

[2] A pump station is defined as critical if it provides service to pressure zone(s) which do not have sufficient fire or emergency storage or meets the following criteria: (1) The largest facility that provides water to a particular pressure zone; (2) A facility that provides the sole source of water to a single or multiple pressure zones; or (3) A facility that provides water from a supply turnout.

Each of these storage components is discussed below. The recommended water storage capacity for the District's potable water system will be evaluated by pressure zone. For pressure zones that have more than one storage tank, the combined storage volume of each pressure zone will be used for storage capacity calculations.

4.2.4.1 Operational Storage

Typically, operational storage is used to meet water demands in excess of available water supply to the pressure zone and to meet the peak hour demands. Operational storage is typically replenished during hours when actual demand is less than the water supply available to the zone. Supply is typically provided at a rate equal to the maximum day demand.

In accordance with AWWA guidelines, and consistent with the 2005 Water Master Plan, an operational storage volume equal to 25 percent of the maximum day demand is recommended.[3]

4.2.4.2 Fire Storage

Fire storage is the volume of storage water reserved for fire flows. The fire storage volume is determined by multiplying the required maximum fire flow rate by the required duration time as described in Section 4.2.2.2 and shown in Table 4-1. As noted above, and consistent with ACFD requirements for the storage evaluation, it is assumed that no more than one fire flow event would occur in any pressure zone at one time.

4.2.4.3 Emergency Storage

A reserve of stored water is also required to meet demands during an emergency. An emergency is defined as an unforeseen or unplanned event that may degrade the quality or quantity of potable water supplies available to serve customers. The three types of emergency events that a water utility typically prepares for are as follows:

- Minor emergency. A fairly routine, normal, or localized event that affects a few customers, such as a distribution or service pipeline break, malfunctioning valve, hydrant break, or a brief power loss. Utilities plan for minor emergencies and typically have staff and materials on-hand and available to mitigate these minor emergencies.
- Major emergency. A disaster that affects an entire, and/or large portion of a water system, lowers the quantity and quality of the water, or places the health and safety of the community at risk. Examples include water treatment plant failures, raw water contamination or major power grid outages. Water utilities seldom experience major emergencies.

[3] AWWA Manual M32, *Distribution Network Analysis for Water Utilities.*

- Natural disaster. A disaster caused by natural forces or events that create a major water utility emergency. Examples include earthquakes, forest or brush fires, hurricanes, tornados or high winds, floods, and other severe weather conditions such as freezing or drought that damage or cause water system facilities to not be able to operate.

Determination of the required volume of emergency storage is a policy decision based on the assessment of the risk of failures, the desired degree of system reliability, the time for staff to repair damaged infrastructure or facilities and water quality concerns. The amount of required emergency storage is a function of several factors including the diversity of the supply sources, redundancy and reliability of the production facilities, and the anticipated length of the emergency outage. The AWWA states that no formula exists for determining the amount of emergency storage required, and that the decision will be made by the individual utility based on a judgment about the perceived vulnerability of the system. As a comparison, the emergency storage criteria for other water suppliers in the area are listed below:

- California Water Service Company: Average Day Demand
- City of Pleasanton: 50 percent of Maximum Day Demand
- City of Stockton: Average Day Demand
- Contra Costa Water District: 75 percent of Maximum Day Demand

Based on this information, the emergency storage component for the District is assumed to be equal to the average day demand (equal to 50 percent of the maximum day demand).

4.2.5 Transmission and Distribution Pipeline Sizing

The following criteria will be used as guidelines for sizing potable transmission and distribution system pipelines. Although these criteria and guidelines have been established, and will be used to size new pipelines, the District's existing potable water system will be evaluated using system pressure as the primary criterion. Secondary criteria, such as pipeline velocity, head loss, age, and material type, are also used as indicators to locate, and to help prioritize where potable water system improvements may be needed. Therefore, the District's existing potable water system will be evaluated on a case-by-case basis. For example, if an existing pipeline experiences velocity or head loss in excess of the criteria described below, this condition, by itself, does not necessarily indicate a problem as long as the minimum system pressure criterion is satisfied. Other conditions such as pipeline age, material type, location and criticality in the system will also be considered.

4.2.5.1 General Definitions and Standards

The following summarizes the general definitions and District standards[4] for transmission and distribution pipelines:

- All new pipelines are required to have a minimum diameter of 8 inches. Upon review and approval by District staff, a 6-inch diameter main is allowed in a small cul-de-sac or dead-end with no fire flow requirements or hydrants.
- All new pipelines less than or equal to 12-inches in diameter are required to be either polyvinyl chloride (PVC) or ductile iron.
- All new pipelines larger than 12-inches in diameter are required to be ductile iron or high-density polyethylene (HDPE) (with District approval).
- New pipelines should be located within designated utility corridors within public rights-of-way, wherever possible, to minimize or eliminate the need for utility easements over private property.
- Hazen Williams coefficient ("C" factor) shall be assumed equal to 120 for Cement-Lined Ductile Iron, 130 for PVC, 150 for HDPE, and 120 to 140 for Transite (asbestos-cement) pipe.

4.2.5.2 Pressure Criteria

Adequate system pressure is a basic indicator of acceptable water distribution system performance. The recommended performance standards for potable water system pressures are:

- Allowable Pressures Under Normal Operating Conditions: 40 psi to 200 psi[5,6]
  - — Minimum Pressure under Maximum Day Demand: 40 psi
  - — Minimum Pressure under Peak Hour Demand: 40 psi
- Minimum System Pressure Under Fire Flow Conditions: 20 psi

These performance standards are applied to all areas that fall within the normal customer service elevation ranges for each pressure zone. As footnoted above, individual services that exceed 80 psi must have an individual pressure regulating device installed on the service line per the California Plumbing Code.

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[4] Dublin San Ramon Services District Standard Procedures, Specifications and Drawings, November 2014.

[5] The District does not have an adopted maximum allowable pressure. For planning purposes, the maximum allowable pressure assumed in this Water System Master Plan is 200 psi.

[6] Individual services that exceed 80 psi must have an individual pressure regulating device installed on the service line per the California Plumbing Code.

4.2.5.3 Velocity Criteria

For planning purposes, West Yost recommends the following velocity criteria for water transmission and distribution system pipelines:

- Maximum velocity of 5 feet per second (ft/s) during normal operating conditions in transmission pipelines, defined as greater than 12-inch diameter;
- Maximum velocity of 8 ft/s during normal operating conditions in distribution pipelines, defined as 12-inch diameter or less; and
- Maximum velocity of 10 ft/s during fire flow conditions.

For the existing water system pipelines, pipeline velocity criteria are not typically used to identify deficient facilities. However, these criteria are used for sizing new transmission and distribution system pipeline facilities.

4.2.5.4 Head Loss Criteria

For planning purposes, West Yost recommends the following head loss criteria for water transmission and distribution system pipelines:

- Maximum head loss of 10 ft/1,000 feet per thousand feet (ft/kft) during fire flow conditions.

Similar to the velocity criteria, for the existing water system pipelines, head loss criteria are not typically used to identify deficient facilities. However, these criteria are used for sizing new transmission and distribution system pipeline facilities.

4.3 RECYCLED WATER SYSTEM CRITERIA

As described in Chapter 2, the District, together with EBMUD, developed the SRVRWP, a joint project operated through DERWA to provide recycled water service to landscape irrigation customers in the San Ramon Valley and adjacent areas. The SRVRWP recycled water system includes components owned by three different agencies:

- DERWA owns the backbone system, including Pump Stations R1 (at the WWTP), R200B, and R200A, as well as reservoirs R100 and R200;
- EBMUD owns and operates the recycled water distribution pipeline system contained within its service area, and has two pump stations (future facilities) and a reservoir; and
- DSRSD operates the DERWA backbone system and owns and operates the recycled water treatment facilities at its wastewater treatment plant that treat wastewater from Dublin, South San Ramon and Pleasanton, and the recycled water distribution pipeline system within its service area, along with three pump stations R300A, R300B, and R20, and two reservoirs R20 and R300.

The following sections describe specific criteria for the sizing of the District's recycled water system facilities and transmission/distribution pipelines. A summary of the recycled water criteria is also provided in Table 4-2.

4.3.1 Operational Conditions

Peak hour demand and minimum (winter) demand conditions are used to assess the adequacy of the District's recycled water system facilities and transmission/distribution pipelines. The following sections discuss the assumptions and recommended performance standards for different operating conditions during peak water demands and during minimum (winter) water demands.

4.3.1.1 Peak Recycled Water Demand – Normal Operation

The peak hour evaluation was conducted assuming peak hour demand is met by storage tanks for each pressure zone. In other words, demands in excess of the maximum day demand are provided from storage.

4.3.1.2 Minimum or No Recycled Water Demand – Tank Fill Condition

During low demand periods, the pump stations refill the recycled water storage tanks. During storage tank refill condition, which typically occurs during very low demand or no demand, the pump stations will operate on high hydraulic head condition which could potentially result in high pressures in some portions of District's recycled water system, as well as relatively high velocity in the recycled water transmission mains. This minimum demand condition was evaluated to assess the adequacy of the District's facilities under these conditions.

Table 4-2. Summary of Recommended Recycled Water System Service and Performance Standards[a]

Component	Criteria	Note(s)
RECYCLED WATER SYSTEM PERFORMANCE		
Peak Supply Capacity		
Peak Water Demands	Provide firm supply capacity equal to maximum day demand; meet peak hour demand from a combination of supply sources and storage.	
Minimum Month Demand (Seasonal) Peaking Factor [b]	0.21 x Average Day Demand	
Maximum Day Demand Peaking Factor [b]	2.50 x Average Day Demand	
Peak Hour Demand Peaking Factor [b]	7.55 x Average Day Demand	
Customer Distribution System Pressures		
Minimum Pressure - Peak Hour Demand Conditions [c]	40 psi at customer service connection	New services with pressure less than 40 psi require an individual booster pump.
Maximum Pressure	125 psi	
DERWA Transmission System Pressures		
Minimum Pressure - Peak Hour Demand Conditions	40 psi at customer service connection	
Maximum Pressure	200 psi	
FACILITIES SIZING		
Pumping Facility Capacity		
Pumping Capacity	Firm pumping capacity equal to maximum day demand in zones (without storage reservoirs) while allowing storage reservoirs to fill within 14-hour period.	Firm pumping capacity defined as the total capacity of all pumps minus the capacity of the largest pumping unit. Pumps located in lower pressure zones must deliver the largest demand requirement of all pressure zones above them.
Backup Power	None	None of the recycled water pump stations have backup power.
Recycled Water Storage Capacity		
Total Recycled Water Storage Capacity	Larger of the following: 1) To meet operational needs plus 10% contingency; or 2) 64% of maximum day demand	
Recycled Water Transmission and Distribution Pipelines		
Minimum Pipeline Diameter	4-inch Diameter	Locate new recycled water pipelines in streets with a minimum of 3 feet from the curb face on the opposite side of the street from potable water mains, and a minimum of 4 feet below the finished street grade.
Maximum Velocity - Normal Operating Conditions	10 ft/s	
Maximum Head Loss - Normal Operating Conditions	10 ft/kft	
Hazen Williams "C" Factor - New Pipelines	135	For consistency in hydraulic modeling.

(a) Design criteria obtained from Appendix A of the April 9, 2001, Technical Memorandum entitled, "5.7 mgd (3.3 mgd DSRSD/2.4 mgd EBMUD) DERWA System Hydraulic Model and Base Project Cost."
(b) Demand peaking factors obtained from the DERWA Model Update and System Evaluation Technical Menorandum, dated November 2015.
(c) Pressure assumed at the pad elevation, which is assumed to be no greater than 20 feet above the pipeline main.

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4.3.2 Pumping Capacity

The recycled water pump stations within the District's recycled water system were planned and designed to meet capacity and facility requirements necessary to ensure they can reliably meet the required recycled water demand conditions. DERWA guidelines[7] for pump station capacity require that the recycled water pump stations must meet the following capacity requirements:

- Pump stations should have the capacity to provide the maximum day demand without assistance from storage tanks; and
- Pump stations should have the capacity to fill storage tanks within a 14-hour non-irrigation period.

Pump stations are equipped with a plug-in adapter to allow interconnection to a portable generator. This requirement will improve the reliability of the recycled water system during a prolonged power outage.

4.3.3 Reservoir Storage Capacity

DERWA guidelines require that recycled water storage tanks meet the larger of the following two capacity requirements:

- Storage tanks should meet operational needs, plus a 10 percent contingency; or
- 64 percent of the maximum day demand.

Storage capacity was evaluated based on each individual pressure zone.

4.3.4 Transmission and Distribution Pipeline Sizing

The general guidelines for recycled system pipelines require that pipelines be sized to meet the following requirements during either a maximum day demand or peak hour demand condition:

- Service pressures for DERWA lines shall be maintained between a maximum of 200 psi and a minimum of 40 psi;
- Service pressures for District customers within the system shall be maintained between a maximum of 125 psi and a minimum of 40 psi;
- Velocities within the District's recycled water distribution system shall be limited to 10 ft/s;
- Head loss within the District's recycled water distribution system shall be limited to 10 ft/kft;
- The District's recycled water distribution pipelines shall not be sized smaller than 4 inches in diameter; and
- Hazen Williams coefficient ("C" factor) shall be assumed equal to 135.

[7] Appendix B – *Summary of Design Assumptions Used in DERWA Predesign*, DERWA Predesign Summary Memorandum, 2001.

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CHAPTER 5: EVALUATION OF EXISTING POTABLE WATER SYSTEM

Chapter Contents:

Chapter Purpose

The purpose of this chapter is to present the evaluation of the District's existing potable water distribution system, and its ability to meet recommended potable water system service and performance standards under various existing potable water demand conditions.

The District's 2013 water demands have been used for this existing system analysis to represent the most current 'normal' demand conditions. The District's 2014 water demand, while available for use in this analysis, is significantly lower than 2013 water demand, reflecting mandatory water use restrictions and water conservation measures in response to drought conditions.

Chapter Highlights

Zone 7 Turnouts:

The District has five turnouts from which it receives Zone 7 water supplies. The total capacity is equal to 1.41 times the District's existing max day demand, and is sufficient to meet existing day demand even if the largest turnout is out of service.

Pumping Capacity:

All of the District's pressure zones have surplus pumping capacity based on the existing maximum day demand. All of the pump stations are equipped with a plug-in adaptor for a portable standby generator; however, only one of the District's pump stations has an on-site emergency generator.

Storage Capacity:

All of the District's pressure zones have adequate storage capacity based on existing demand conditions except for Pressure Zone 2, which has a storage deficit of 0.27 million gallons. Under existing conditions this storage deficit can be supplied from Pressure Zone 3, and therefore, no additional storage in required in Pressure Zone 2 under existing demand conditions.

Distribution System Capacity:

The District's existing distribution system pipelines are adequate to meet existing maximum day plus fire and peak hour demand conditions.

Summary of Existing System Recommendations:

New On-Site Generators: To improve pump station reliability during power outages, five additional on-site backup generators are recommended be provided at the following five pump stations: PS 2C, PS 3A, PS 20B, PS 200A and PS 300B.

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CHAPTER 5
Evaluation of Existing Potable Water System

The purpose of this chapter is to present the evaluation of the District's existing potable water distribution system, and its ability to meet recommended potable water system service and performance standards under various existing potable water demand conditions. Existing water demand conditions evaluated were as determined in *Chapter 3 Existing and Projected Water Demands*. The District's 2013 water demands have been used for this existing system analysis to represent the most current 'normal' demand conditions. The District's 2014 and 2015 water demand, while available for use in this analysis, was significantly lower than 2013 water demand, reflecting mandatory water use restrictions and water conservation measures in response to drought conditions.

5.1 OVERVIEW

The evaluation of the District's existing potable water system included both system capacity and hydraulic performance evaluations. The system capacity evaluation includes an analysis of pumping and water storage capacity. The hydraulic performance evaluation assesses the existing potable water system's ability to meet recommended service and performance standards under maximum day, maximum day demand plus fire flow, and peak hour demand conditions.

Evaluations, findings, and recommendations for addressing any deficiencies identified in the District's existing potable water distribution system are included in this chapter. Recommendations are used to develop a recommended CIP which is further described in Chapter 7.

The following sections present the evaluation methodology and results from the existing potable water system evaluation:

- Existing Potable Water Demands by Pressure Zone,
- Existing Potable Water System Facility Capacity Evaluation,
- Existing Potable Water System Performance Evaluation, and
- Summary of Findings and Recommended Improvements for the Existing Potable Water System.

5.2 EXISTING POTABLE WATER DEMANDS BY PRESSURE ZONE

The potable water demands used for the existing water system evaluation by pressure zone are summarized in Table 5-1. The demands were spatially allocated into the hydraulic model using water meter records from 2013[1]. The total water purchased for 2013 was 11,244 af, averaging 10 mgd[2]. Maximum day and peak hour demands were calculated based on the adopted peaking factors of 2.0 and 2.4 times the average day demand, respectively, as described in *Chapter 3 Existing and Projected Water Demands*.

[1] Source: *Con_his(062614).xlsx and Standard Water Audit - 12 Dec 2013.xls* received from the District.

[2] The District's 2013 water demands have been used for this existing system analysis to represent the most current 'normal' demand conditions. The District's 2014 water demand, while available for use in this analysis, was significantly lower than 2013 water demand, reflecting mandatory water use restrictions and water conservation measures in response to drought conditions.

Table 5-1. Summary of Existing Potable Water Demands by Pressure Zone

Pressure Zone	Average Day Demand [a]		Maximum Day Demand [b]		Peak Hour Demand [c]	
	gpm	mgd	gpm	mgd	gpm	mgd
Zone 1	3,345	4.82	6,690	9.63	8,028	11.56
Zone 2	281	0.40	562	0.81	674	0.97
Zone 3	236	0.34	472	0.68	566	0.82
Zone 4	86	0.12	173	0.25	208	0.30
Zone 20	784	1.13	1,568	2.26	1,882	2.71
Zone 30	297	0.43	593	0.85	712	1.03
Zone 200	617	0.89	1,234	1.78	1,481	2.13
Zone 300	1,298	1.87	2,597	3.74	3,116	4.49
Total	6,944	10.00	13,889	20.00	16,666	24.00

(a) Based on 2013 water meter records and globally scaled to represent total water purchased in 2013.
Water meter records were spatially located and then aggregated by pressure zone. The sources of water meter record data were con_hist(062614).xlsx and Standard Water Audit - 12 Dec 2013.xls files provided by the District.

(b) Maximum day demand calculated using a peaking factor of 2 times the average day demand.

(c) Peak hour demand calculated using a peaking factor of 2.4 times the average day demand.

5.3 EXISTING POTABLE WATER SYSTEM FACILITY CAPACITY EVALUATION

To evaluate the capacity of the existing potable water facilities, the following analyses were conducted:

- Zone 7 Turnout Capacity Evaluation,
- Potable Pumping Capacity Evaluation, and
- Potable Storage Capacity Evaluation.

The results of the existing water system facility capacity evaluation are discussed below.

5.3.1 Zone 7 Turnout Capacity Evaluation

The District purchases potable water from Zone 7 which is conveyed to the District's potable water system through five turnouts. The total capacity of these turnouts is 28.27 mgd, as shown in Table 5-2. This total capacity is equal to 1.41 times the District's existing maximum day demand of 20 mgd. If the largest turnout is out of service at any given time due to mechanical breakdowns or scheduled maintenance, the total capacity of these turnouts is still large enough to meet the existing maximum day demand.

Table 5-2. Existing District Turnout Facilities

Turnout	Maximum Design Capacity, gpm	Maximum Design Capacity, mgd
1	5,000	7.20
2[(a)]	3,630	5.23
3[(b)]	0	0
4	5,000	7.20
5	6,000[(c)]	8.64
Total	19,630	28.27

(a) Turnout 2 capacity is based on the average recorded flow rate at PS 1A. The average flow rate value was calculated based on Turnout 2 flows from 2009 to 2013 (*Source: Max day and avg day demand 2005-2013.xlsx*).
(b) Turnout 3 is planned to be removed in the future as development in its vicinity occurs.
(c) The actual capacity of Turnout 5 ranges between 5,200 and 5,300 gpm.

5.3.2 Potable Pumping Capacity Evaluation

The District's pumping facilities are used to deliver potable water to pressure zones that cannot be supplied directly from the Zone 7 turnouts. Currently, the District operates one pump station to deliver water from Zone 7's Turnout 2 to Pressure Zone 1, and sixteen additional pump stations to deliver water to the District's higher pressure zones[3]. The pumping capacity evaluation criteria and results from the evaluation are provided below.

[3] Including Pump Station 10A which has not been operated because Reservoir 10A has been off-line.

The District's pump stations were evaluated based on the criteria described in *Chapter 4 System Planning and Performance Criteria* (see Table 4-1). These criteria include the ability to deliver a firm, reliable capacity equal to the maximum day demand within each pressure zone, or any pressure zones located above that pressure zone.

Firm capacity assumes a reduction in total pumping capacity to account for pumps that are out of service at any given time due to mechanical breakdowns, maintenance, water quality, or other operational issues. At each pump station, firm pumping capacity was defined as the total pump station capacity with one pump out of service.

Table 5-3 compares the existing firm pumping capacity with required firm pumping capacity for existing water demand conditions. This table shows the service zones and the corresponding supported zones, their associated water demand, and the pump stations serving each service zone. For example, Pump Station (PS) 1A directly serves Zone 1, but must also have sufficient pumping capacity to supply Zones 2, 20 and 200 because they are supported by Zone 1. Table 5-3 indicates that all service zones have surplus pumping capacity in excess of the existing maximum day demand. The firm pumping capacity surplus ranges from 207 to 2,939 gpm.

All of the District's existing pump stations are equipped with a plug-in adaptor for a portable standby generator, except PS 4B which has an on-site generator that was installed to meet the fire flow requirement in Zone 4. The District owns two portable standby generators. Currently, there is no regulation on the number of on-site generators and/or portable standby generators that a water utility agency should maintain. The standard practice for emergency preparedness recommends backup power at critical facilities to maintain an acceptable level of service during a power outage[4].

It is recommended that the District provide permanent, on-site backup generators at the most critical pump stations (those serving multiple pressure zones). It is recommended that on-site backup generators be provided at the following five pump stations: PS 2C, PS 3A, PS 20B, PS 200A and PS 300B. If space at these existing pump stations is unavailable for a permanent, on-site backup generator, a combination of on-site backup generators and portable standby generators is recommended for these five pump station sites.

5.3.3 Potable Storage Capacity Evaluation

Potable water system storage provides the following:

- Operational storage to balance differences in demands and supplies,
- Emergency storage in case of supply failure, and
- Water to fight fires.

[4] "Is Your Water or Wastewater System Prepared? What You Need to Know About Generators" United States Environmental Protection Agency Mid-Atlantic, EPA 903-F-11-002, March 2011.

Table 5-3. Comparison of Existing and Required Pumping Supply Capacity

Service Zone and Supported Upper Zones	Maximum Day Demand, gpm	Pump Station/Turnout	Existing Supply Capacity, gpm[a]		Required Firm Supply Capacity, gpm	Firm Supply Capacity Surplus (Deficit), gpm	Backup Power at Pump Station
			Total Capacity	Firm Capacity[b]			
Zone 1	6,690	1A[c]	3,600	2,400	10,054	1,114	Plug-in adaptor for standby generator
		10A	3,150	2,100			
		Zone 7 Turnouts[d]	11,668	6,668			
		Total	18,418	11,168			
Zone 2	562	2A	600	300	1,034	566	Plug-in adaptor for standby generator
		2B	600	300			
		2C	1,000	1,000			
		Total	2,200	1,600			
Zone 3	472	3A	600	400	645	605	Plug-in adaptor for standby generator
		3B	375	250			
		3C	900	600			
		Total	1,875	1,250			
Zone 4	173	4A	1,200	800	173	1,027	PS 4A has a plug-in adaptor for standby generator; and PS 4B has on-site backup generator which is required to meet the fire flow requirement in Zone 4
		4B[e]	400	400			
		Total	1,600	1,200			
Zone 20	1,568	20A	2,250	1,500	3,460	1,289	Plug-in adaptor for standby generator
		20B	4,332	3,249			
		Total	6,582	4,749			
Zone 30	593	30A	1,200	800	593	207	Plug-in adaptor for standby generator
		Total	1,200	800			
Zone 200	1,234	200A	3,720	2,790	2,532	258	Plug-in adaptor for standby generator
		Total	3,720	2,790			
Zone 300	2,597	300A	2,604	1,736	2,597	2,939	Plug-in adaptor for standby generator
		300B	3,750	2,500			
		300C	1,950	1,300			
		TOTAL	8,304	5,536			

(a) Nominal pump capacities (summarized in Table 2-6) were used to evaluate pumping supply capacity.

(b) Firm pumping capacity is defined as the total pumping capacity with the largest pump unit out of service.

(c) Zone 7 Turnout No. 2 is the supply for the District's PS 1A.

(d) Zone 7 Turnout capacities were based on the maximum capacity of Turnouts 1 and 4. Because Turnout 5 serves both Zone 20 and Zone 1, the capacity of Turnout 5 was reduced by the total capacity of PS 20B. The remaining capacity of Turnout 5 was applied to Zone 1. The firm capacity of Zone 7 supply for Zone 1 was calculated based on Turnout 4 and partial capacity of Turnout 5. Additionally, Turnout 3 is planned to be removed in the future; therefore, the capacity of Turnout 3 was not included.

(e) PS 4B has a lead pump and a lag pump, but no standby pump, so firm pumping capacity equals total pumping capacity.

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The District's potable water storage capacity requirement is as follows:

- Operational storage equal to 25 percent of a maximum day demand;
- Emergency storage equal to 50 percent of a maximum day demand; and
- Fire flow storage equal to the highest fire flow and duration recommended in a particular pressure zone based on land uses within the pressure zone.

During review of the fire flow storage requirements for the District's potable water system, the District met with the ACFD to discuss specific parcels in Pressure Zones 2, 3 and 20 that require higher fire flow. The land use types for these parcels include commercial, light industrial/manufacturing, school, and community center/semi-public. The fire storage requirements for these pressure zones are considered large considering the land use within these pressure zones is primarily single family residential. Therefore, fire flow assumptions for several specific parcels were provided to the ACFD Fire Marshal for review.

The Fire Marshal provided the District with detailed fire flow requirements for buildings located on the specific parcels. Appendix C provides information received from the Fire Marshal. Based on the Fire Marshal's comments, the required fire flow for the buildings could be reduced by up to 75 percent, in accordance to the 2013 California Fire Code, because each building has an automatic fire sprinkler system. However, the resulting fire flow shall not be less than 1,500 gpm.

Table 5-4 compares the District's available storage capacity with the required storage capacity by pressure zone. The comparison between the District's available required storage capacities indicates that there is an existing storage deficit in Zone 2. The existing storage deficit in Pressure Zone 2 is 0.27 MG. The fire flow storage requirement in Pressure Zone 2 was calculated based on the commercial fire flow requirement of 1,625 gpm for a 4-hour period which was provided by the Fire Marshal. This commercial fire flow requirement includes a fire flow reduction of up to 75 percent for an automatic fire sprinkler system.

In Pressure Zone 2, storage is sufficient for normal operations and emergencies, but insufficient for normal operations, emergencies and fire flow volume. Pump stations that supply Zone 2 are equipped with a plug-in adaptor for a portable standby generator, and are recommended to be equipped with on-site generators (see Section 5.3.2 above) to improve their reliability to supply the zone during an emergency or fire, if power is disrupted at the pump station. Additionally, Pump Station 3A has a pressure reducing/sustaining valve which could provide supply from Pressure Zone 3 to Pressure Zone 2 during a fire flow event. Because backup power and a pressure reducing/sustaining valve at Pump Station 3A provide supply reliability for this zone, additional storage is not recommended for the existing storage deficiency. Storage needs will also be evaluated for these zones for future demand conditions (see Chapter 6).

It should also be noted that the existing Reservoir 10A, constructed in the 1940s, is located at a higher elevation and higher HDL than other reservoirs in Zone 1 and requires a complex operational strategy for Zone 1 operations. As part of the future system evaluation described in Chapter 6, alternatives for future Zone 1 storage have been evaluated to possibly replace the existing Reservoir 10A (see also Appendix D).

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Table 5-4. Summary of Existing Potable Water Storage Capacity Evaluation

Pressure Zone	Storage Reservoir	Available Storage Capacity, MG: Reservoir Capacity	Available Storage Capacity, MG: Total Available Storage	Required Fire Flow Duration, hours[a]	Required Fire Flow, gpm [a]	Required Storage Capacity, MG: Operational[b]	Required Storage Capacity, MG: Fire Flow [c]	Required Storage Capacity, MG: Emergency[d]	Required Storage Capacity, MG: Total	Storage Capacity Surplus (Deficit), MG
Zone 1	1A	2.00	10.35	4	4,500	2.41	1.08	4.82	8.31	2.04
	1B	2.35 [e]								
	10A	3.00								
	10B	3.00								
Zone 2	2A	0.72	0.72	4	1,625 [f]	0.20	0.39	0.40	0.99	(0.27)
Zone 3	3A	0.65	0.99	2	2,500 [g]	0.17	0.3	0.34	0.81	0.18
	3B	0.34								
Zone 4	4A	0.70	0.70	2	2,500	0.06	0.30	0.12	0.48	0.22
Zone 20	20A	3.30	3.30	4	4,000	0.56	0.96	1.13	2.65	0.65
Zone 30	30A	1.12	1.12	2	1,500	0.21	0.18	0.43	0.82	0.30
Zone 200	200A	2.60	3.80	4	4,000	0.44	0.96	0.89	2.29	1.51
	200B	1.20								
Zone 300	300A	2.30	4.00	4	4,000	0.93	0.96	1.87	3.76	0.24
	300B	1.70								
	TOTAL	24.98	24.98			4.98	5.13	10.00	20.11	4.87

[a] Based on the highest fire flow requirement within the pressure zone.
[b] Equal to 25 percent of maximum day demand.
[c] Equal to the fire flow requirement (gpm) multiplied by the required duration (hours).
[d] Equal to 50 percent of maximum day demand.
[e] Total reservoir capacity is 4 MG which is shared between the District and Zone 7 Water Agency. 1.175 MG of working storage is owned by DSRSD and 1.175 MG of working storage is leased by DSRSD from Zone 7 through 4/18/2033 per Supplemental Zone 7/DSRSD Agreement dated 2/20/1990.
[f] Land use category in Zone 2 includes single family residential and commercial/office. Three commercial properties in Zone 2 were provided to the Alameda County Fire Marshal for review. Alameda County Fire Marshal provided the fire flow requirement for these special commercial buildings which is included in Appendix C. Based on this information, the highest fire flow requirement in Zone 2 would be for the DeSilva Gate Construction building that requires a 6,500 gpm for a 4-hour fire flow duration. Because the building has a sprinkler system, the fire flow requirement could be reduced by up to 75 percent (but not resulting in a fire flow less than 1,500 gpm) which resulted a fire flow requirement of 1,625 gpm. For the Water Master Plan, the required fire flow storage is calculated based on the 1,625 gpm for a 4-hour fire flow duration.
[g] Land use category in Zone 3 includes single family residential, multi-family residential (California Highland), and school (Valley Christian Center). The Alameda County Fire Marshal has reviewed the school property, and determined the fire flow requirement for the school is 5,500 gpm for a 4-hour fire flow duration. The Alameda County Fire Marshal confirmed that the school building has a sprinkler system. Therefore, the fire flow requirement could be reduced by up to 75 percent (but not resulting in a fire flow less than 1,500 gpm) which resulted a fire flow requirement of 1,500 gpm. Because the fire flow requirement for the multi-family residential in Zone 3 (multi-family residential fire flow requirement is 2,500 gpm for a 2-hour duration) is higher than the reduced school fire flow requirement, the required fire flow storage calculation for Zone 3 in this Water Master Plan is based on 2,500 gpm flow for 2-hour duration.

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5.4 EXISTING POTABLE WATER SYSTEM PERFORMANCE EVALUATION

The purpose of the existing potable water system performance evaluation is to identify necessary improvements to support the District's existing potable water demands while meeting the District's recommended potable water system planning and design criteria.

The following evaluations were performed to assess distribution system performance under existing potable water demand conditions:

- Normal Operations – Peak Hour Demand Scenario: This scenario evaluates customer service pressures in the system during a peak hour demand condition.
- Emergency Operations – Maximum Day plus Fire Flow Scenario: This scenario evaluates fire flow availability in the system under a maximum day demand condition.
- Extended Period Simulation – Maximum Day Demand Scenario: This scenario evaluates the hydraulics of the system during a maximum day demand (non-fire) condition over a 72-hour period.

The water system hydraulic model developed and updated for the Water System Master Plan was used to evaluate the existing potable water system performance[5]. The existing potable water system is expected to deliver peak hour flows and maximum day demand plus fire flow within the acceptable pressure, velocity and head loss ranges as identified in the planning and design criteria presented in Chapter 4.

5.4.1 Normal Operations – Peak Hour Demand Scenario

5.4.1.1 Evaluation Overview

A steady-state hydraulic evaluation was conducted using the hydraulic model to evaluate system performance under an existing peak hour demand condition. As shown in Table 5-1, the peak hour demand for the existing water service area was calculated to be 16,666 gpm (24 mgd). This analysis assumed that storage reservoirs are 75 percent full and pump stations are operating at their firm capacity.

During a peak hour demand condition, a minimum pressure of 40 psi and a maximum pressure of 120 psi must be maintained at service connections throughout the entire potable water system. In addition, for pipelines, it is recommended that the maximum velocities should not exceed 5 fps in transmission pipelines or 8 fps in distribution pipelines during normal operating conditions, to help minimize energy (pumping) costs and excessive head loss due to undersized pipelines.

[5] The development and update of the water system hydraulic model is described in the DSRSD Water System Hydraulic Model Modeler's Notebook dated December 2015.

5.4.1.2 Evaluation Results

Results from the peak hour demand simulation indicate that the existing potable water system can meet the District's minimum pressure criterion of 40 psi at all customer services, except for the locations described in Table 5-5 and shown in red on Figure 5-1.

Table 5-5. Summary of Existing System Peak Hour Evaluation Results

Zone-Area	Finding	Recommendation
Pressure Zone 1: Low pressures occur in the Central Dublin and West Dublin areas.	Low pressures in Central Dublin range from 33 to 36 psi and are located near Pump Station 10A, and at Crossridge Road. The simulated pressures near Pump Station 10A are at hydraulic model junctions with no customer demands. The simulated pressures at Crossridge Road are 36 psi. The elevations of the model junctions range from 426 to 428 feet which is close or equal to the normal highest customer service elevation of 428 feet for the pressure zone. Low pressures in the West Dublin area of Pressure Zone 1 are located near the suction pipelines of Pump Stations 2A and 2B. Pressures are 39 psi. The elevations of these areas range from 414 to 416 feet, which is close to the normal highest customer service elevation. Additionally, there are no customer demands at these locations.	No mitigation is recommended.
Pressure Zone 2: There are three low pressure areas, located on Bay Laurel Street, Hansen Drive and Betlen Drive.	The simulated peak hour pressures range from 18 psi to 36 psi. After reviewing the area with District staff, there are no customer services located in these areas. The residential customers in these areas are served by Pressure Zone 3 transmission mains which parallel the Pressure Zone 2 transmission mains.	No mitigation is recommended.
Pressure Zone 3: There are three low pressure areas (Marwick Drive, Valley Christian School property, and the intersection of Inspiration Circle and Mountain Rise Place).	Simulated peak hour demand condition pressures range from 30 to 39 psi. Service elevations for these areas range from 742 to 764 feet which are near or above the normal highest customer service elevation of 746 feet for this pressure zone. The static pressure at elevation 764 feet is 32 psi, as calculated from the tank overflow elevation.	No mitigation is recommended.
Pressure Zone 30: There is an area located downstream of the Reservoir 30A where low pressures occur.	There are no customer demands in this area. Pressures are 36 psi. Elevations at this area range from 796 to 798 feet, which is located above the normal customer service elevation of 794 feet for this pressure zone.	No mitigation is recommended.

The simulated velocity results indicate all pipelines within the District's potable water network met the velocity criterion of 5 fps in transmission pipelines and 8 fps in distribution pipelines, except for discharge pipelines of Pump Station 20A (these pipeline velocities were 7.3 fps which exceeded the transmission pipeline velocity criterion of 5 fps). However, because pipeline velocity is a secondary criterion, no improvements are recommended since the primary criterion (pressure) is met.

5.4.2 Emergency Operations – Maximum Day Demand plus Fire Flow Scenario

5.4.2.1 Evaluation Overview

To evaluate the existing potable water system under the maximum day demand plus fire flow scenario, InfoWater's "*Available Fire Flow Analysis*" tool was used to determine the available fire flow while maintaining a minimum residual pressure of 20 psi at all service junctions within the zone. For the existing system fire flow analysis, key junctions that represent hydrant locations were evaluated to determine the available flow that can be provided, in addition to meeting the maximum day demand. The analysis assumed that storage reservoirs are 50 percent full and pump stations are operating at their firm capacity. Maximum velocity was not considered in the evaluation because it is a secondary design criterion.

As discussed in *Chapter 4 System Planning and Performance Criteria*, recommended fire flow criteria are established for new developments. Currently, the District does not have a specific policy requiring the replacement of pipelines or other mitigation measures to meet current fire flow standards since much of the existing distribution system is older and was designed to meet standards in place at the time of development. This policy is consistent with other utilities within the region that may have a fire flow deficit in their service area where older developments were built under less stringent fire flow requirements.

5.4.2.2 Fire Flow Evaluation Results

Figure 5-2 summarizes the available fire flow at each hydrant location while meeting the minimum residual pressure criterion of 20 psi. Results presented on Figure 5-2 are representative of the system capacity and do not represent available flow from a specific hydrant.

As shown on Figure 5-2, there are areas in Pressure Zones 1, 2, 3 and 300 that could not provide the required fire flow at a single location. However, as noted in Table 5-6, fire flow demand in these areas could be met by multiple hydrants at most locations. Therefore, as noted, no mitigation is recommended in most cases.

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Table 5-6. Summary of Existing System Fire Flow Evaluation Results

Zone-Area	Finding	Recommendation
Zone 1 – Area 1: This area is within the redevelopment of Parks RFTA that would include new barracks, administrative offices, training facilities, maintenance facilities and a 300-room hotel.	A 2,500 gpm fire flow is required for the area. The available fire flow at system residual pressure in this area ranges from 730 to 2,350 gpm.	The redevelopment project would include new potable water system infrastructure that would be designed to adequately serve the community in this area; therefore, no mitigation is recommended.
Zone 1 – Area 2: This area is within the Dublin Crossing project area that encompasses mixed-used residential community with commercial, retail, parks and open space land uses. The project area may also include a 12-acre elementary school.	A 4,000 gpm fire flow is required for the area due to the school land use, but could be reduced by up to 75 percent if an automatic fire sprinkler system is installed; however, the resulting fire flow shall not be less than 1,500 gpm. The available fire flow at system residual pressure in this area ranges from 1,640 to 8,250 gpm.	The redevelopment project would include new potable water system infrastructure that would be designed to adequately serve the community in this area[a]; therefore, no mitigation is recommended.
Zone 1 – Area 3: This area is located between Scarlet Court and Scarlet Drive.	The available fire flow at this location ranges from 3,300 to 4,200 gpm. This area is a looped by a 6-inch diameter pipeline which is connected to an existing 12-inch diameter pipeline. The fire flow requirement for this area is 4,500 gpm which is required for an industrial land use type.	Multiple hydrants could be used to meet fire flow requirement during fire flow event; therefore, no mitigation is recommended.
Zone 1 – Area 4: This area includes Donlon Way and Hansen Drive/ Dublin Boulevard.	The land use types in these areas are commercial and industrial, respectively. The fire flow requirement for commercial is 2,500 gpm, and the fire flow requirement for industrial is 4,500 gpm. These requirements can be reduced by up to 75 percent if buildings have automatic fire sprinkler systems; however, the resulting fire flow shall not be less than 1,500 gpm. Available fire flow in these areas under a minimum pressure of 20 psi ranges from 1,783 to 4,157 gpm;	No mitigation is recommended.
Zone 1 – Area 5: This area includes San Sabana Road, Mape Way and Calle Verde Road.	The land use type in this area is a single family residential. The fire flow requirement for a single family residential is 1,500 gpm if it is sprinklered or 2,000 gpm if it is non-sprinklered and its size is unknown. The available fire flow at 20 psi residual pressure ranges from 1,300 to 1,625 gpm. The average building size in this neighborhood is approximately 1,905 square feet. Based on the 2013 California Fire Code, any Type V-B building that is under 3,600 square feet should have a minimum 1,500 gpm fire flow for a 2-hour flow duration if an automatic sprinkler is not available[b]. Based on the 2013 California Fire Code for Type V-B buildings, some houses in this area meet the fire flow requirement.	For houses that have available fire flow less than 1,500 gpm, no mitigation is recommended at this time. This is because this area is an older neighborhood (based on pipeline installation year – 1962) which may have been built based on different standards in place at the time of development. However, it is recommended to consider installing larger diameter pipelines in this area in the future as part of the District's pipeline renewal and replacement program.
Zone 1 – Area 6: This area is near the suction side of the PS 2C on Shannon Avenue.	The land use type in this area is institutional (St. Raymond School) which requires a 3,750 gpm fire flow based on information received from the ACFD Fire Marshal. This fire flow could be reduced by up 75 percent because it has an automatic fire sprinkler system; however, the resulting fire flow shall not be less than 1,500 gpm. Available fire flow at this area ranges from 2,300 to 2,500 gpm.	No mitigation is recommended.
Zone 1 – Area 7: This area includes two school land use parcels: 1) Murray Elementary School located on Davona Drive, and 2) Frederiksen Elementary School located on Tamarack Drive.	A 4,000 gpm fire flow is required for a school land use type. Fire flow at these two school locations are 2,200 and 2,900 gpm.	At these school properties, there are multiple hydrants which can be used to meet the 4,000 gpm fire flow requirement, therefore, no mitigation is recommended.
Zone 1 – Area 8: Fire flow deficiencies occur in the single family residential area which requires either a 1,500 gpm fire flow if it has an automatic sprinkler system or 2,000 gpm if the building does not have an automatic sprinkler system and its size is unknown.	The available fire flow in this area ranges from 1,200 gpm to 1,700 gpm. The houses in this area are under 3,600 square feet. Based on the 2013 California Fire Code, any Type V-B building that is under 3,600 square feet should have a minimum 1,500 gpm fire flow for 2-hour flow duration if an automatic sprinkler is not available. Based on the 2013 California Fire Code, some houses in this area meet the fire flow requirement.	For houses that have available fire flow less than 1,500 gpm, no mitigation is recommended at this time. This is because this area is an older neighborhood (based on pipeline installation year – 1960s) which may have been built based on different standards in place at the time of development. However, it is recommended to consider installing larger diameter pipelines in this area in the future as part of the District's pipeline renewal and replacement program.
Zone 2: Fire flow deficiencies occur in the single family residential area.	The fire flow requirement for a single family residential is 1,500 gpm if it is sprinklered or 2,000 gpm if it is non-sprinklered and its size is unknown. The houses in this Zone 2 area are less than 3,600 square feet. Based on the 2013 California Fire Code, any Type V-B building that is under 3,600 square feet should have a minimum 1,500 gpm fire flow for 2-hour flow duration if an automatic sprinkler is not available.	Based on the 2013 California Fire Code, no mitigation is recommended because the houses in this area meet the 1,500 gpm fire flow criteria.
Zone 3: This area includes Valley Christian School.	The fire flow requirement for the school is 5,500 gpm based on fire flow information received from the ACFD Fire Marshal. This fire flow could be reduced by up to 75 percent because it has an automatic fire sprinkler system; however, the resulting fire flow shall not be less than 1,500 gpm. The available fire flow in this area ranges from 3,400 gpm to 4,000 gpm.	No mitigation is required.
Zone 30: This area includes Cantara Drive and Positano Parkway.	The fire flow requirement for a public parcel is 4,000 gpm. The available fire flow at this location ranges from 3,170 to 3,360 gpm.	Multiple hydrants could be used to meet fire flow requirement. No mitigation is recommended.
Zone 200: This area includes Stoneleaf Drive.	The fire flow requirement for a public parcel is 4,000 gpm. The available fire flow at this location ranges from 3,600 to 3,800 gpm.	Multiple hydrants could be used to meet fire flow requirement. No mitigation is recommended.
Zone 300: This area includes Sherwood Way.	The land use type for this area is a school which has a fire flow requirement of 4,000 gpm. The available fire flow in this area ranges from 3,800 gpm to 4,000 gpm.	Multiple hydrants could be used to meet fire flow requirement. No mitigation is recommended.

[a] Dublin Crossing Project Evaluation of Required Potable Water, Recycled Water and Sanitary Sewer Infrastructure Technical Memorandum prepared and documented by West Yost Associate on August 22, 2013.

[b] 2013 California Fire Code, Appendix B, Table B105.1 – Minimum Required Fire Flow and Flow Duration for Buildings.

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5.4.2.3 Multiple Simultaneous Fire Flow Evaluation Results

Based on ACFD's requirement, the existing system located within Alameda County is required to be able to meet multiple fire events. Therefore, in addition to the single fire flow event evaluation described above, West Yost also simulated two simultaneous fires in all pressure zones within Alameda County (Pressure Zones 1, 2, 3, 4, 20 and 30). There is no multiple fire event requirement for Pressure Zones 200 and 300, because these pressure zones are located outside Alameda County, and are governed by the SRVFPD, which does not have a multiple fire event requirement.

The two simultaneous fire events evaluation includes the following:

- One fire event for a single family residential land use and one fire event for a commercial land use;
- Two single family residential fire flow events when there is no commercial land use existing within the pressure zone; or
- Two commercial fire flow events in the Central Dublin area that consists mostly of commercial land use.

Figure 5-3 presents the locations of the simulated multiple simultaneous fire flow (MSFF) events. These locations were randomly chosen based on the land use type. Results indicate the District's potable water system within the Alameda County could meet the minimum 20 psi residual pressure when two simultaneous fire events occur.

5.4.3 Extended Period Simulation – Maximum Day Demand Scenario

5.4.3.1 Evaluation Overview

The purpose of the maximum day demand extended period simulation (EPS) evaluation is to further assess the hydraulics of the District's potable water system including reservoir levels during a 72-hour simulation (three successive maximum days). A 72-hour period was selected for the maximum day demand EPS evaluation to provide results that are not influenced by the initial conditions from the storage reservoirs. Generally, reservoir levels are expected to cycle within their operational storage criteria in an effort to maintain adequate water quality. A 72-hour EPS was conducted using the hydraulic model to evaluate system performance under maximum day demand (non-fire) conditions.

Two EPS simulations were conducted as follows:

- EPS Simulation 1: Assumed Zone 7 Turnouts 1, 2, 4 and 5 were operated at their maximum design flow capacity as presented in Table 5-2. The average maximum day demand for the 72-hour period is 13,889 gpm (20 mgd) as presented on Table 5-1. This maximum day demand represents the planned existing maximum day demand (two times the existing average day demand).

- EPS Simulation 2: Assumed Turnouts 1, 2 and 5 were operated at their maximum design flow and Turnout 4 was offline. The average maximum day demand for the 72-hour period is 10,201 gpm (14.7 mgd) which represents the actual existing maximum day demand which occurred on July 13, 2013.

For the EPS existing system evaluations, Reservoir 10A was assumed to be inactive and did not operate. Reservoir 10A is located at a higher elevation and higher HDL than other reservoirs in Zone 1 and requires a complex operational strategy for Zone 1 operations. As part of the future system evaluation described in Chapter 6, alternatives for future Zone 1 storage are evaluated to possibly replace the existing Reservoir 10A (see also Appendix D).

5.4.3.2 EPS Simulation 1 with Supply from Zone 7 Turnouts 1, 2, 4 and 5

The first EPS simulation evaluated how the District's existing system performed when the supply from Zone 7 was optimized by assuming all four turnouts (Turnouts 1, 2, 4 and 5) provided the maximum design flow into the District's existing system. Both Turnouts 4 and 5 were operated based on Reservoir 10B tank level.

Figures 5-4 to 5-6 present reservoir levels for all of the District's reservoirs over the 72-hour maximum day demand simulation. As shown on Figure 5-4, Reservoir 1A located in Pressure Zone 1 only fills to 90 percent of its level, and Reservoir 10B, also located in the Pressure Zone 1, fills to its maximum level between hours 0 to 14 and between hours 51 to 72.

Figures 5-5 and 5-6 show the storage reservoirs in the higher pressure zones of the potable water system generally recover within one day.

A pressure management evaluation was also performed to identify and address low pressure deficiencies based on the results from the maximum day demand extended period simulation. The purpose of the evaluation is to identify potential changes that could be made to existing potable water system operations to address low pressure areas.

Figure 5-7 presents the minimum pressures during the extended period maximum day demand simulation. As shown on Figure 5-7, low pressure areas were identified in Zones 1, 2, 3, 20 and 30. These low pressures occur between 4:00 am and 6:00 am or between 7:30 pm and 11:30 pm in the extended period simulation, which corresponds to a peak hour demand. There are more low pressure areas during the EPS maximum day demand than during the peak hour demand scenario. Pressures from the EPS are different from the steady-state peak hour demand simulation because during an EPS, reservoir levels which were initially set at 75 percent full, change during the simulation. In contrast, the steady-state peak hour demand scenario assumed tank levels at 75 percent full.

5.4.3.3 EPS Simulation 2 with Supply from Zone 7 Turnouts 1, 2 and 5

Based on the past records of the Zone 7 turnout flow information, there was a period when the supply from Zone 7 only included Turnouts 1, 2 and 5. The second EPS simulation was conducted to evaluate if the District's existing system performs when the supply from Zone 7 only includes these three turnouts.

Figures 5-8 to 5-10 present reservoir levels for all the District's reservoirs over 72-hour maximum day demand simulation. As shown on these figures, all tanks within the District's service area fluctuate between 75 percent of their tank level to maximum level (100 percent).

Figure 5-11 presents the minimum pressures during the extended period maximum day demand simulation which occurred in Zones 1, 2, 3, 20 and 30. These low pressures occur between 3:00 am to 8:00 am or between 8:00 pm to 11:00 pm in the extended period simulation, which corresponds to a peak hour demand.

5.5 SUMMARY OF FINDINGS AND RECOMMENDED IMPROVEMENTS FOR THE EXISTING POTABLE WATER SYSTEM

Findings from the evaluation of the existing water distribution system and the recommended improvements needed to eliminate deficiencies are summarized below. These recommendations are used to develop a recommended CIP which is further described in Chapter 7. Recommended existing system improvements are shown on Figure 5-12.

- Pumping Capacity
  - All service zones were found to have surplus pumping capacity in excess of existing maximum day demand. No pump station mitigation is recommended based on existing demand conditions.
  - There is only one pump station that has an on-site backup generator (PS 4B). To improve pump station reliability during power outages, on-site backup generators are recommended at the following five pump stations: PS 2C, PS 3A, PS 20B, PS 200A and PS 300B. It should be noted that mechanical and/or electrical improvements may be required at these pump stations to accommodate the installation of permanent, on-site backup generators.
- Storage Capacity
  - Zone 2 was found to have a storage capacity deficit of 0.27 MG. As noted previously, the Zone 2 pump stations are equipped with a plug-in adaptor for portable standby generators, and are recommended for installation of permanent on-site generators, providing additional supply reliability for these zones. In the event of fire flow or emergency conditions, the permanent on-site generator could be used to operate the Zone 2 pump station without time delay to bring the portable generator to power up the pump station. In addition, there is a pressure reducing/sustaining valve at PS 3A which could also provide supply reliability for Pressure Zone 2 in the event of fire flow or emergency conditions in Pressure Zone 2; therefore, no additional storage in Pressure Zone 2 is recommended based on existing demand conditions.
- Pipelines
  - Discharge pipelines for PS 20A exceeded the recommended pipeline velocity criteria during a peak hour demand condition. However, no improvements for pipelines exceeding the velocity criteria in the existing potable water system are recommended since the primary criterion (pressure) is met.

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Last Saved: 8/3/2015 11:44:52 AM bcoox; O:\Clients\406 DSRSD\02-14-38 Wtr Sys MP Capacity Study\GIS\Figures\Figure 5-1 Existing PHD.mxd

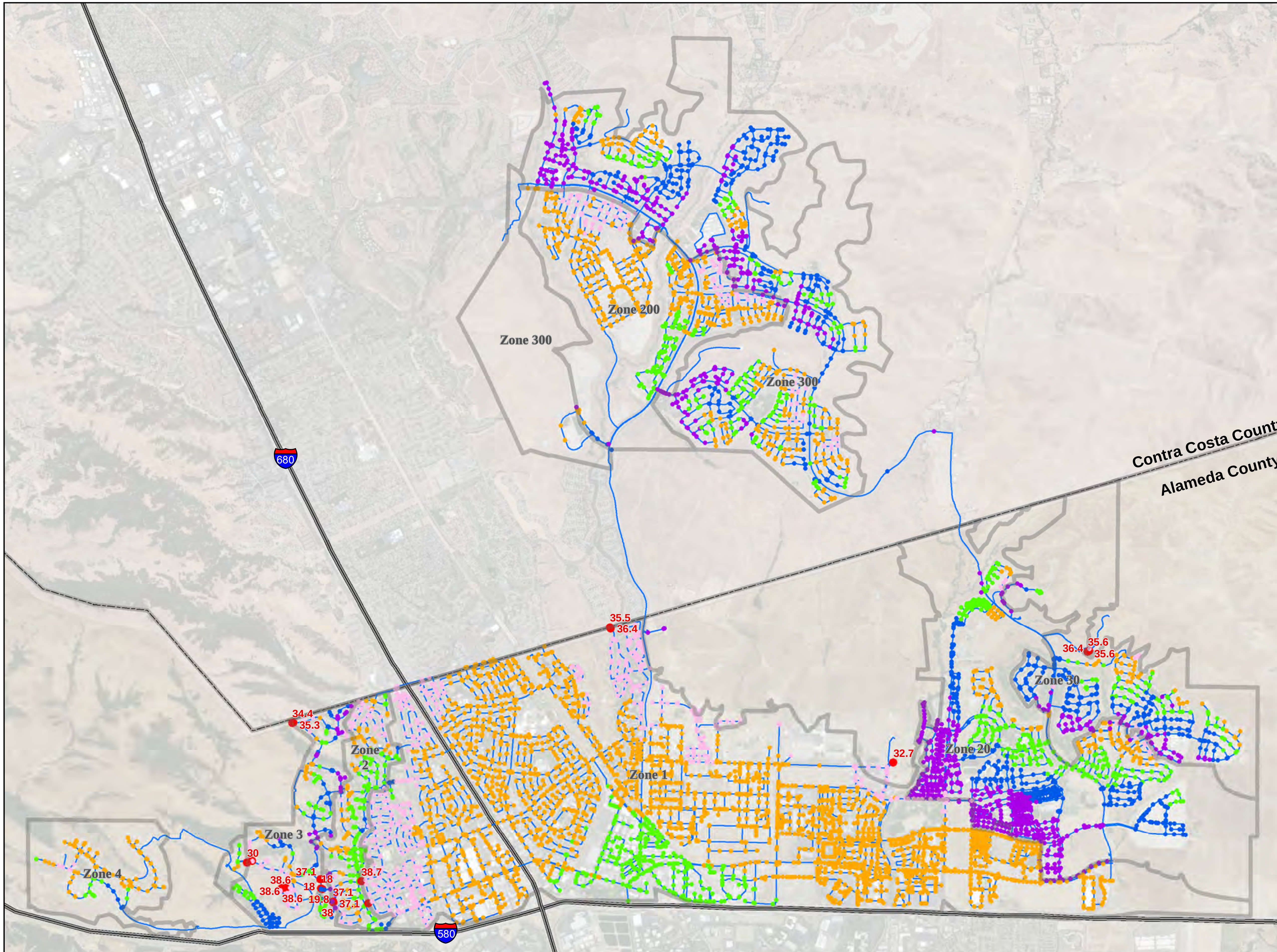

FIGURE 5-1

Dublin San Ramon Services District
Water Master Plan Update

EXISTING SYSTEM PEAK HOUR DEMAND RESULTS

N

0 1,750 3,500
Scale in Feet

Note:
1. Existing peak hour demand is equal to 24 mgd (16,666 gpm).
2. Storage reservoirs were assumed to be 75% full.
3. Values in red are in pounds per square inch (psi),
4. The velocity criteria is 5 feet per second (fps) for transmission mains and 8 fps for distribution mains.

LEGEND

- Pressure < 40 psi
- 40 psi ≤ Pressure < 60psi
- 60 psi ≤ Pressure < 80psi
- 80 psi ≤ Pressure < 100psi
- 100 psi ≤ Pressure < 120psi
- Pressure ≥ 120psi
- Velocity < Velocity Criteria

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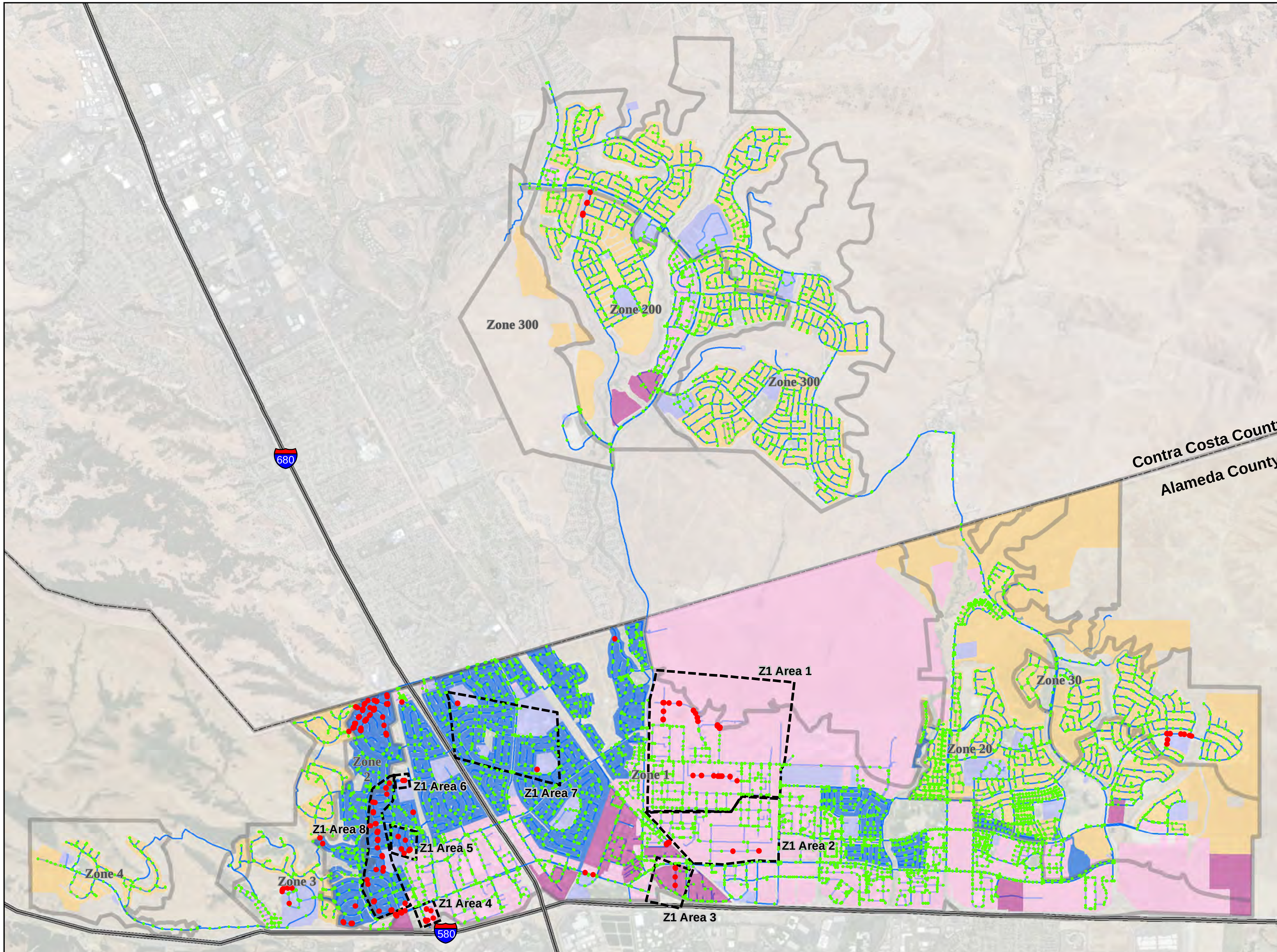

FIGURE 5-2

Dublin San Ramon Services District Water System Master Plan

AVAILABLE FIREFLOW UNDER MAXIMUM DAY DEMAND

N

0 1,750 3,500

Scale in Feet

Note:
1. Existing maximum day demand is 20 mgd (13,889 gpm).
2. Storage reservoirs were assumed to be 50% full.
3. Results are based on a minimum system residual pressure of 20 psi.

LEGEND

- Available Fireflow Meets or Exceeds Requirement
- Available Fireflow Less Than Requirement

Fireflow Requirements Based on Land Use Type:

- 1,500 gpm for Single Family (sprinkler)
- 2,000 gpm for Single Family (non-sprinkler)
- 2,500 gpm for Multi-Family or Commercial
- 4,000 gpm for Institutional or School
- 4,500 gpm for Industrial or Business Park
- Pipeline

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Last Saved: 11/16/2015 10:53:30 AM bcoox; O:\Clients\406 DSRSD\02-14-38 Wtr Sys MP Capacity Study\GIS\Figures\Figure 5-3 Multiple FF.mxd

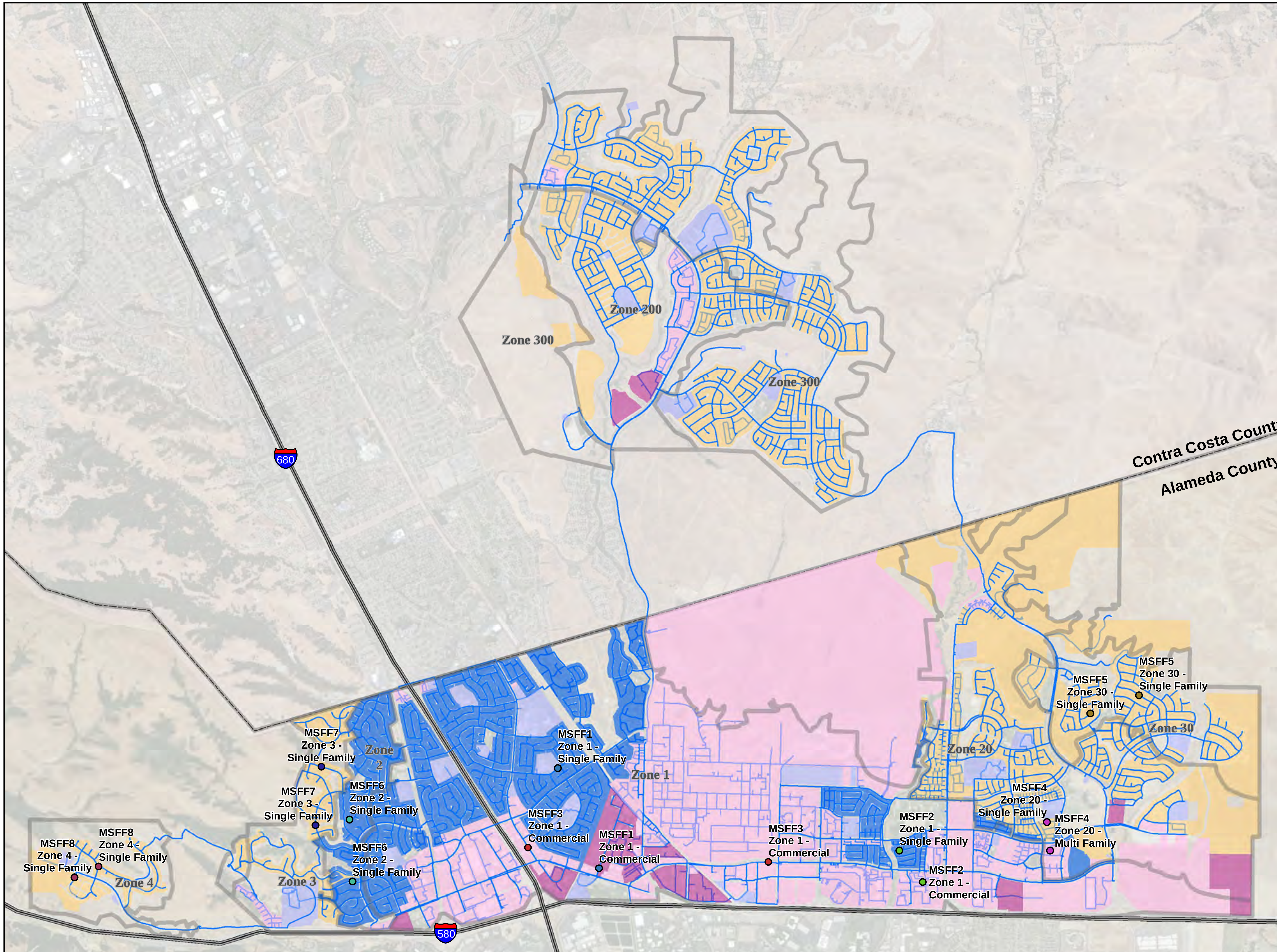

FIGURE 5-3

Dublin San Ramon Services District Water System Master Plan

MULTIPLE FIRE FLOW EVENTS EVALUATION UNDER MAXIMUM DAY DEMAND

N

0 1,750 3,500

Scale in Feet

Note:
1. Existing maximum day demand is 20 mgd (13,889 gpm).
2. Storage reservoirs were assumed to be 50% full.
3. Results are based on a minimum system residual pressure of 20 psi.
4. Multiple fire flow evaluation is required by the Alameda County Fire Department.

LEGEND

Multiple Simultaneous Fire Flow (MSFF):

- MSFF1
- MSFF2
- MSFF3
- MSFF4
- MSFF5
- MSFF6
- MSFF7
- MSFF8

Fireflow Requirements Based on Land Use Type:

- 1,500 gpm for Single Family (sprinkler)
- 2,000 gpm for Single Family (non-sprinkler)
- 2,500 gpm for Multi-Family or Commercial
- 4,000 gpm for Institutional or School
- 4,500 gpm for Industrial or Business Park
- Pipeline

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Figure 5-4. Zone 1 Reservoir Levels - Maximum Day Demand EPS Simulation 1

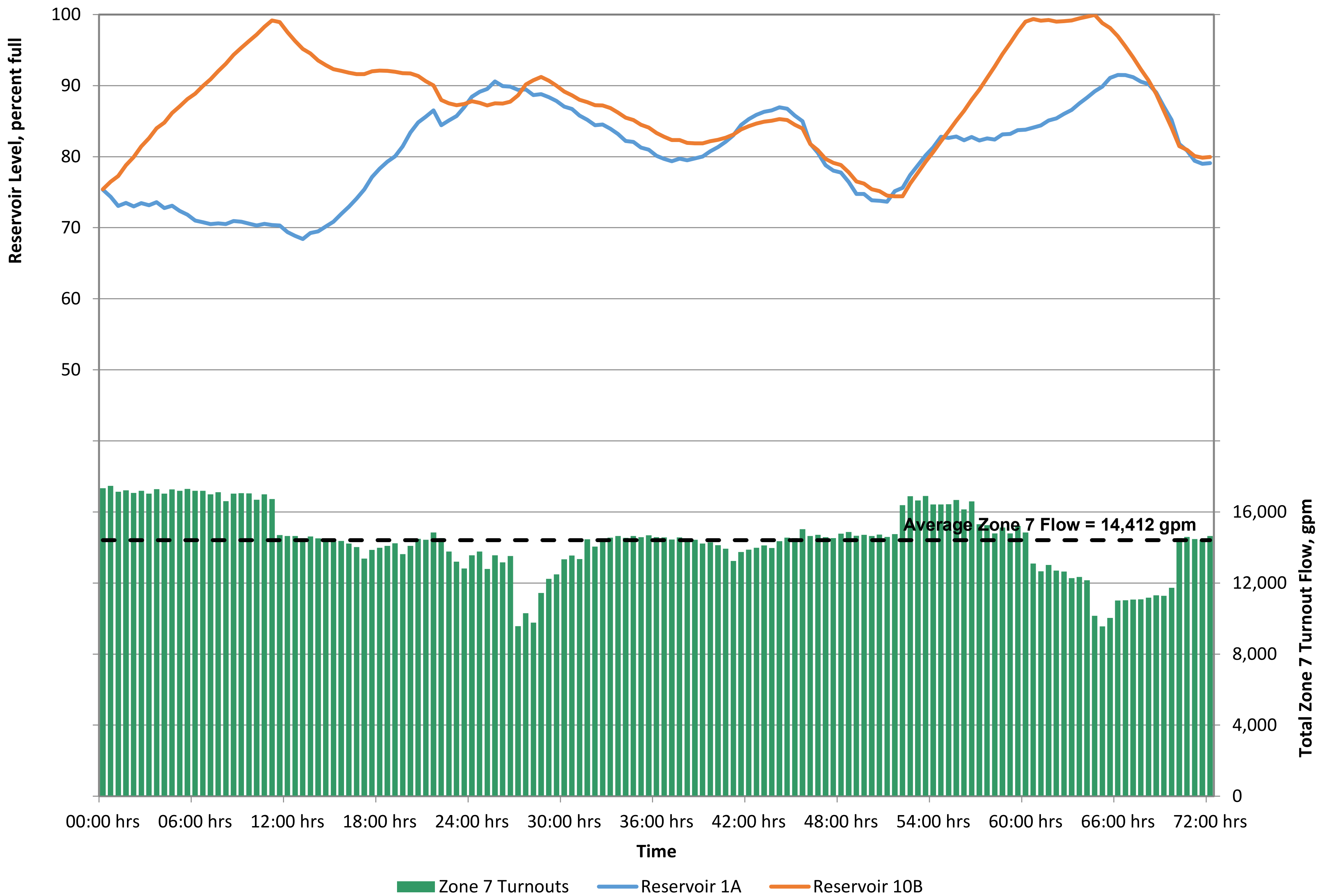

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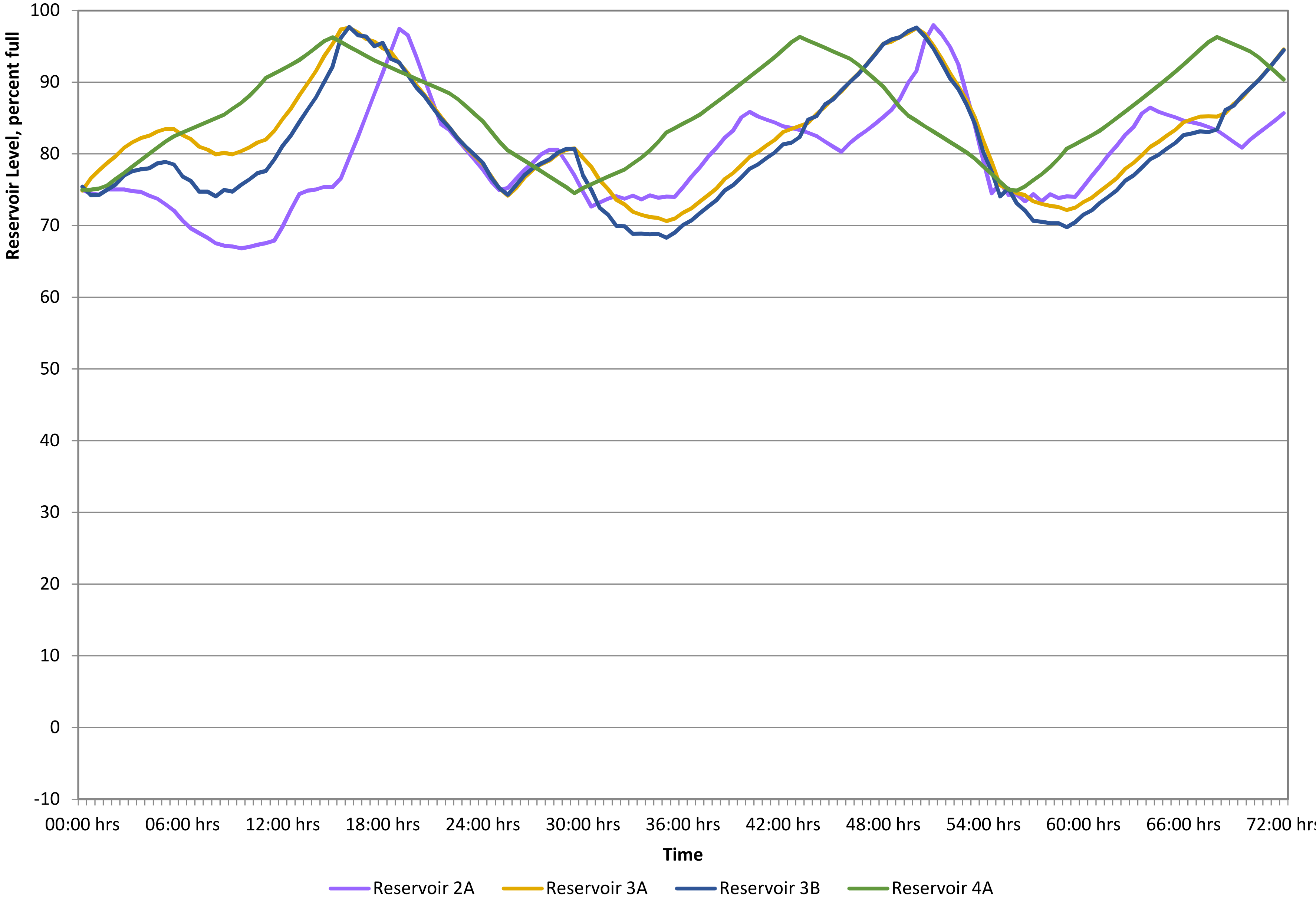
Figure 5-5. Zones 2, 3 and 4 Reservoir Levels - Maximum Day Demand EPS Simulation 1



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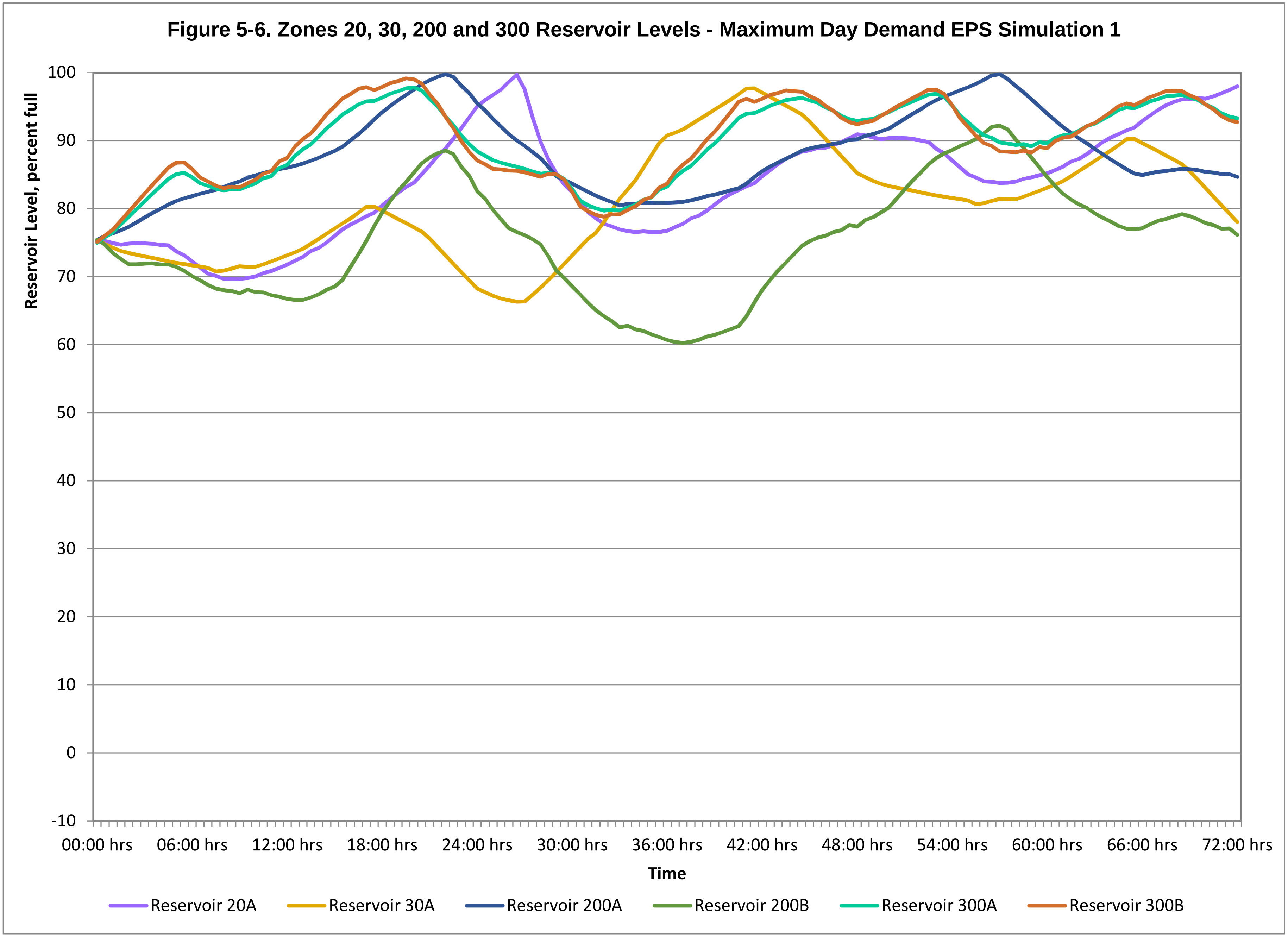
Figure 5-6. Zones 20, 30, 200 and 300 Reservoir Levels - Maximum Day Demand EPS Simulation 1
Reservoir Level, percent full
100
90
80
70
60
50
40
30
20
10
0
-10
00:00 hrs
06:00 hrs
12:00 hrs
18:00 hrs
24:00 hrs
30:00 hrs
36:00 hrs
42:00 hrs
48:00 hrs
54:00 hrs
60:00 hrs
66:00 hrs
72:00 hrs
Time
Reservoir 20A
Reservoir 30A
Reservoir 200A
Reservoir 200B
Reservoir 300A
Reservoir 300B

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Last Saved: 8/4/2015 2:32:10 PM bcoox; O:\Clients\406 DSRSD\02-14-38 Wtr Sys MP Capacity Study\GIS\Figures\Figure 5-7 Existing MDD EPS.mxd

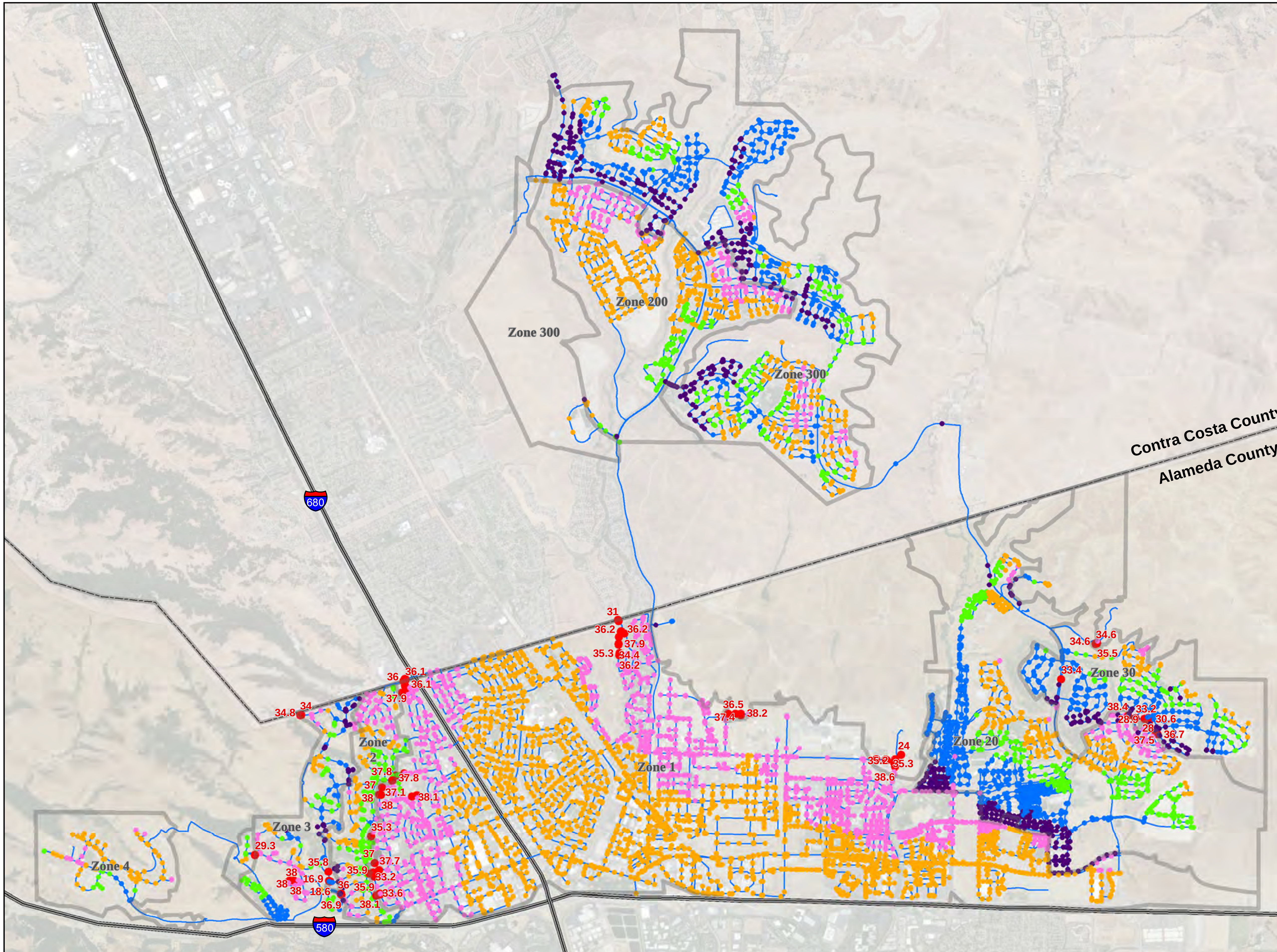

FIGURE 5-7

Dublin San Ramon Services District
Water System Master Plan

EXISTING SYSTEM MAXIMUM DAY DEMAND MINIMUM PRESSURE RESULTS DURING EPS SIMULATION 1

(Supply from Zone 7 Turnouts 1, 2, 4 and 5)

0 2,000 4,000
Scale in Feet

Note:
1. Existing maximum day demand is equal to 20 mgd (13,889 gpm).
2. Supply from Zone 7 include flows from Turnouts 1, 2, 4 and 5.
3. Initial reservoir levels were set to 75% full.
4. Values in red are in pounds per square inch (psi),

LEGEND

- Pressure < 40 psi
- 40 psi ≤ Pressure < 60 psi
- 60 psi ≤ Pressure < 80 psi
- 80 psi ≤ Pressure < 100 psi
- 100 psi ≤ Pressure < 120 psi
- Pressure ≥ 120 psi
- Pipeline

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Figure 5-8. Zone 1 Reservoir Levels - Maximum Day Demand EPS Simulation 2

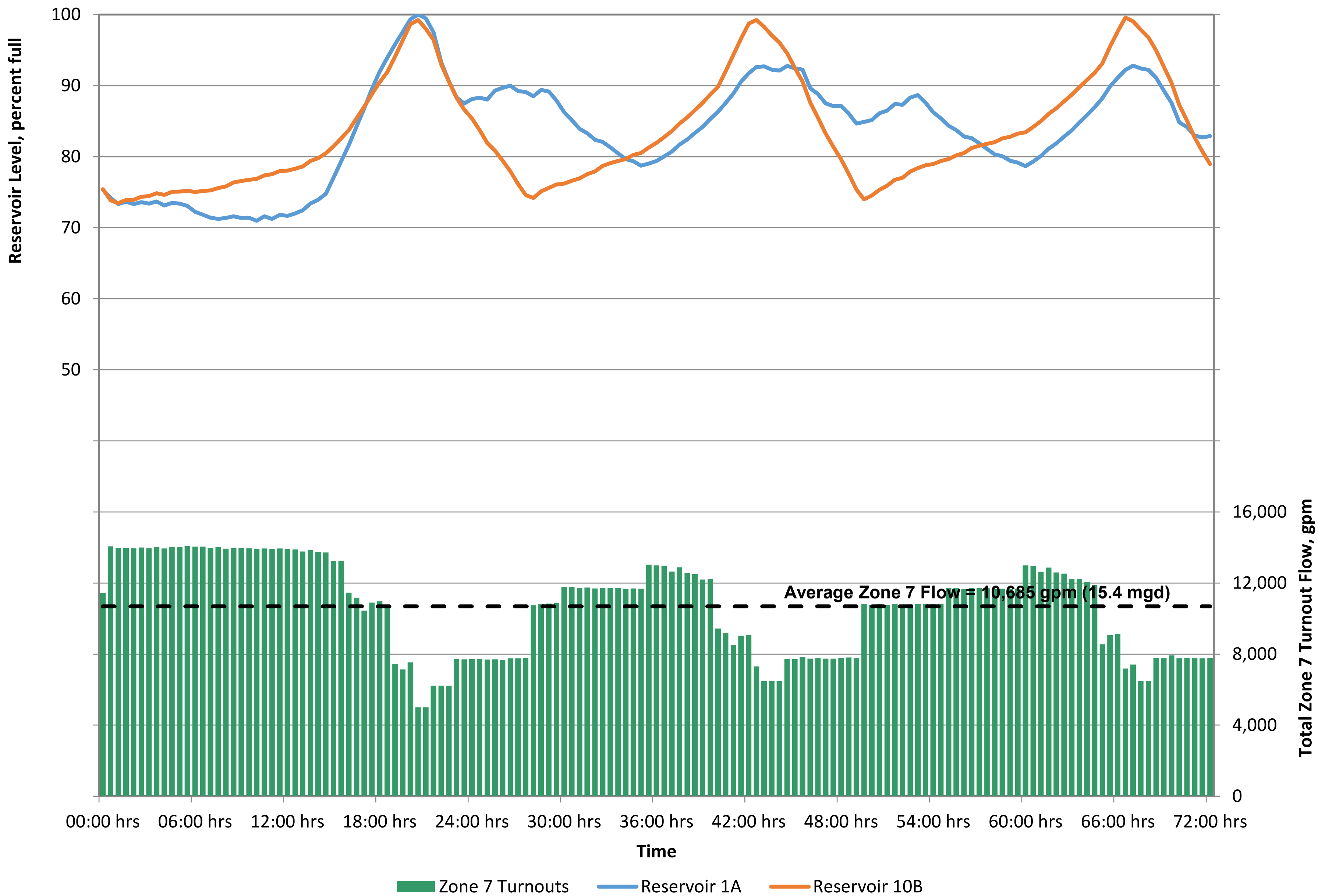

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Figure 5-9. Zones 2, 3 and 4 Reservoir Levels - Maximum Day Demand EPS Simulation 2

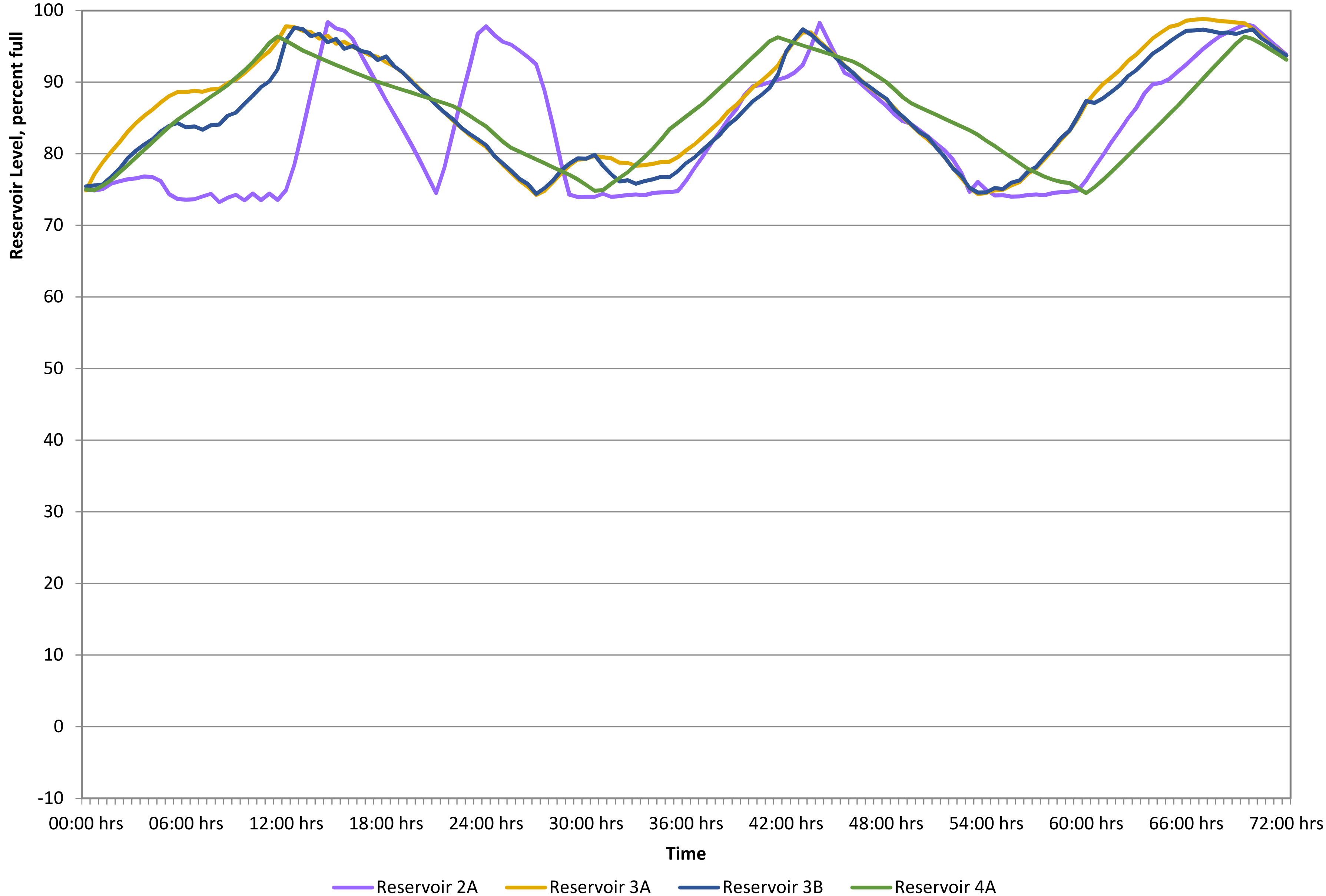

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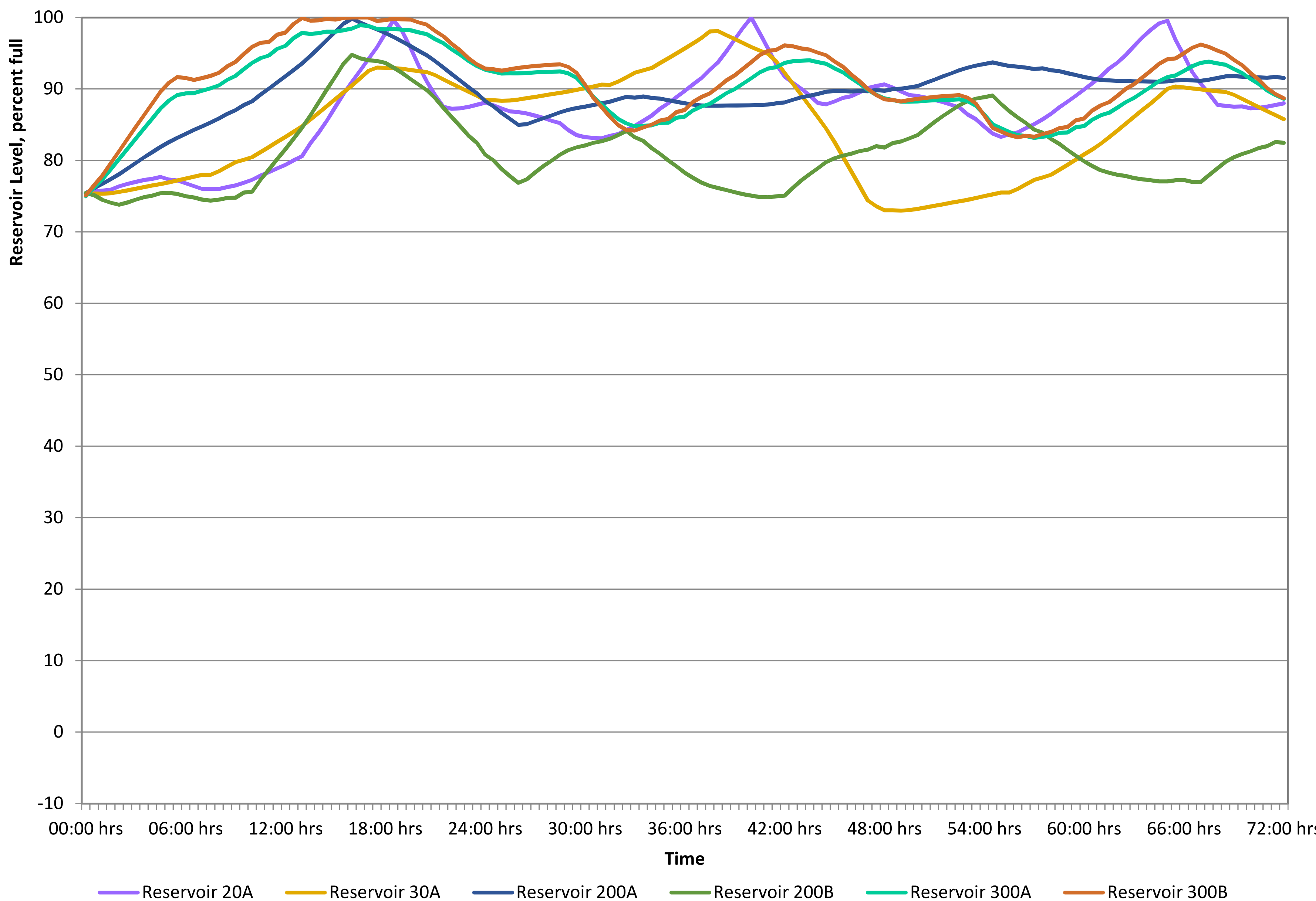
Figure 5-10. Zones 20, 30, 200 and 300 Reservoir Levels - Maximum Day Demand EPS Simulation 2



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Last Saved: 8/4/2015 2:39:53 PM bcoox; O:\Clients\406 DSRSD\02-14-38 Wtr Sys MP Capacity Study\GIS\Figures\Figure 5-11 Existing MDD EPS2.mxd

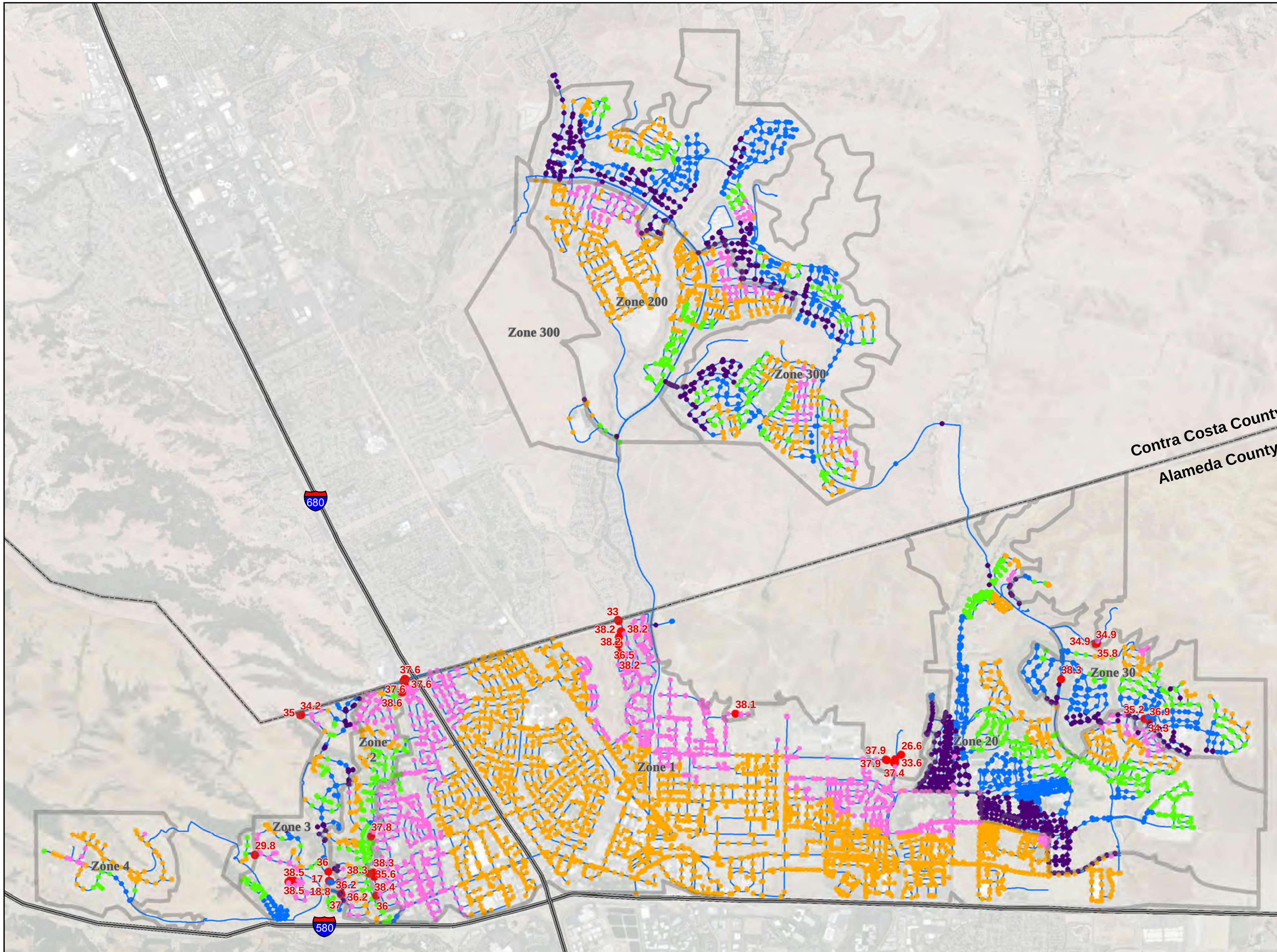

FIGURE 5-11

Dublin San Ramon Services District Water System Master Plan

EXISTING SYSTEM MAXIMUM DAY DEMAND MINIMUM PRESSURE RESULTS DURING EPS Simulation 2

(Supply from Zone 7 Turnouts 1, 2, and 5)

N

0 2,000 4,000

Scale in Feet

Note:
1. Existing maximum day demand is equal to 14.7 mgd (10,201 gpm).
2. Supply from Zone 7 include flows from Turnouts 1, 2, and 5.
3. Initial reservoir levels were set to 75% full.
4. Values in red are in pounds per square inch (psi),

LEGEND

- Pressure < 40 psi
- 40 psi ≤ Pressure < 60 psi
- 60 psi ≤ Pressure < 80 psi
- 80 psi ≤ Pressure < 100 psi
- 100 psi ≤ Pressure < 120 psi
- Pressure ≥ 120 psi
- Pipeline

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Last Saved: 12/2/2015 11:25:16 AM bcoox; O:\Clients\406 DSRSD\02-14-38 Wtr Sys MP Capacity Study\GIS\Figures\Figure 5-12 Recommended Near-Term Improvements.mxd

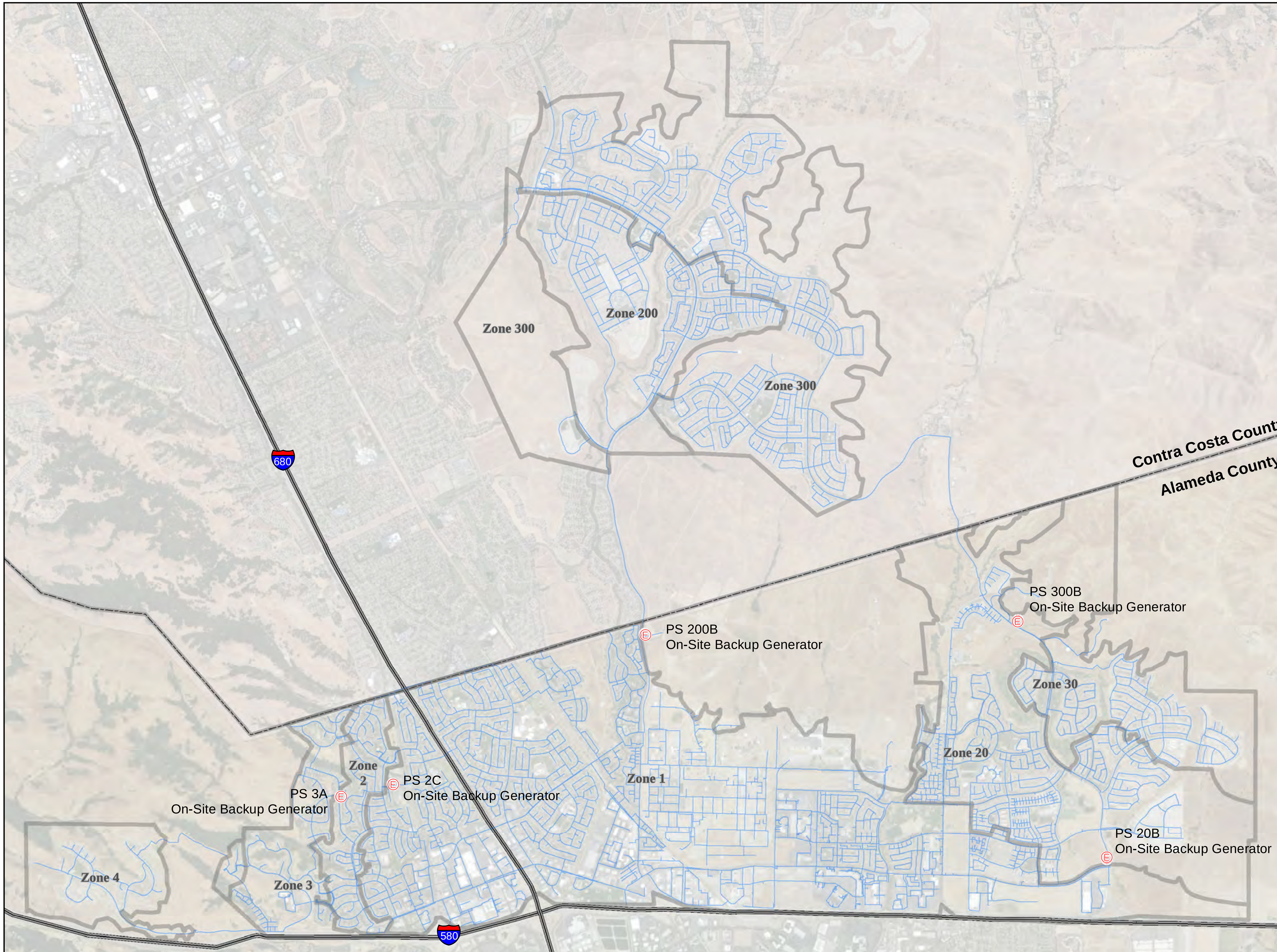

FIGURE 5-12

Dublin San Ramon Services District Water System Master Plan

RECOMMENDED NEAR-TERM IMPROVEMENTS

N

0 1,750 3,500

Scale in Feet

Note:
1. The on-site backup generator improvement locations were selected based on a review of critical pump station locations (single feed, serving multiple zones). The aerial photo was reviewed for available space at the District's pump stations. Locations could be changed after the District reviews the actual site availability to install the on-site backup generator.

LEGEND

- On-site Backup Generator
- Existing Pipeline

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CHAPTER 6: EVALUATION OF FUTURE POTABLE WATER SYSTEM

Chapter Contents:

Chapter Purpose

The purpose of this chapter is to present the evaluation of the District's future potable water distribution system, and its ability to meet recommended potable water system service and performance standards under future water demand conditions. Future water demand conditions evaluated included 2020 demand conditions and Buildout (2035) demand conditions as determined in Chapter 3 Existing and Projected Water Demands.

Chapter Highlights

Zone 7 Turnouts:

The District has five turnouts from which it receives Zone 7 water supplies. The total capacity is essentially equal to the District's Buildout (2035) maximum day demand; therefore, a new turnout (Turnout 6) is recommended in the future to provide additional supply reliability.

Pumping Capacity:

Under Buildout (2035) demand conditions, the District's pump stations in Pressure Zones 1, 20, 30 and 200 have pumping deficiencies. The deficit in Pressure Zone 30 is very small (only 6 gpm) and is therefore not a concern. Deficiencies in Pressure Zones 1, 20 and 200 are larger and could be eliminated by installing larger pumps at PS1A, PS20B and PS200A. These improvements are not needed in the near-term and are based on future demand conditions which are subject to change as development plans change and as water use in the District's service area changes. Therefore, these improvements have been deferred in this Water System Master Plan and should be re-evaluated in future updates. A new pump station will be constructed in Zone 300 (Pump Station 300D) to provide emergency supply within the Moller Ranch project area; construction of PS 300D will be developer funded.

Storage Capacity:

Under 2020 and Buildout (2035) demand conditions, additional potable water storage is required in Pressure Zones 1 and 20. Two new reservoirs are recommended (a new Reservoir 10A and a new Reservoir 20B). A reservoir siting evaluation was conducted to evaluate potential reservoir sites (see Appendix D).

Distribution System Capacity:

The District's existing distribution system pipelines are adequate to meet future maximum day plus fire and peak hour demand conditions. Additional in-tract distribution pipelines will be constructed as needed by developers as new developments are constructed.

Summary of Future System Recommendations:

- New Turnout 6: To provide additional supply reliability a new Turnout 6 with a capacity of 6,000 gpm (8.64 mgd) is recommended
- New Reservoir 10A: A new Reservoir 10A with a capacity of 4.1 MG is recommended to replace the existing Reservoir 10A (new Reservoir 10A shall be constructed at a lower elevation consistent with the Pressure Zone 1 HGL)
- New Reservoir 20B: A new Reservoir 20B with a capacity of 1.3 MG is recommended near the Windemere Development

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CHAPTER 6
Evaluation of Future Potable Water System

The purpose of this chapter is to present the evaluation of the District's future potable water distribution system, and its ability to meet recommended potable water system service and performance standards under future water demand conditions. Future water demand conditions evaluated included 2020 demand conditions and Buildout (2035) demand conditions as determined in *Chapter 3 Existing and Projected Water Demands*.

6.1 OVERVIEW

The evaluation of the future potable water system included both system facility capacity and hydraulic performance evaluations. The system facility capacity evaluation includes an analysis of pumping and water storage capacity. The system performance evaluation assesses the future potable water system's ability to meet recommended planning and design criteria under two conditions: future maximum day demand plus fire flow and peak hour demand conditions. In addition, the future potable water system was further analyzed using an extended period simulation under a maximum day demand condition to evaluate storage turnover.

West Yost conducted this evaluation using an updated hydraulic model that incorporated improvements to eliminate deficiencies identified in the existing water system evaluation (see *Chapter 5 Evaluation of Existing Potable Water System*). In addition, West Yost also conducted a storage siting evaluation for Pressure Zone 1 and Pressure Zone 20. Appendix D presents results of that analysis.

Evaluation findings and recommendations for addressing any deficiencies identified in the future water distribution system are described in this chapter. Recommendations are used to develop a recommended CIP which is further described in Chapter 7.

The following sections present the evaluation methodology and results from the future potable water system evaluation:

- Projected Future Potable Water Demands by Pressure Zone,
- Future Potable Water System Facility Capacity Evaluation,
- Future Potable Water System Performance Evaluation, and
- Summary of Findings and Recommended Improvements for the Future Potable Water System.

6.2 PROJECTED FUTURE POTABLE WATER DEMANDS BY PRESSURE ZONE

Table 6-1 presents the projected future water demands used for the future water system evaluation by pressure zone. As discussed in Chapter 3, future potable water demands were developed for both the 2020 and Buildout (2035) timeframes for the District's water service area using both a per capita water use method and a unit water demand method based on land use type. The 2020 and Buildout (2035) potable water demands are summarized as follows:

- 2020 Potable Water Demands
  - The District's 2020 average day demands are expected to increase by approximately 22 percent over existing baseline (2013) water demands.
  - The projected 2020 average day demand is 13,690 af (12.2 mgd).
  - These growth projections are based on near-term development anticipated to occur by 2020.
- Buildout (2035) Potable Water Demands
  - The District's Buildout (2035) average day demands are expected to increase by approximately 41 percent over existing baseline (2013) water demands.
  - The projected Buildout (2035) average day demand is 15,840 acre-feet (14.1 mgd).
  - These growth projections are long-term projections that assume future development based on Buildout (2035) planning projections.

6.3 FUTURE POTABLE WATER SYSTEM FACILITY CAPACITY EVALUATION

To evaluate the capacity of the future water system facilities, the following analyses were conducted:

- Zone 7 Turnout Capacity Evaluation,
- Potable Pumping Capacity Evaluation, and
- Potable Storage Capacity Evaluation.

The results of the future water system facility capacity evaluation are discussed below.

Table 6-1. Summary of 2020 and Buildout (2035) Potable Water Demands by Pressure Zone[a]

Pressure Zone	2020 Average Day Demand[b]		2020 Maximum Day Demand[c]		2020 Peak Hour Demand[d]		Buildout (2035) Average Day Demand[b]		Buildout (2035) Maximum Day Demand[c]		Buildout (2035) Peak Hour Demand[d]	
	gpm	mgd	gpm	mgd	gpm	mgd	gpm	mgd	gpm	mgd	gpm	mgd
Zone 1	3,864	5.6	7,728	11.2	9,274	13.4	4,782	6.9	9,565	13.8	11,478	16.5
Zone 2	252	0.3	503	0.6	604	0.7	258	0.3	516	0.6	619	0.7
Zone 3	235	0.3	471	0.6	565	0.7	243	0.3	485	0.6	583	0.7
Zone 4	162	0.2	324	0.4	389	0.5	171	0.2	341	0.4	409	0.5
Zone 20	1,396	2.0	2,791	4.0	3,349	4.8	1,665	2.4	3,330	4.8	3,996	5.8
Zone 30	363	0.5	726	1.0	871	1.3	403	0.6	806	1.2	967	1.4
Zone 200	888	1.3	1,777	2.6	2,132	3.1	911	1.3	1,823	2.6	2,187	3.1
Zone 300	1,392	2.0	2,784	4.0	3,341	4.8	1,428	2.1	2,856	4.2	3,427	5.0
Total	8,552	12.2	17,105	24.4	20,526	29.3	9,861	14.1	19,721	28.2	23,665	33.8

[a] Includes anticipated system-wide water loss of 6 percent.

[b] Average day demand is based on 2013 average day demand (baseline) plus future developments anticipated by 2020 and 2035. Projections include potable water offsets for areas anticipated to be served recycled water (Source: Chapter 3, Table 3-19). The 2020 demand includes three future developments: 1) Dublin Crossing (Site 2); 2) Wallis Ranch (Site 25) ; and 3) Moller Ranch (Site 28).

[c] Maximum day demand calculated using a peaking factor of 2.0 times the average day demand.

[d] Peak hour demand calculated using a peaking factor of 2.4 times the average day demand.

6.3.1 Zone 7 Turnout Capacity Evaluation

Table 6-2 presents the design capacity of Zone 7's turnouts that supply water to the District's potable water system. The total capacity of these existing turnouts is 28.27 mgd, and is essentially equal to the District's Buildout (2035) maximum day demand of 28.4 mgd. When the largest turnout (Turnout 5) is out of service at any given time due to mechanical breakdowns or scheduled maintenance, the total capacity of the four remaining turnouts is 19.6 mgd, which would not be able to meet the Buildout (2035) maximum day demand. Therefore, a future turnout (Turnout 6) is recommended to provide additional supply reliability under the Buildout (2035) demand condition. The recommended minimum capacity of this future turnout is 6,000 gpm (8.64 mgd).

The proposed location for the new turnout is on the south side of Interstate 580 at Pimlico Drive. To provide for a new turnout from the Zone 7 transmission system to the District's potable water system approximately 2,281 lineal feet (LF) of a new 20-inch diameter pipeline will need to be installed from the south side of Interstate 580 and connected into the District's potable water system. Installation of this new turnout will require a jack and bore installation of approximately 205 LF of 20-inch diameter pipeline underneath Interstate 580.

Table 6-2. Existing District Turnout Facilities

Turnout	Maximum Design Capacity	
	gpm	mgd
1	5,000	7.20
2[(a)]	3,630	5.23
3[(b)]	0	0
4	5,000	7.20
5	6,000[(c)]	8.64
Total	19,630	28.27

(a) Turnout 2 capacity is based on the average recorded flow rate at PS 1A. The average flow rate value was calculated based on Turnout 2 flows from 2009 to 2013 (*Source: Max day and avg day demand 2005-2013.xlsx*).
(b) Turnout 3 is planned to be removed in the future as development in its vicinity occurs.
(c) The actual capacity of Turnout 5 ranges between 5,200 and 5,300 gpm.

6.3.2 Potable Pumping Capacity Evaluation

The District's pumping facilities were evaluated to assess their ability to deliver potable water to pressure zones that cannot be supplied directly from the Zone 7 turnouts. The pump stations were evaluated based on the criteria described in *Chapter 4 System Planning and Performance Criteria* (see Table 4-1). These criteria include the ability to deliver a firm, reliable capacity equal to the maximum day demand within each pressure zone, or any pressure zones located above that pressure zone.

Firm capacity assumes a reduction in total pumping capacity to account for pumps that are out of service at any given time due to mechanical breakdowns, maintenance, water quality, or other operational issues. At each pump station, firm pumping capacity was defined as the total pump station capacity with one pump out of service.

Tables 6-3 and 6-4 compare the existing firm pumping capacity with the required firm pumping capacity for 2020 water demand conditions and Buildout (2035) water demand conditions, respectively. These tables show the service zones and the corresponding supported zones, their associated future water demand, and the pump stations serving each service zone. For example, PS 1A directly serves Zone 1, but must also have sufficient pumping capacity to supply Zones 2, 20 and 200 because they are supported by Zone 1. It should be noted that the future pumping capacity analysis assumes the construction of a new PS 300D with a firm pumping capacity of 1,500 gpm to provide emergency fire flow for Moller Ranch Pressure Zone 300 (the construction of PS 300D will be fully funded by the Moller Ranch developer).

As shown in Table 6-3, all service zones have surplus pumping capacity in excess of the 2020 maximum day demand except for Zones 1, 20 and 200. As shown in Table 6-4, under Buildout (2035) water demand conditions, Zone 30 also has a slight pumping deficiency. The pumping deficits in these zones are discussed further below.

- **Pressure Zone 1:** The pumping deficit for Zone 1 for the 2020 demand condition is 3,732 gpm and Buildout (2035) demand condition is 6,165 gpm (8.88 mgd). As discussed in *Section 6.3.1 Zone 7 Turnout Capacity Evaluation*, a future new Turnout 6 with a capacity of 6,000 gpm (8.64 mgd) is recommended to provide additional supply reliability to the District's potable water system.

  The additional supply from the new Turnout 6 would increase the supply capacity in Pressure Zone 1; hence, the pumping capacity deficit in Zone 1 would be decreased to 165 gpm under the Buildout (2035) demand condition. The existing pumps at PS 1A could be replaced with larger pumps in the future to address this pumping deficiency along with a replacement of the existing 12-inch diameter pipeline downstream of PS 1A with a 16-inch diameter pipeline. However, this pumping deficiency is based on future demand conditions which are subject to change as development plans change and as water use in the District's service area changes. Therefore, no mitigation is recommended at this time as this identified deficiency does not need to be addressed in the near-term, but should be re-evaluated in future updates to the District's Water System Master Plan.

  It should be noted that the total firm capacity in Zone 1 was calculated based on the pumping capacity at PS 1A and the supply from the existing Zone 7 turnouts (without the recommended future Turnout 6). The pumping capacity at PS 10A was not included because it is used only to fill Reservoir 10A, which has a higher overflow elevation than the other Zone 1 reservoirs (see further discussion regarding Reservoir 10A in *Section 6.3.3 Potable Storage Capacity Evaluation*).

Table 6-3. Comparison of Existing and Required Pumping Supply Capacity under 2020 Demand Conditions

Service Zone and Supported Upper Zones	Maximum Day Demand, gpm	Pump Station/Turnout	Existing Pumping Capacity, gpm[a]		Required Firm Pumping Capacity, gpm	Firm Supply Capacity Surplus (Deficit), gpm	Backup Power at Pump Station
			Total Capacity	Firm Capacity[b]			
Zone 1	7,728	1A[c]	3,600	2,400	12,800	(3,732)	Plug-in adaptor for standby generator
		10A	0	0			
		Zone 7 Turnouts[d]	11,668	6,668			
		Total	15,268	9,068			
Zone 2	503	2A	600	300	974	626	On-site backup generator
		2B	600	300			
		2C	1,000	1,000			
		Total	2,200	1,600			
Zone 3	471	3A	600	400	795	455	On-site backup generator
		3B	375	250			
		3C	900	600			
		Total	1,875	1,250			
Zone 4	324	4A	1,200	800	324	876	PS 4A has a plug-in adaptor for standby generator; and PS 4B has on-site backup generator
		4B	400	400			
		Total	1,600	1,200			
Zone 20	2,791	20A	2,250	1,500	4,909	(160)	On-site backup generator
		20B	4,332	3,249			
		Total	6,582	4,749			
Zone 30	726	30A	1,200	800	726	74	Plug-in adaptor for standby generator
		Total	1,200	800			
Zone 200	1,777	200A	3,720	2,790	3,169	(379)	On-site backup generator
		Total	3,720	2,790			
Zone 300	2,784	300A	2,604	1,736	2,784	4,252	On-site backup generator
		300B	3,750	2,500			
		300C	1,950	1,300			
		300D	2,250	1,500			
		Total	10,554	7,036			

[a] Nominal pump capacities (summarized in Table 2-6) were used to evaluate pumping supply capacity.
[b] Firm pumping capacity is defined as the total pumping capacity with the largest pump unit out of service.
[c] Zone 7 Turnout No. 2 is the supply for the District's PS 1A.
[d] Zone 7 Turnout capacities were based on the maximum design capacity of Turnouts No. 1 and 4. Because Turnout 5 serves both Zone 20 and Zone 1, the capacity of Turnout 5 was reduced by the total capacity of PS 20B. The remaining capacity of Turnout 5 was applied to Zone 1. The firm capacity of Zone 7 supply for Zone 1 was calculated based on Turnout 4 and partial capacity of Turnout 5. The firm capacity also did not include Turnout 3 which will be removed in the future, and did not include the future Turnout 6.

Table 6-4. Comparison of Existing and Required Pumping Supply Capacity under Buildout (2035) Demand Conditions

Service Zone and Supported Upper Zones	Maximum Day Demand, gpm	Pump Station/Turnout	Existing Pumping Capacity, gpm[a] Total Capacity	Existing Pumping Capacity, gpm[a] Firm Capacity[b]	Required Firm Pumping Capacity, gpm	Firm Supply Capacity Surplus (Deficit), gpm	Backup Power at Pump Station
Zone 1	9,565	1A[c]	3,600	2,400	15,233	(6,165)	Plug-in adaptor for standby generator
		10A[d]	0	0			
		Zone 7 Turnouts[e]	11,668	6,668			
		Total	15,268	9,068			
Zone 2	516	2A	600	300	1,001	599	On-site backup generator
		2B	600	300			
		2C	1,000	1,000			
		Total	2,200	1,600			
Zone 3	485	3A	600	400	827	423	On-site backup generator
		3B	375	250			
		3C	900	600			
		Total	1,875	1,250			
Zone 4	341	4A	1,200	800	341	859	PS 4A has a plug-in adaptor for standby generator; and PS 4B has on-site backup generator
		4B	400	400			
		Total	1,600	1,200			
Zone 20	3,330	20A	2,250	1,500	5,563	(814)	On-site backup generator
		20B	4,332	3,249			
		Total	6,582	4,749			
Zone 30	806	30A	1,200	800	806	(6)	Plug-in adaptor for standby generator
		Total	1,200	800			
Zone 200	1,823	200A	3,720	2,790	3,250	(460)	On-site backup generator
		Total	3,720	2,790			
Zone 300	2,856	300A	2,604	1,736	2,856	4,180	On-site backup generator
		300B	3,750	2,500			
		300C	1,950	1,300			
		300D	2,250	1,500			
		Total	10,554	7,036			

[a] Nominal pump capacities (summarized in Table 2-6) were used to evaluate pumping supply capacity.

[b] Firm pumping capacity is defined as the total pumping capacity with the largest pump unit out of service.

[c] Zone 7 Turnout No. 2 is the supply for the District's PS 1A.

[d] Zone 7 Turnout No. 2 is the supply for the District's PS 1A.

[e] Zone 7 Turnout capacities were based on the maximum design capacity of Turnouts No. 1 and 4. Because Turnout 5 serves both Zone 20 and Zone 1, the capacity of Turnout 5 was reduced by the total capacity of PS 20B. The remaining capacity of Turnout 5 was applied to Zone 1. The firm capacity of Zone 7 supply for Zone 1 was calculated based on Turnout 4 and partial capacity of Turnout 5. The firm capacity also did not include Turnout 3 which will be removed in the future, and did not include the future Turnout 6.

- **Pressure Zone 20:** The pumping deficit in Zone 20 is 160 gpm for the 2020 demand condition and 814 gpm for the Buildout (2035) demand condition. To alleviate the future pumping deficit in Zone 20, it may be possible to install an additional pump at PS 20A in the future as there is an extra pump can available at PS 20A, or replace pumps at PS 20B with larger capacity pumps. However, the 2020 pumping deficiency is minimal and 2035 pumping deficiency is based on future demand conditions which are subject to change as development plans change and as water use in the District's service area changes. Therefore, no mitigation is recommended at this time as these identified deficiencies do not need to be addressed in the near-term, but should be re-evaluated in future updates to the District's Water System Master Plan.
- **Pressure Zone 30:** The pumping deficit in Zone 30 is 6 gpm for the Buildout (2035) demand condition. Since this pumping deficit is minimal, there is no mitigation recommended at this time.
- **Pressure Zone 200:** The pumping deficit in Zone 200 is 379 gpm for the 2020 demand condition and 460 gpm for the Buildout (2035) demand condition. To alleviate the future pumping deficit in Zone 200, the existing pumps at PS 200A could be replaced with larger pumps in the future. However, it should be noted that these pumping deficiencies are relatively small and are based on future demand conditions which are subject to change as development plans change and as water use in the District's service area changes. Therefore, these identified deficiencies do not need to be addressed in the near-term, but should be re-evaluated in future updates to the District's Water System Master Plan.

6.3.3 Potable Storage Capacity Evaluation

Potable water system storage provides the following:

- Operational storage to balance differences in demands and supplies;
- Emergency storage in case of supply failure; and
- Water to fight fires.

The District's potable water storage capacity requirement is as follows:

- Operational storage equal to 25 percent of a maximum day demand;
- Emergency storage equal to 50 percent of a maximum day demand; and
- Fire flow storage equal to the highest fire flow and duration recommended in a particular pressure zone based on land uses within the pressure zone.

Tables 6-5 and 6-6 compare the District's available storage capacity with the required storage capacity by pressure zone for 2020 demand conditions and for Buildout (2035) demand conditions, respectively.

As shown on Table 6-5, the comparison between the District's available required storage capacities for the 2020 demand condition indicates that there are storage deficits in Zones 1, 2 and 20. The storage deficit in these pressure zones range from 0.21 MG to 2.08 MG. The storage deficit in Zone 2 also occurs under existing conditions. Based on the storage evaluation discussion in *Chapter 5 Evaluation of Existing Potable Water System*, no mitigation is recommended because the District would install an on-site backup generator at one of the Zone 2 pump stations to provide supply reliability in Zone 2. In addition, there is a bypass valve located at the Zone 3 pump station which could supply water from Pressure Zone 3 to Pressure Zone 2 during a fire flow event in Pressure Zone 2. Future storage requirements for Zone 1 and Zone 20 are discussed further below.

Table 6-6 presents the comparison between the District's available required storage capacities for Buildout (2035) demand conditions. As shown in Table 6-6, Pressure Zone 300 has a minor storage capacity deficit of 0.04 MG. Because the storage deficit is small, and a new pump station (PS 300D) will be constructed with a total capacity of 1.56 mgd to provide emergency fire flow for Moller Ranch Pressure Zone 300, no mitigation is recommended.

At the District's request, West Yost conducted a hydraulic evaluation to evaluate alternative locations for future new storage tanks in Zone 1 and Zone 20. Three potential storage sites were evaluated in Pressure Zone 1 and three potential storage sites were evaluated in Pressure Zone 20. Results of the analysis are summarized as follows:

- Pressure Zone 1:
  - A new 4.1 MG reservoir located at a lower elevation at the existing Reservoir 10A site ranked higher than the previously proposed Reservoir 1C or the use of the Tassajara Reservoir currently owned by the City of Pleasanton[1].
  - The replacement of the existing Reservoir 10A is recommended as Reservoir 10A was constructed in the 1940s and does not meet the District's performance criteria without significant operating issues.
- Pressure Zone 20:
  - A new 1.3 MG reservoir (Reservoir 20B) near the existing Windemere Development ranked higher than the reservoir site at the existing Reservoir 20A or at the proposed Moller Ranch development.

Details of the Zone 1 and Zone 20 storage siting evaluations are included in Appendix D.

[1] Since the completion of the storage evaluation conducted in coordination with this Water System Master Plan, the City of Pleasanton has moved forward with the conversion of the Tassajara Reservoir from a potable water reservoir to a recycled water reservoir, so it is no longer an available option for potable water storage for the District.

Table 6-5. Comparison of Existing and Required Storage Capacity under 2020 Demand Conditions

Pressure Zone	Storage Facility	Available Storage Capacity, MG		Required Fire Flow Duration, hours[a]	Required Fire Flow, gpm[a]	Required Storage Capacity, MG			Total Required Storage, MG	Storage Surplus (Deficit), MG
		Reservoir Capacity	Total Available Storage			Operational[b]	Fire Flow[c]	Emergency[d]		
Zone 1	1A	2.00	7.35	4	4,500	2.78	1.08	5.56	9.43	(2.08)
	1B[e]	2.35								
	10A[f]	0.00								
	10B	3.00								
Zone 2	2A	0.72	0.72	4	1,625 [g]	0.18	0.39	0.36	0.93	(0.21)
Zone 3	3A	0.65	0.99	2	2,500 [h]	0.17	0.30	0.34	0.81	0.18
	3B	0.34								
Zone 4	4A	0.70	0.70	2	2,500	0.12	0.30	0.23	0.65	0.05
Zone 20	20A	3.30	3.30	4	4,000	1.00	0.96	2.01	3.97	(0.67)
Zone 30	30A	1.12	1.12	2	1,500	0.26	0.18	0.52	0.96	0.16
Zone 200	200A	2.60	3.80	4	4,000	0.64	0.96	1.28	2.88	0.92
	200B	1.20								
Zone 300	300A	2.30	4.00	4	4,000	1.00	0.96	2.00	3.97	0.03
	300B	1.70								
	Total	21.98	21.98			6.16	5.13	12.32	23.60	(1.62)

[a] Based on the highest fire flow requirement within the pressure zone.

[b] Equal to 25 percent of maximum day demand.

[c] Equal to the fire flow requirement (gpm) multiplied by the required duration (hours).

[d] Equal to 50 percent of maximum day demand.

[e] Reservoir 1B is a shared storage facility between Zone 7 Water Agency and DSRSD. 1.175 MG of working storage is owned by DSRSD and 1.175 MG of working storage is leased by DSRSD from Zone 7 through 4/18/2033 per Supplemental Zone 7/DSRSD Agreement dated 2/20/1990.

[f] Assumed Reservoir 10A is not in service. Reservoir 10A has higher hydraulic grade line compared to the other reservoirs in Zone 1 which requires specific operation control setting at the Pump Station 10A and the Pressure Regulating Station at Reservoir 10A.

[g] Land use category in Zone 2 includes single family residential and commercial/office. Three commercial properties in Zone 2 were provided to the Alameda County Fire Marshal for review. Alameda County Fire Marshal provided the fire flow requirement for these special commercial buildings which is included in Appendix C. Based on this information, the highest fire flow requirement in Zone 2 would be for the DeSilva Gate Construction building that requires a 6,500 gpm for a 4-hour fire flow duration. Because the building has a sprinkler system, the fire flow requirement could be reduced by up to 75 percent (but not resulting in a fire flow less than 1,500 gpm) which resulted a fire flow requirement of 1,625 gpm. For the Water Master Plan, the required fire flow storage is calculated based on the 1,625 gpm for a 4-hour fire flow duration.

[h] Land use category in Zone 3 includes single family residential, multi-family residential (California Highland), and school (Valley Christian Center). The Alameda County Fire Marshal has reviewed the school property, and determined the fire flow requirement for the school is 5,500 gpm for a 4-hour fire flow duration. The Alameda County Fire Marshal confirmed that the school building has a sprinkler system. Therefore, the fire flow requirement could be reduced by up to 75 percent (but not resulting in a fire flow less than 1,500 gpm) which resulted a fire flow requirement of 1,500 gpm. Because the fire flow requirement for the multi-family residential in Zone 3 (multi-family residential fire flow requirement is 2,500 gpm for a 2-hour duration) is higher than the reduced school fire flow requirement, the required fire flow storage calculation for Zone 3 in this Water Master Plan is based on 2,500 gpm flow for 2-hour duration.

Table 6-6. Comparison of Existing and Required Storage Capacity under Buildout (2035) Demand Conditions

Pressure Zone	Storage Facility	Available Storage Capacity, MG		Required Fire Flow Duration, hours[a]	Required Fire Flow, gpm[a]	Required Storage Capacity, MG			Total Required Storage, MG	Storage Surplus (Deficit), MG
		Reservoir Capacity	Total Available Storage			Operational[b]	Fire Flow[c]	Emergency[d]		
Zone 1	1A	2.00	11.45	4	4,500	3.44	1.08	6.89	11.41	0.04
	1B[e]	2.35								
	10A (new)[f]	4.10								
	10B	3.00								
Zone 2	2A	0.72	0.72	4	1,625 [g]	0.19	0.39	0.37	0.95	(0.23)
Zone 3	3A	0.65	0.99	2	2,500 [h]	0.17	0.30	0.35	0.82	0.17
	3B	0.34								
Zone 4	4A	0.70	0.70	2	2,500	0.12	0.30	0.25	0.67	0.03
Zone 20	20A	3.30	4.60	4	4,000	1.20	0.96	2.40	4.56	0.04
	20B[i]	1.30								
Zone 30	30A	1.12	1.12	2	1,500	0.29	0.18	0.58	1.05	0.07
Zone 200	200A	2.60	3.80	4	4,000	0.66	0.96	1.31	2.93	0.87
	200B	1.20								
Zone 300	300A	2.30	4.00	4	4,000	1.03	0.96	2.06	4.04	(0.04)
	300B	1.70								
	Total	27.38	27.38			7.10	5.13	14.20	26.43	0.95

(a) Based on the highest fire flow requirement within the pressure zone.
(b) Equal to 25 percent of maximum day demand.
(c) Equal to the fire flow requirement (gpm) multiplied by the required duration (hours).
(d) Equal to 50 percent of maximum day demand.
(e) Reservoir 1B is a shared storage facility between Zone 7 Water Agency and DSRSD. 1.175 MG of working storage is owned by DSRSD and 1.175 MG of working storage is leased by DSRSD from Zone 7 through 4/18/2033 per Supplemental Zone 7/DSRSD Agreement dated 2/20/1990.
(f) Existing Reservoir 10A is replaced with a new 4.1 MG Reservoir 10A.
(g) Land use category in Zone 2 includes single family residential and commercial/office. Three commercial properties in Zone 2 were provided to the Alameda County Fire Marshal for review. Alameda County Fire Marshal provided the fire flow requirement for these special commercial buildings which is included in Appendix C. Based on this information, the highest fire flow requirement in Zone 2 would be for the DeSilva Gate Construction building that requires a 6,500 gpm for a 4-hour fire flow duration. Because the building has a sprinkler system, the fire flow requirement could be reduced by up to 75 percent (but not resulting in a fire flow less than 1,500 gpm) which resulted a fire flow requirement of 1,625 gpm. For the Water Master Plan, the required fire flow storage is calculated based on the 1,625 gpm for a 4-hour fire flow duration.
(h) Land use category in Zone 3 includes single family residential, multi-family residential (California Highland), and school (Valley Christian Center). The Alameda County Fire Marshal has reviewed the school property, and determined the fire flow requirement for the school is 5,500 gpm for a 4-hour fire flow duration. The Alameda County Fire Marshal confirmed that the school building has a sprinkler system. Therefore, the fire flow requirement could be reduced by up to 75 percent (but not resulting in a fire flow less than 1,500 gpm) which resulted a fire flow requirement of 1,375 gpm. Because the fire flow requirement for the multi-family residential in Zone 3 (multi-family residential fire flow requirement is 2,500 gpm for a 2-hour duration) is higher than the reduced school fire flow requirement, the required fire flow storage calculation for Zone 3 in this Water Master Plan is based on 2,500 gpm flow for 2-hour duration.
(i) New Reservoir 20B planned in Pressure Zone 20.

6.4 FUTURE POTABLE WATER SYSTEM PERFORMANCE EVALUATION

The purpose of the future potable water system performance evaluation is to identify necessary improvements to support the District's Buildout (2035) potable water demands while meeting the District's recommended potable water system planning and design criteria. The following evaluations were performed to assess distribution system performance under Buildout (2035) potable water demand conditions:

- Normal Operations – Peak Hour Demand Scenario: This scenario evaluates customer service pressures in the system during a peak hour demand condition.
- Emergency Operations – Maximum Day plus Fire Flow Scenario: This scenario evaluates fire flow availability in the system under a maximum day demand condition.
- Extended Period Simulation – Maximum Day Demand Scenario: This scenario evaluates the hydraulics of the system during a maximum day demand (non-fire) condition over a 72-hour period.

These three scenarios used the updated hydraulic model to evaluate the future potable water system performance. The future potable water system is expected to deliver peak hour flows and maximum day demand plus fire flow within the acceptable pressure, velocity and head loss ranges as identified in the planning and design criteria presented in Chapter 4.

The future potable water system performance evaluation identifies if improvements are required to support the District's 2035 buildout demand conditions while meeting the District's recommended water system planning and design criteria. As described below, no major distribution system improvements have been identified for 2035 conditions, so there was no need to conduct these analyses under 2020 demand conditions.

6.4.1 Normal Operations – Peak Hour Demand Scenario

6.4.1.1 Evaluation Overview

The future peak hour demand scenario was evaluated using a steady-state hydraulic model scenario. The Buildout (2035) peak hour demand, as presented on Table 6-1, was calculated to be 23,665 gpm (approximately 33.8 mgd). The hydraulic analysis assumed storage reservoirs are 75 percent full and pump stations are operating at their firm capacity.

During a peak hour demand condition, system pressures must be maintained between 40 psi and 200 psi throughout the entire potable water system. In addition, for pipelines, it is recommended that the maximum velocities should not exceed 5 fps in transmission pipelines or 8 fps in distribution pipelines during normal operating conditions, to help minimize energy (pumping) costs and excessive head loss due to undersized pipelines.

6.4.1.2 Evaluation Results

Figure 6-1 presents the hydraulic results under Buildout (2035) peak hour demand conditions. Results indicate that the future potable water system can meet the District's minimum pressure criterion of 40 psi, except for the locations described in Table 6-7 and shown in red on Figure 6-1.

Table 6-7. Summary of Future System Peak Hour Evaluation Results

Zone-Area	Finding	Recommendation
Pressure Zone 1: Low pressures occur in the Central Dublin and West Dublin areas.	Low pressures in the Central Dublin range from 30 to 39 psi, and are located in the Parks RFTA and Crossridge Road areas. Low pressures in the Parks RFTA area are simulated at hydraulic model junctions with no customer demands. Low pressures simulated at Crossridge Road range from 33 to 39 psi. The elevations of the model junctions range from 416 to 428 feet which is close or equal to the normal highest customer service elevation of 428 feet for the pressure zone, therefore, no mitigation is recommended. Low pressures in West Dublin are located near the suction pipeline of PS 2A and 2B, and east of Alcosta Boulevard and San Ramon Valley Boulevard. Pressures range from 37 to 39 psi. The elevations of these areas range from 410 to 422 feet, which is close to the normal highest customer service elevation.	There are no customer demands at these locations, therefore, no mitigation is recommended.
Pressure Zone 2: Low pressures occur in two areas: (1) Betlen Drive and Prow Way; and (2) between Bay Laurel Street and Hansen Drive.	Pressures in these areas range from 18 to 38 psi. The elevations for these areas are 550 and 596 feet – these are close to or above the normal highest customer service elevation of 552 feet for Pressure Zone 2. The low pressure located at Hansen Drive and Bay Laurel Street is located between Pressure Zones 2 and 3. As discussed in Chapter 5, there are no customer services located in these areas. The residential customers in these areas are served from Pressure Zone 3 transmission mains, which parallel the Pressure Zone 2 transmission mains.	No mitigation is recommended.
Pressure Zone 3: Low pressures occur in three areas: (1) Marwick Drive; (2) Valley Christian School property; and (3) the intersection of Inspiration Circle and Mountain Rise Place.	Pressures in these areas range from 30 to 39 psi. Service elevations for these areas range from 742 to 764 feet which are near or above the normal highest customer service elevation of 746 feet for this pressure zone. The static pressure at elevation 764 feet is 32 psi, as calculated from the tank overflow elevation.	No mitigation is recommended.

The simulated velocity results indicate all pipelines within the District's potable water network met the velocity criterion of 5 fps in transmission pipelines and 8 fps in distribution pipelines, except for an existing 6-inch diameter pipeline located at the intersection of Brighton Drive and Amador Valley Boulevard, as presented on Figure 6-1. The pipeline length is 16 lineal feet. This pipeline is connected to the parallel 6-inch diameter and 16-inch diameter pipelines along Amador Valley Boulevard, and is also connected to the 10-inch diameter pipeline along Brighton Drive. The pipeline velocity was 9.9 fps which exceeded the transmission pipeline velocity criterion of 5 fps. Since pipeline velocity is a secondary criterion, no mitigation is recommended.

6.4.2 Emergency Operations – Maximum Day plus Fire Flow Scenario

6.4.2.1 Evaluation Overview

To evaluate the existing potable water system under the maximum day demand plus fire flow scenario, InfoWater's "*Available Fire Flow Analysis*" tool was used to determine the available fire flow while maintaining a minimum residual pressure of 20 psi at all service junctions within the zone. For the Buildout (2035) fire flow analysis, key junctions that represent hydrant locations were evaluated to determine the available flow that can be provided, in addition to meeting the maximum day demand. The analysis assumed that storage reservoirs are 50 percent full and pump stations are operating at their firm capacity. Maximum velocity was not considered in the evaluation because it is a secondary design criterion.

6.4.2.2 Fire Flow Evaluation Results

Figure 6-2 summarizes the available fire flow at each hydrant location while meeting the minimum residual pressure criterion of 20 psi. Available fire flows are similar to available flows under existing maximum day conditions. There are a few areas in Pressure Zones 1, 2, 3, 20, and 200 that could not provide the required fire flow at a single location. As discussed in Chapter 5, the fire flow demand in these areas could be met by multiple hydrants because the areas are well-looped and/or there is a larger diameter parallel pipeline serving the area and/or the required fire flow can be reduced by up to 75 percent if automatic fire sprinkler systems are installed. Additionally, the simulated available fire flows for areas with fire flow deficiencies are no less than 85 percent of the fire flow requirement. Figure 6-2 presents the simulated available fire flow ranges for the areas with deficit.

6.4.2.3 Multiple Simultaneous Fire Flow Evaluation Results

Based on ACFD's requirement, the future system located within Alameda County is required to be able to meet multiple fire events. Therefore, in addition to the single fire flow event evaluation described above, West Yost simulated two simultaneous fires in all pressure zones located within Alameda County (Pressure Zones 1, 2, 3, 4, 20 and 30). There is no multiple fire event requirement for Pressure Zones 200 and 300, because these pressure zones are located outside Alameda County, and are governed by the SRVFPD, which does not have a multiple fire event requirement.

The two simultaneous fire events evaluation includes the following:

- One fire event for a single family residential land use and one fire event for a commercial land use;
- Two single family residential fire flow events when there is no commercial land use existing within the pressure zone; or
- Two commercial fire flow events in the Central Dublin area that consists mostly of commercial land use.

The locations of multiple fire flow events are presented in Figure 6-3. Results indicate the District's potable water system within Alameda County could meet the minimum 20 psi residual pressure when two simultaneous fire events occur.

6.4.3 Extended Period Simulation – Maximum Day Demand Scenario

6.4.3.1 Evaluation Overview

The purpose of the maximum day demand EPS evaluation is to further assess the hydraulics of the District's future potable water system during a 72-hour simulation (three successive maximum days). Generally, reservoir levels are expected to cycle within the operational storage volume, since the remaining volume is reserved for emergencies and/or providing fire flow volume. A 72-hour EPS was conducted using the hydraulic model to evaluate system performance under Buildout (2035) maximum day demand (non-fire) conditions. As shown in Table 6-1, the maximum day demand for the Buildout (2035) potable water service area was calculated to be 19,721 gpm (approximately 28.2 mgd).

6.4.3.2 Evaluation Results

Figures 6-4 to 6-6 present reservoir levels of the District's reservoirs over the 72-hour simulation. As shown on Figure 6-4, water level trends for Reservoirs 10A (new) and 10B fluctuate between 75 to 100 percent. For the Buildout (2035) demand condition, Zone 7 Turnouts 4, 5 and 6 were operated based on the Reservoir 10B level. Reservoirs 10A (new) and 10B are close to each other, and the water levels for both reservoirs trend similarly. Reservoir 1A is located further to the west in the District's potable water system. The Zone 7 Turnouts that supply Reservoir 1A are Turnouts 1 and 2. Although the water level trend for Reservoir 1A fluctuates between 60 to 80 percent, the overall water level over the 72-hour simulation period indicates an ascending trend.

The evaluation indicates that flows to Reservoir 1A could be improved under the Buildout (2035) condition with several system improvements including:

- Replacing three of the existing pumps at PS 1A with 20 horsepower (hp) pumps and adding an additional 20 hp pump;
- Replacing 367 LF of 12-inch diameter pipeline with 16-inch diameter pipeline along Amador Valley Boulevard from downstream of PS 1A to Iron Horse Trail; and
- Constructing 1,786 LF of 16-inch diameter pipeline along Amador Valley Boulevard from Village Way to Donohue Drive to parallel an existing 12-inch diameter pipeline.

These suggested system improvements are based on future demand conditions which are subject to change as development plans change and as water use in the District's service area changes. Therefore, these identified deficiencies do not need to be addressed in the near-term and can be deferred, but should be re-evaluated in future updates to the District's Water System Master Plan.

Figures 6-5 and 6-6 show the storage reservoirs in the higher pressure zones of the potable water system, which generally recover within one or two days.

A pressure management evaluation was also performed to identify and address low pressure deficiencies based on the results from the maximum day demand extended period simulation. The purpose of the evaluation is to identify low pressure areas that resulted from the additional demands that were added to the hydraulic model to represent the Buildout (2035) demand condition.

Figure 6-7 presents the minimum pressures during the extended period simulation. As shown on Figure 6-7, low pressure areas were identified in Pressure Zones 1, 2, 3 and 20. The low pressures occur during the peak hour period, and/or when the water level in the reservoir has dropped and the pump station has not started to operate to fill the reservoir. The low pressures in Pressure Zone 20 occur on Cantalise Drive and Forino Drive which are located at the border of Pressure Zone 20 and Pressure Zone 30. As noted previously, low pressure areas in Zones 1, 2, and 3 are located where customer service elevations are either close to or above the top of zone service elevation and no mitigation is recommended.

It should be noted that pressures from the EPS analysis are different (generally slightly lower) than the steady-state peak hour demand simulation because during an EPS reservoir levels, which were initially set at 75 percent full, can change during the extended period simulation. In contrast, the steady-state peak hour demand scenario assumed tank levels stay at 75 percent full.

6.5 SUMMARY OF FINDINGS AND RECOMMENDED IMPROVEMENTS FOR THE FUTURE POTABLE WATER SYSTEM

Findings from the evaluation of the future water distribution system and the recommended improvements needed to eliminate deficiencies are summarized below. These recommendations are used to develop a recommended CIP which is further described in Chapter 7. Recommended future system improvements are shown on Figure 6-8.

The following potable water system improvements are recommended:

- In-Tract Emergency Fire Pump Station for New Development (2020):
  - Construct new 1.56 mgd PS 300D at Moller Ranch project site to provide emergency supply to Pressure Zone 300 of the Moller Ranch project (to be entirely developer-funded; not included in recommended CIP in Chapter 7); and
  - This addresses the lack of a secondary pipeline into the Moller Ranch project area, which is a standard requirement for the District.

- Additional Storage Capacity (2020):
  - Replace the existing Reservoir 10A with a new 4.1 MG Reservoir 10A at a lower elevation for additional storage capacity in Pressure Zone 1; and
  - Construct a new 1.3 MG Reservoir 20B for additional storage capacity in Pressure Zone 20 (also requires 8,674 LF of 12-inch diameter pipeline from Tassajara Road to the planned new Reservoir 20B location in the Windermere Development area).
- In-Tract Pipelines for New Development Projects for 2020 and Buildout (2035):
  - Construct new in-tract pipelines for new developments in Eastern Dublin, Moller Ranch and Dougherty Valley (see Figure 6-8) (to be entirely developer-funded; not included in recommended CIP in Chapter 7)
- Supply Reliability for Buildout (2035):
  - To provide supply reliability under future maximum day demand, a new Zone 7 turnout (Turnout 6) is recommended south of Interstate 580 at Pimlico Drive. The capacity of this turnout should be equal to 6,000 gpm (8.64 mgd). Requires 2,281 LF of new 20-inch diameter pipeline, of which 205 LF must be installed using jack and bore techniques underneath Interstate 580.

The following additional future system improvements have been identified to address potential future system deficiencies based on future Buildout (2035) demand conditions. However, because future demand conditions are subject to change as development plans change and as water use in the District's service area changes, these future system improvements are recommended to be deferred and are not included in the recommended CIP described in Chapter 7. The need for the following potential future system improvements should be re-evaluated in future updates to the District's Water System Master Plan:

- Pump Station 1A:
  - Replace three of the existing pumps at PS 1A with 20 hp pumps and adding an additional 20 hp pump;
  - Replace 367 LF of 12-inch diameter pipeline with 16-inch diameter pipeline along Amador Valley Boulevard from downstream of PS 1A to Iron Horse Trail; and
  - Construct 1,786 LF of 16-inch diameter pipeline along Amador Valley Boulevard from Village Way to Donohue Drive to parallel an existing 12-inch diameter pipeline.
- Pump Station 20B:
  - Replace existing pumps with 100 hp pumps to provide additional pumping capacity in Zone 20, or provide an additional pump at Pump Station 20A.
- Pump Station 200A:
  - Replace existing pumps with 100 hp pumps to provide additional pumping capacity.

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Last Saved: 3/22/2016 9:44:21 AM akwong; O:\Clients\406 DSRSD\02-14-38 Wtr Sys MP Capacity Study\GIS\Figures\Figure 6-1 Future PHD.mxd

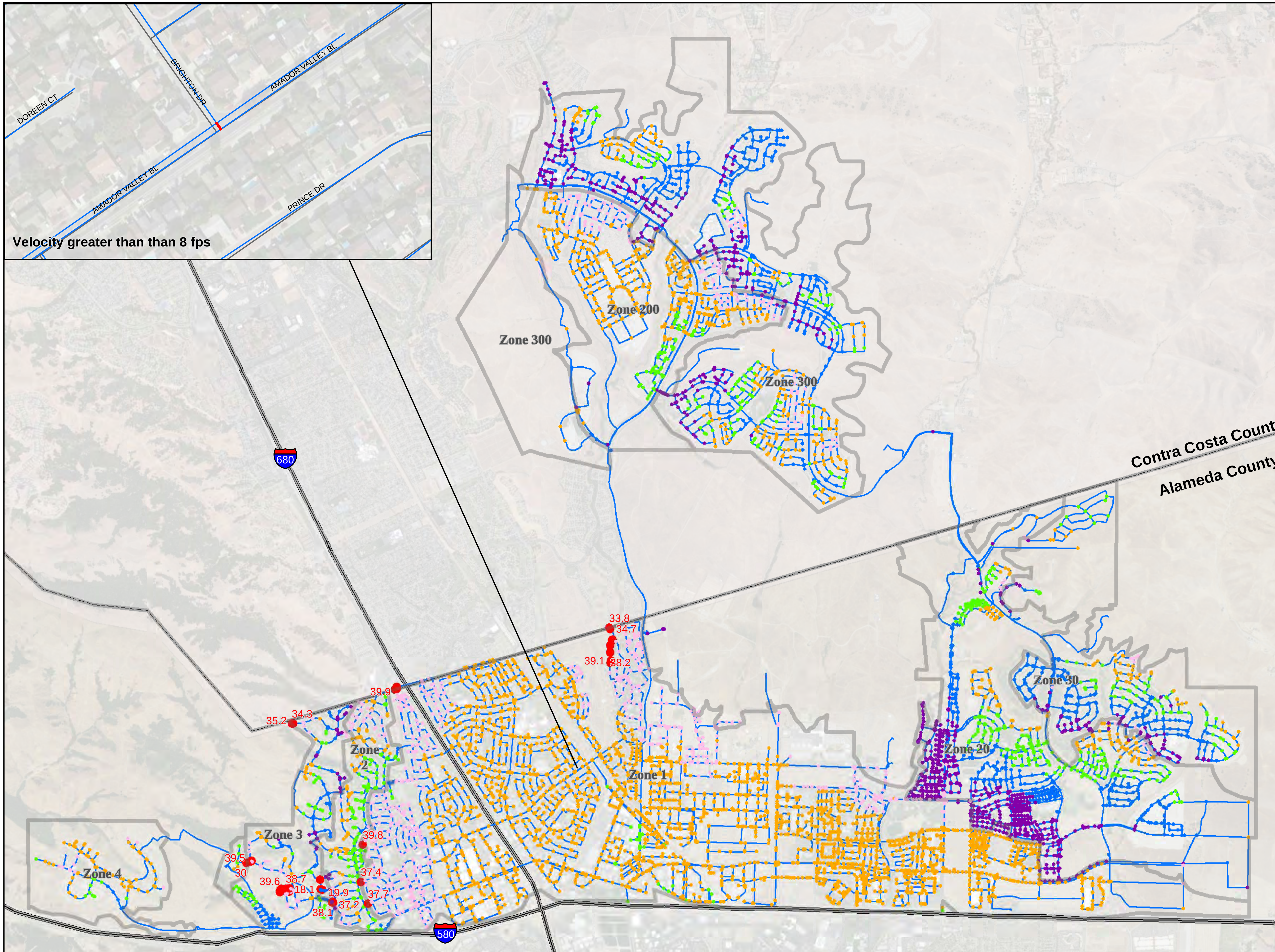

FIGURE 6-1

Dublin San Ramon Services District Water System Master Plan

FUTURE SYSTEM PEAK HOUR DEMAND RESULTS

N

0 1,750 3,500
Scale in Feet

Note:
1. Buildout (2035) peak hour demand is equal to 34.1 mgd (23,665 gpm).
2. Storage reservoirs were assumed to be 75% full.
3. Values in red are in pounds per square inch (psi),
4. The velocity criterion is 5 feet per second (fps) for transmission mains and 8 fps for distribution mains.

LEGEND

- Pressure < 40 psi
- 40 psi ≤ Pressure < 60psi
- 60 psi ≤ Pressure < 80psi
- 80 psi ≤ Pressure < 100psi
- 100 psi ≤ Pressure < 120psi
- Pressure ≥ 120psi
- Velocity ≤ Velocity Criteria
- Velocity > Velocity Criteria

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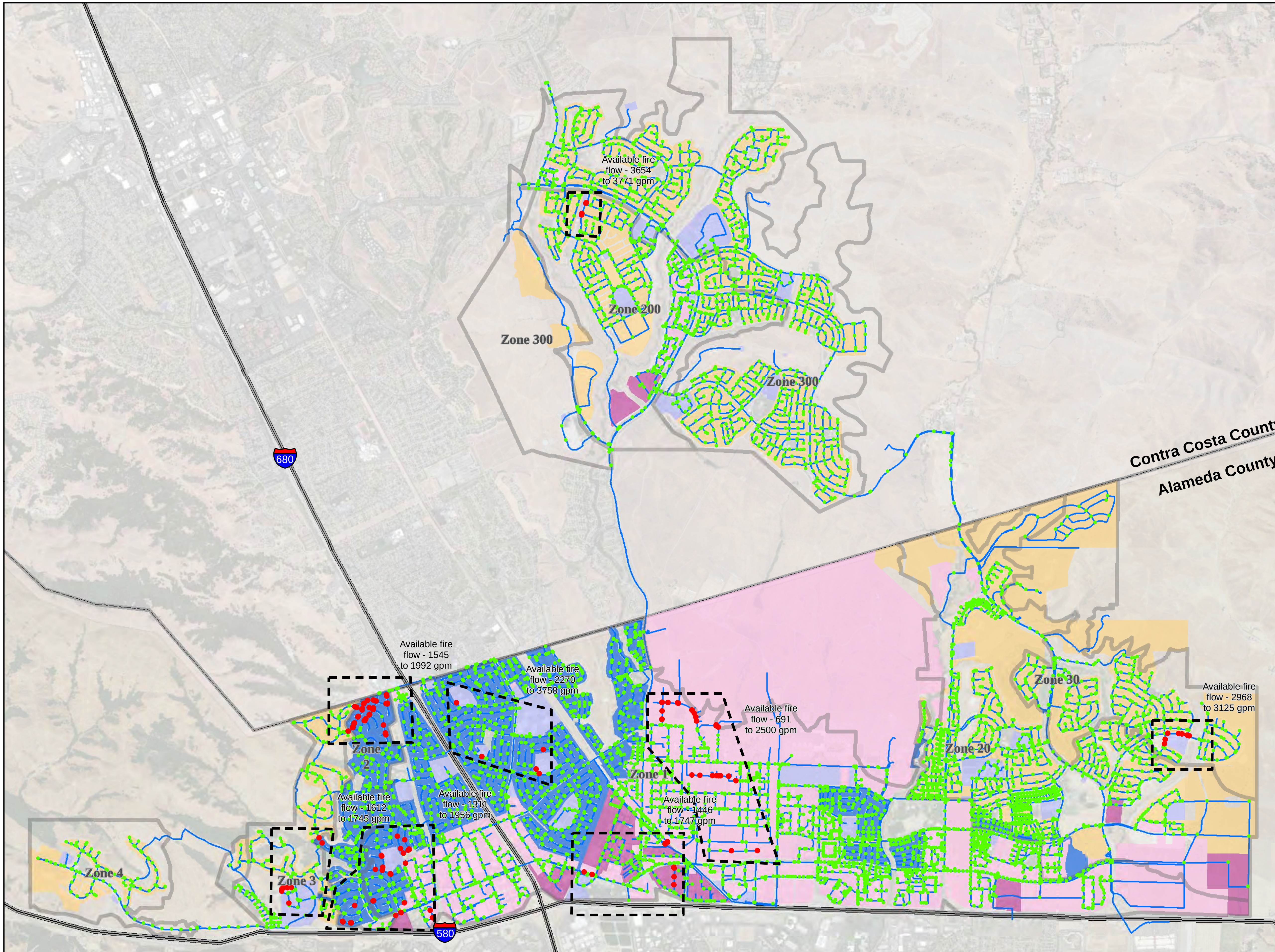

FIGURE 6-2

Dublin San Ramon Services District Water System Master Plan

AVAILABLE FIRE FLOW UNDER FUTURE MAXIMUM DAY DEMAND

N

0 1,750 3,500

Scale in Feet

Note:
1. Buildout (2035) maximum day demand is equal to 28.4 mgd (19,721 gpm).
2. Storage reservoirs were assumed to be 50% full.
3. Results are based on a minimum system residual pressure of 20 psi.
4. Results shown are representative of system capacity and do not represent available flow from a specific hydrant.

LEGEND

- Available Fireflow Meets or Exceeds Requirement
- Available Fireflow Less Than Requirement

Fireflow Requirements Based on Land Use Type:

- 1,500 gpm for Single Family (sprinkler)
- 2,000 gpm for Single Family (non-sprinkler)
- 2,500 gpm for Multi-Family or Commercial
- 4,000 gpm for Institutional or School
- 4,500 gpm for Industrial or Business Park

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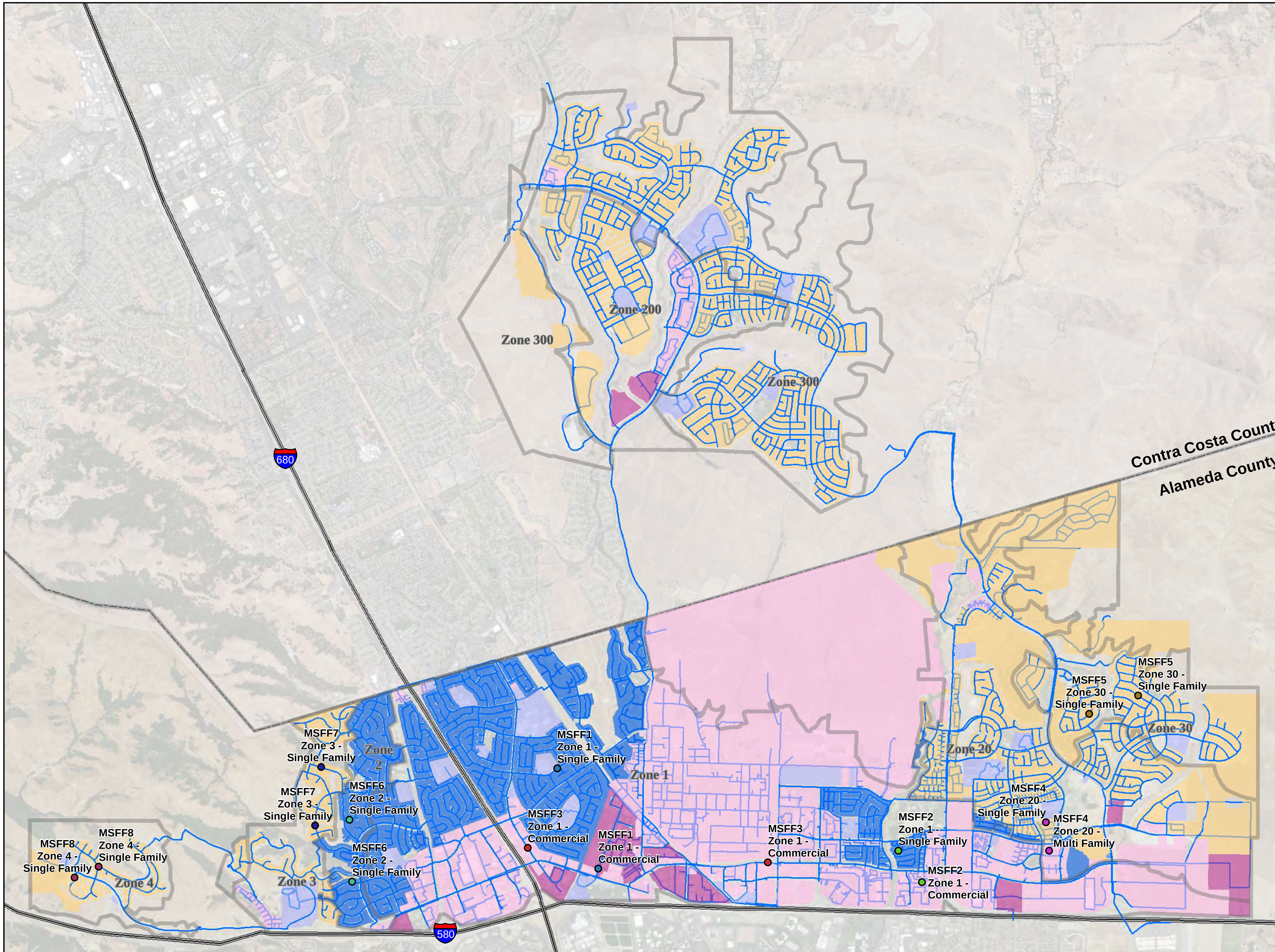

FIGURE 6-3

Dublin San Ramon Services District Water System Master Plan

MULTIPLE FIRE FLOW EVENTS EVALUATION UNDER MAXIMUM DAY DEMAND

N

0 1,750 3,500

Scale in Feet

Note:
1. Buildout (2035) maximum day demand is 28.4 mgd (19,721 gpm).
2. Storage reservoirs were assumed to be 50% full.
3. Results are based on a minimum system residual pressure of 20 psi.
4. Multiple fire flow evaluation is required by the Alameda County Fire Department.

LEGEND

Multiple Simultaneous Fire Flow (MSFF):

- MSFF1
- MSFF2
- MSFF3
- MSFF4
- MSFF5
- MSFF6
- MSFF7
- MSFF8

Fireflow Requirements Based on Land Use Type:

- 1,500 gpm for Single Family (sprinkler)
- 2,000 gpm for Single Family (non-sprinkler)
- 2,500 gpm for Multi-Family or Commercial
- 4,000 gpm for Institutional or School
- 4,500 gpm for Industrial or Business Park
- Pipeline

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Figure 6-4. Zone 1 Reservoir Levels - Buildout (2035) Maximum Day Demand EPS

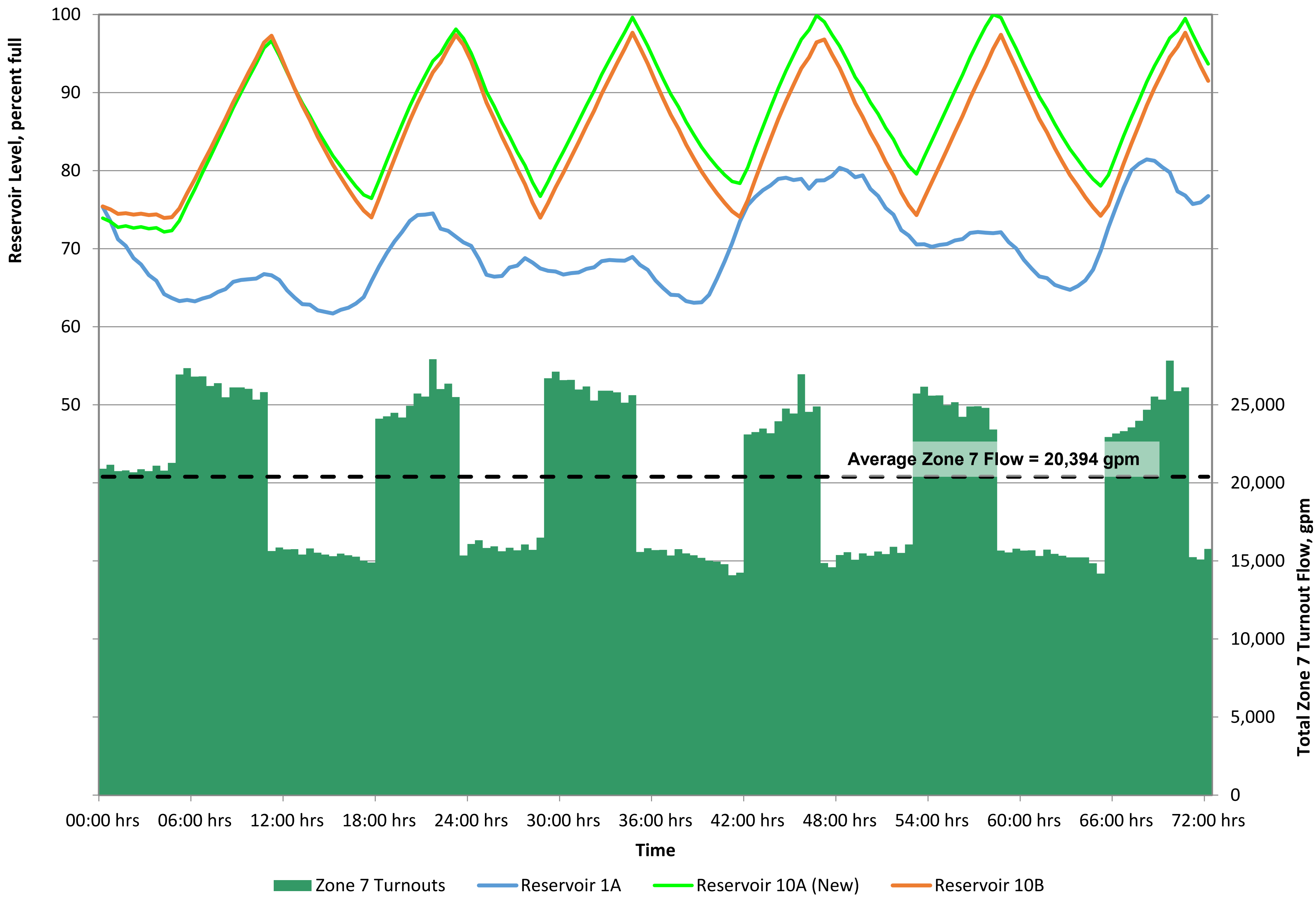

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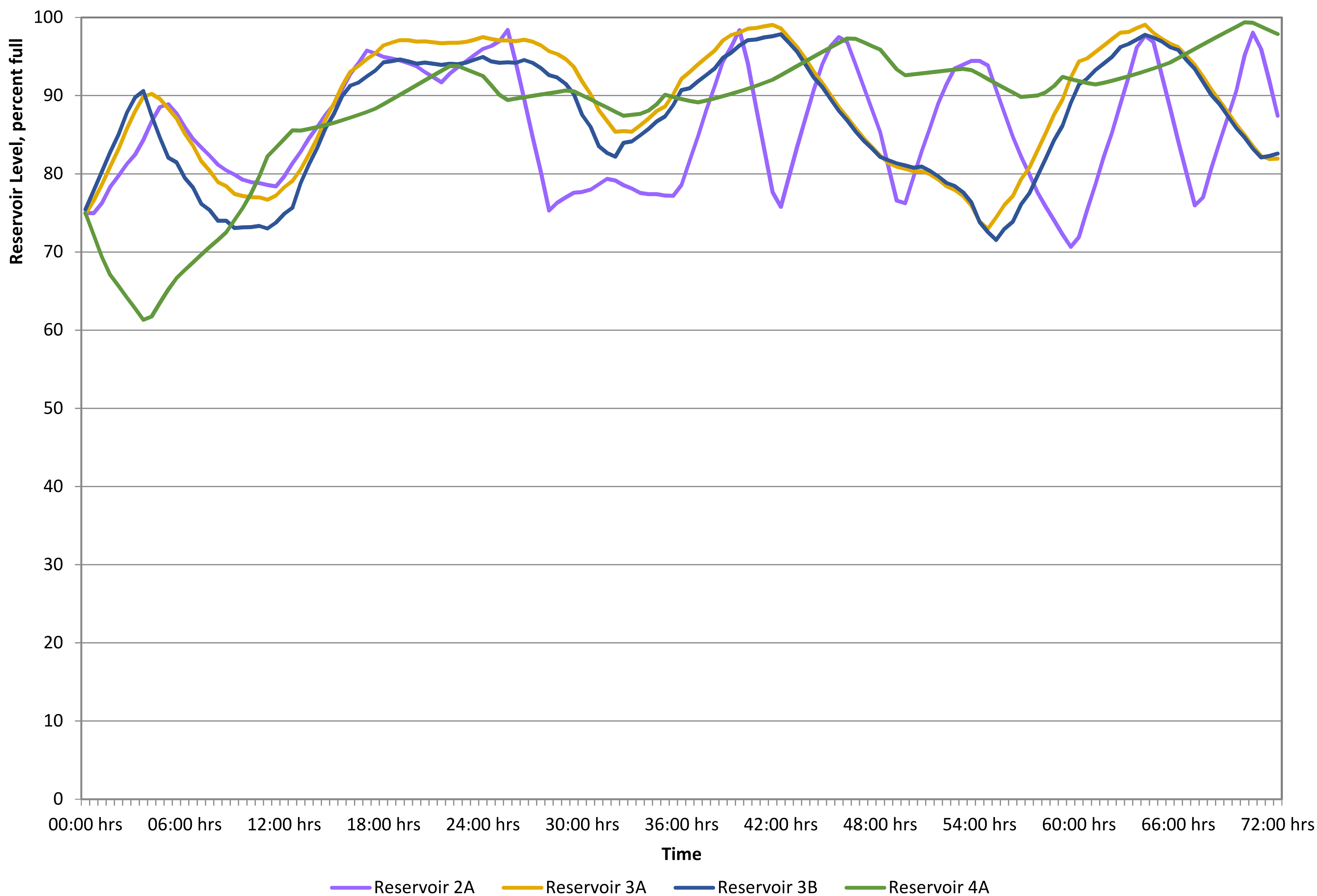
Figure 6-5. Zones 2, 3 and 4 Reservoir Levels - Buildout (2035) Maximum Day Demand EPS



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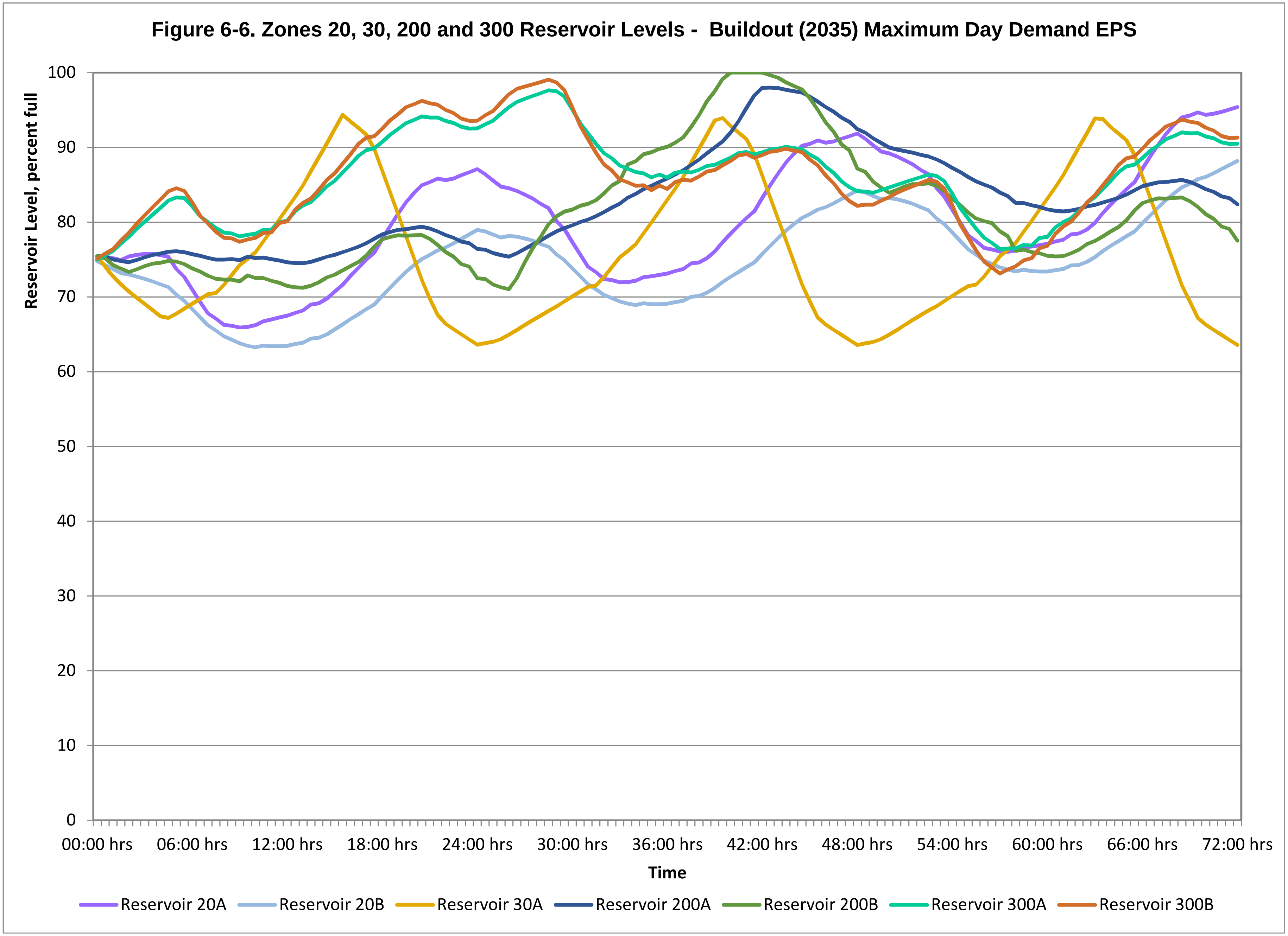
Figure 6-6. Zones 20, 30, 200 and 300 Reservoir Levels - Buildout (2035) Maximum Day Demand EPS
Reservoir Level, percent full
100
90
80
70
60
50
40
30
20
10
0
00:00 hrs
06:00 hrs
12:00 hrs
18:00 hrs
24:00 hrs
30:00 hrs
36:00 hrs
42:00 hrs
48:00 hrs
54:00 hrs
60:00 hrs
66:00 hrs
72:00 hrs
Time
Reservoir 20A
Reservoir 20B
Reservoir 30A
Reservoir 200A
Reservoir 200B
Reservoir 300A
Reservoir 300B

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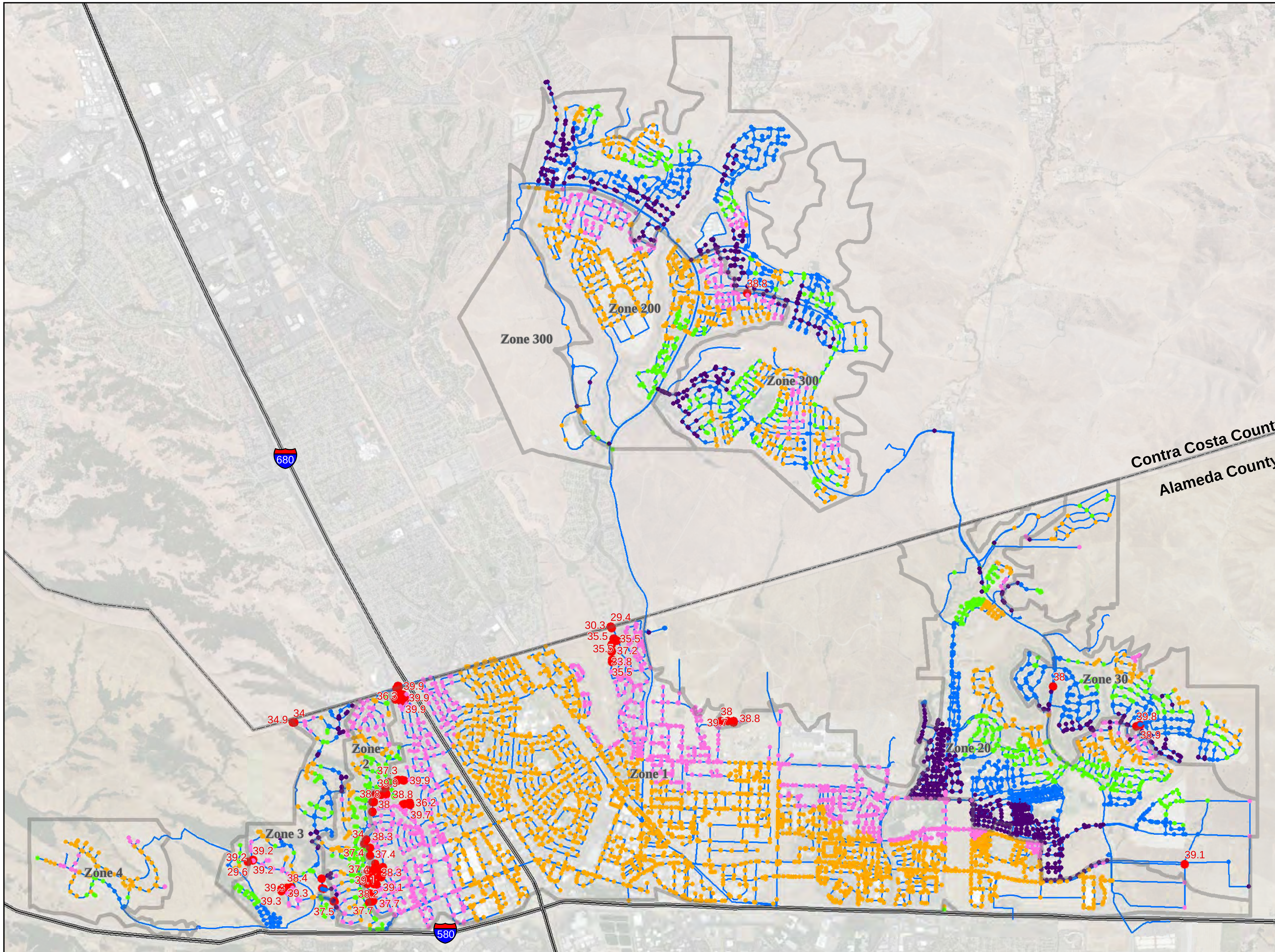

FIGURE 6-7

Dublin San Ramon Services District Water System Master Plan

FUTURE SYSTEM MAXIMUM DAY DEMAND MINIMUM PRESSURE RESULTS DURING EPS

N

0 2,000 4,000

Scale in Feet

Note:
1. Buildout (2035) maximum day demand is equal to 28.4 mgd (19,721 gpm).
2. Initial reservoir levels were set to 75% full.
3. Values in red are in pounds per square inch (psi),

LEGEND

- Pressure < 40 psi
- 40 psi ≤ Pressure < 60 psi
- 60 psi ≤ Pressure < 80 psi
- 80 psi ≤ Pressure < 100 psi
- 100 psi ≤ Pressure < 120 psi
- Pressure ≥ 120 psi
- Pipeline

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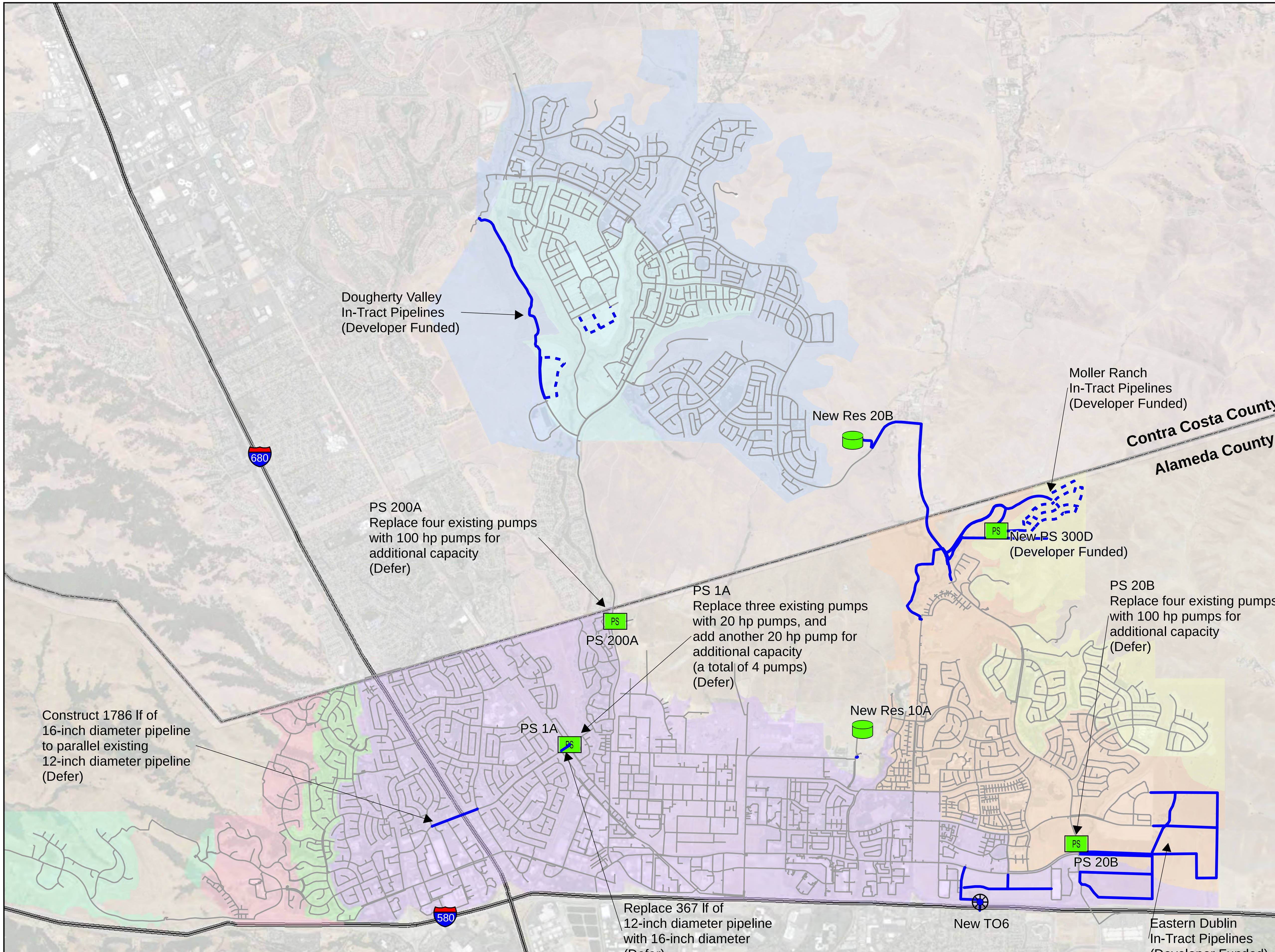
FIGURE 6-8

Dublin San Ramon Services District Water System Master Plan

RECOMMENDED FUTURE SYSTEM IMPROVEMENTS



N

0 1,750 3,500

Scale in Feet

LEGEND

- Recommended Storage Improvement for Future System
- PS Recommended Pump Station for Future System
- Recommended Pipeline for Projected Future Development (Pipeline = 8-inch)
- Recommended Pipeline for Projected Future Development (Pipeline ≥12-inch)
- Existing Pipeline

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CHAPTER 7: RECOMMENDED CAPITAL IMPROVEMENT PROGRAM

Chapter Contents:

- Overview
- Recommended Potable Water System Capital Improvement Program
- Capital Improvement Program Costs and Implementation

Chapter Purpose

This chapter presents the recommended Capital Improvement Program (CIP) for the District's existing and future potable water system. Recommendations for improvements to the existing and future potable water system were described previously in Chapters 5 and 6, respectively.

It should be noted that although an evaluation of the District's recycled water system was also performed in conjunction with this Water System Master Plan (see Appendix F), no capital improvements have been identified for the District's recycled water distribution system.

Chapter Highlights

The recommended CIP includes the following projects:

Existing (Near-Term) Improvements:

Install permanent, on-site generators at the following five pump stations: PS 2C, PS 3A, PS 20B, PS 200A and PS 300B to provide system reliability during power outages.

Intermediate (2020) Improvements:

- Replace the existing Reservoir 10A with a new 4.1 MG Reservoir 10A at a lower elevation for additional storage capacity in Pressure Zone 1
- Construct a new 1.3 MG Reservoir 20B in the Windemere Development area for additional storage capacity in Pressure Zone 20.

Buildout (2035) Improvements:

Construct a new 6,000 gpm (8.6 mgd) Zone 7 turnout (Turnout 6) south of I-580 at Pimlico Drive

Construction Cost Assumptions

Estimated construction costs are presented in October 2015 dollars at an Engineering News Record (ENR) Construction Cost Index (CCI) of 11169 (San Francisco Average).

The total CIP cost includes mark-ups equal to 69 percent of the estimated base construction costs: a 30 percent design and construction contingency and an additional 30 percent to account for professional services.

Improvement Type	Existing (Near-Term)	Intermediate (2020)	Buildout (2035)	Total
On-site Generators	$3,040,000	$0	$0	$3,040,000
Storage	$0	$15,389,000	$0	$15,389,000
Pipelines[(a)]	$0	$1,139,756	$0	$1,139,756
Zone 7 Turnout	$0	$0	$2,009,000	$2,009,000
Total Capital Improvement Cost	$3,040,000	$16,528,756	$2,009,000	$21,577,756

(a) See Table 7-2 for a description of the pipeline CIP projects which are included in the District's current adopted CIP.

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CHAPTER 7
Recommended Capital Improvement Program

This chapter presents the recommended CIP for the District's existing and future potable water system based on the evaluations described in Chapters 5 and 6 of this Water System Master Plan. This chapter also provides an update to the potable water projects included in the District's current adopted CIP based on the findings and recommendations of the evaluations performed for this Water System Master Plan.

An evaluation of the District's recycled water system was also performed in parallel with this Water System Master Plan and is provided in Appendix F. As described in the recycled water evaluation, no capital improvements to the District's recycled water distribution have been identified and therefore no recycled water projects are recommended for the District's capital improvement program.

7.1 RECOMMENDED POTABLE WATER SYSTEM CAPITAL IMPROVEMENT PROGRAM

The recommended potable water system capital improvement projects are described below, listed in Table 7-1 and shown in Figure 7-1. It should be noted that developer-funded projects identified in Chapter 6 (e.g., in-tract pipelines that will be funded and constructed by developers) are not included in the recommended CIP, and future system improvements that have been deferred as described in Chapter 6, are also not included in the recommended CIP.

It should also be noted that the recommended CIP only identifies improvements at a Master Planning level and does not constitute a design of such improvements. Subsequent detailed design will be required to determine the exact sizes and locations of these proposed improvements and to refine the cost estimates.

7.1.1 Existing System Potable Water Capital Improvement Program

Chapter 5 provided a summary of the evaluation of the District's existing potable water system and its ability to meet the recommended planning and design criteria described in Chapter 4. Based on the existing water system evaluation, improvements were recommended to eliminate existing system deficiencies. The recommended existing potable water system improvements are as follows:

- Pump Station Improvements
  - Install permanent, on-site backup generators at the following five pump stations: PS 2C, PS 3A, PS 20B, PS 200A and PS 300B to provide system reliability during power outages.

The recommended existing system improvements should be implemented in the near-term.

Table 7-1. Summary of Recommended Capital Improvement Projects and Estimated Cost[a]

CIP ID	Improvement Type	Improvement by District or Developer	Reason for Improvement	Improvement Description	Zone	Estimated Construction Cost[b]	Capital Cost (includes mark-ups)[b+A1]
Existing System Improvements (Near-Term Improvements)							
Booster Pump Station Improvements							
CIP Sta 2C	New Generator	District	Emergency/Supply Reliability	On-site backup generator at Station 2C	2	$ 468,000	$ 608,000
CIP Sta 3A	New Generator	District	Emergency/Supply Reliability	On-site backup generator at Station 3A	3	$ 468,000	$ 608,000
CIP Sta 20B	New Generator	District	Emergency/Supply Reliability	On-site backup generator at Station 20B	20	$ 468,000	$ 608,000
CIP Sta 200A	New Generator	District	Emergency/Supply Reliability	On-site backup generator at Station 200A	200	$ 468,000	$ 608,000
CIP Sta 300B	New Generator	District	Emergency/Supply Reliability	On-site backup generator at Station 300B	300	$ 468,000	$ 608,000
						Subtotal	$ 3,040,000
						Existing System Improvement Projects (Near-Term Projects) Total	**$ 3,040,000**
Intermediate Improvements (2020 Improvements)							
Storage Improvements							
CIP Res 10A	New Reservoir	District	Storage Deficiency	Construct new 4.1 MG Reservoir 10A (includes demolition of existing Reservoir 10A)	1	$ 5,920,000	$ 7,636,000
CIP Res 20B	New Reservoir	District	Storage Deficiency	Construct new 1.3 MG storage reservoir (includes 8,674 LF of 12-inch diameter pipeline from Tassajara Road to Reservoir 20B and property purchase)	20	$ 5,999,000	$ 7,753,000
						Subtotal	$ 15,389,000
Pipeline Improvements							
CIP No. 05-6204	New Pipeline	To be installed by Developer and reimbursed by District	Storage Operation	Construct 1,700 feet of 14-inch diameter pipeline from Bollinger Canyon Road south to Reservoir 200B	200	[c]	$ 824,256
CIP No. 12-W013	New Pipeline	Already installed by Developer; to be reimbursed by District	Distribution Improvement	Construct 400 feet of 16-inch diameter Pressure Zone 20 water main and 1,700 feet of 20-inch diameter Pressure Zone 30 water main on Fallon Road	20 & 30	[d]	$ 315,500
						Subtotal	$ 1,139,756
						Intermediate Improvement Projects (2020 Projects) Total	**$ 16,528,756**
Buildout Improvements (2035 Improvements)							
Supply Improvements							
CIP FUT TO6	Supply Reliability	District	Buildout	Construct new Zone 7 Turnout 6 at Pimlico Drive and I-580 including 205-foot Jack and Bore and 2,076 LF of 20-inch diameter pipeline to Dublin Boulevard	1	$ 1,546,000	$ 2,009,000
						Subtotal	$ 2,009,000
						Buildout Improvement Projects Total	**$ 2,009,000**
						Total Capital Improvement Plan	**$ 21,577,756**

[a] Costs shown are based on the October 2015 SF ENR CCI of 11169.
[b] Costs include base construction costs plus 30 percent design and construction contingency, and an additional markup equal to 30 percent for professional services.
[c] Cost shown is based on maximum amount to be reimbursed to the developer by the District.
[d] Cost shown is based on amount to be reimbursed to the developer by the District.

7.1.2 Future System Potable Water Capital Improvement Program

Chapter 6 provided a summary of the evaluation of the District's future potable water system and its ability to meet the recommended water system planning and design criteria described in Chapter 4. Based on the future potable water system evaluation, improvements were recommended to eliminate future system deficiencies and to meet intermediate future demand at 2020 and Buildout (2035) demand.

The recommended intermediate (2020) potable water system improvements are as follows:

- New Reservoir 10A
  - — Replace the existing Reservoir 10A with a new 4.1 MG Reservoir 10A at a lower elevation for additional storage capacity in Pressure Zone 1;
  - — Replaces previously recommended CIP for a new Reservoir 1C (CIP No. 08-6203).
- New Reservoir 20B
  - — Construct a new 1.3 MG Reservoir 20B in the Windemere Development area in Dougherty Valley;
  - — Requires approximately 8,674 lf of 12-inch diameter pipeline from Tassajara Road and the purchase of approximately 6 acres of land (actual storage site requires approximately 2 acres, however, a property mitigation ratio of 3:1 is required for open space property purchases);
  - — Updates previously recommended CIP for a new Reservoir 20B (CIP No. 14-W008).
- New Pipelines
  - — Approximately 1,700 lf of new 14-inch diameter pipeline from Bollinger Canyon Road south to Reservoir 200B to replace existing pipeline to Reservoir 200B (project is included in District's adopted 2015 CIP as CIP No. 05-6204) (see additional discussion in Section 7.1.3 below);
  - — Approximately 400 lf of 16-inch diameter Pressure Zone 20 pipeline and 1,700 lf of 20-inch diameter Pressure Zone 30 pipeline on Fallon Road (project is included in District's adopted 2015 CIP as CIP No. 12-W013) (these pipelines have already been installed by the developer but need to be reimbursed by the District) (see additional discussion in Section 7.1.3 below).

The recommended Buildout (2035) potable water system improvements are as follows:

- New Turnout 6
  - — Construct a new Zone 7 turnout (Turnout 6) south of Interstate 580 at Pimlico Drive; the minimum capacity of the new Turnout 6 should be 6,000 gpm (8.6 mgd);
  - — Requires installation of 2,281 LF of new 20-inch diameter pipeline, of which 205 LF must be installed using jack and bore techniques underneath Interstate 580;
  - — Updates previously recommended CIP for a new Turnout 6 (CIP No. T00-29).

7.1.3 Reconciliation with District's Current Adopted CIP

In June 2015, the District adopted its current CIP which includes a Ten-Year Plan for Fiscal Years ending 2016 through 2025 and a Two-Year Budget for Fiscal Years ending 2016 and 2017. The District's current adopted CIP includes a number of projects related to the recommended improvements described above. Table 7-2 provides a summary of the District's currently identified potable water CIP projects to be funded through the District's Water Expansion Fund (Fund 620) and their status based on the findings and recommendations of this Water System Master Plan.

7.2 CAPITAL IMPROVEMENT PROGRAM COSTS AND IMPLEMENTATION

7.2.1 Construction Cost Assumptions

Construction cost estimates are presented in October 2015 dollars based on an Engineering News Record (ENR) Construction Cost Index (CCI) of 11169 (San Francisco Average). Construction costs were developed based on bids on other water facilities design projects and from standard cost estimating guides. The total CIP cost includes a mark-up equal to 69 percent of the estimated base construction costs, which includes a design and construction contingency of 30 percent of the base construction costs and an additional markup of 30 percent for professional services during design and construction, as listed below.

- Design and Construction Contingency: 30 percent
- Professional Services: 30 percent of the base construction cost plus the Design and Construction Contingency. Professional services are comprised of the following:

Design:	10 percent
Construction Management and Inspection:	10 percent
Permitting, Regulatory and CEQA[1] Compliance:	5 percent
District Administration, Public Outreach, and Legal:	5 percent
Total:	30 percent

[1] CEQA = California Environmental Quality Act

Table 7-2. Status of Previously Identified Potable Water System CIP Projects[a]			
CIP No.	CIP Name	Total Estimated Project Cost and Year(s)[b]	Status
12-W013	Water Main – Fallon Road, Tassajara Road to Tassajara Creek	$315,000 (FY15-16)	**Continue to recommend.** This pipeline has been installed by the developer and the developer will be reimbursed by the District. This project should be included in the updated CIP for inclusion in updated capacity reserve fee (see CIP No. 12-W013 in Table 7-1).
08-6202	Pump Station 20A	$360,800 (FY17-18)	**Defer.** As described in Chapter 6, improvements to pumping facilities in Pressure Zone 20 are recommended to be deferred as future demand conditions are subject to change as development plans change and as water use in the District's service area change. The need for these potential future system improvements should be re-evaluated in future updates to the District's Water System Master Plan.
14-W008	Reservoir 20B	$7,150,000 (FY18-19 to FY20-21)	**Continue to recommend.** See CIP Res 20B in Table 7-1 for updated cost.
05-6204	Water Main – Bollinger Canyon Road to Reservoir 200B	$653,123 (FY20-21)	**Continue to recommend.** This new pipeline will replace an existing pipeline installed in an unpaved roadway to Reservoir 200B and will be constructed by the developer and the developer will be reimbursed by the District. This project should be included in the updated CIP for inclusion in updated capacity reserve fee (see CIP No. 05-6204 in Table 7-1 for updated cost).
08-6203	Water Reservoir 1C	$7,433,000 (FY24-25)	**No longer needed.** Previously proposed Reservoir 1C to be replaced by the recommended new Reservoir 10A per the storage evaluation prepared in conjunction with this Water System Master Plan (see CIP Res 10-A in Table 7-1).
T00-15	Water Main – Dublin Blvd to Turnout 6	$668,500 (FY24-25)	**Continue to recommend.** See CIP FUT TO6 in Table 7-1 for updated pipeline alignment and turnout location and updated cost.
T00-23	Water Main – Reservoir 1C to Shady Creek	$258,000 (Future)	**No longer needed.** Previously proposed Reservoir 1C to be replaced by the recommended new Reservoir 10A per the storage evaluation prepared in conjunction with this Water System Master Plan (see CIP Res 10A in Table 7-1).
T00-24	Water Main – Reservoir 1C to Stagecoach Road & South Lake Drive	$390,100 (Future)	**No longer needed.** Previously proposed Reservoir 1C to be replaced by the recommended new Reservoir 10A per the storage evaluation prepared in conjunction with this Water System Master Plan (see CIP Res 10A in Table 7-1).
T00-27	Water Pump Station 1B (to fill Reservoir 1C)	$4,136,000 (Future)	**No longer needed.** Previously proposed Reservoir 1C to be replaced by the recommended new Reservoir 10A per the storage evaluation prepared in conjunction with this Water System Master Plan (see CIP Res 10A in Table 7-1).
T00-28	Water Main – Turnout 2 to Reservoir 1C	$950,800 (Future)	**No longer needed.** Previously proposed Reservoir 1C to be replaced by the recommended new Reservoir 10A per the storage evaluation prepared in conjunction with this Water System Master Plan (see CIP Res 10A in Table 7-1).
T00-29	Turnout 6	$2,533,000 (Future)	**Continue to recommend.** See CIP FUT TO6 in Table 7-1 for updated pipeline alignment and turnout location and updated cost.

(a) Includes Water System Projects to be funded through the District's Water Expansion Fund (Fund 620).
(b) Total estimated project cost and year shown is as included in DSRSD June 2015 CIP.

For this Water System Master Plan, it is assumed that new distribution system facilities, except new storage reservoir facilities, will be developed in public rights-of-way or on public property; therefore, land acquisition costs have not been included. Proposed construction costs do not include costs for annual operation and maintenance. A complete description of the assumptions used in the development of the estimated probable construction costs is provided in Appendix E.

7.2.2 Estimated Water System Improvement Costs

The construction cost estimates for the recommended existing, intermediate (2020) and Buildout (2035) potable water system improvements are presented in Table 7-1.

Table 7-3 summarizes planning-level capital cost estimates by project type to mitigate existing system deficiencies, and to meet future growth in the District's potable water system. It should be noted that any in-tract pipelines required to be installed as part of new development projects will be fully funded and installed by the project proponents. Therefore, these facilities and corresponding costs are not included.

Existing water system improvements (Near-term Improvements) to address existing system deficiencies should be completed as funding permits. The construction of capital improvements for the intermediate (2020) and Buildout (2035) demand conditions should be coordinated with the proposed schedules of new development to ensure that require infrastructure will be in place to serve future customers.

The total planning-level cost of potable water system improvements to support the District's existing and future water demands is estimated to be $21.6 million (M). Of this amount, approximately $3.0M is required to address existing system deficiencies, and approximately $18.5M is required to support future planned growth ($16.5M for 2020 + $2.0M for Buildout (2035)).

Table 7-3. Estimated Cost for Recommended Potable Water Capital Improvements by Project Type(a,b)

Potable Water System Improvement Type	Existing (Near-Term)	Intermediate (2020)	Buildout (2035)	Total
Emergency Generators	$3,040,000	$0	$0	$3,040,000
Storage	$0	$15,389,000	$0	$15,389,000
Pipelines	$0	$1,139,756	$0	$1,139,756
Zone 7 Turnout	$0	$0	$2,009,000	$2,009,000
Total Capital Improvement Cost	$3,040,000	$16,528,756	$2,009,000	$21,577,756

(a) Costs shown are based on the October 2015 SF ENR CCI of 11169.
(b) Costs include base construction costs plus 30 percent design and construction contingency, and an additional markup equal to 30 percent for professional services.

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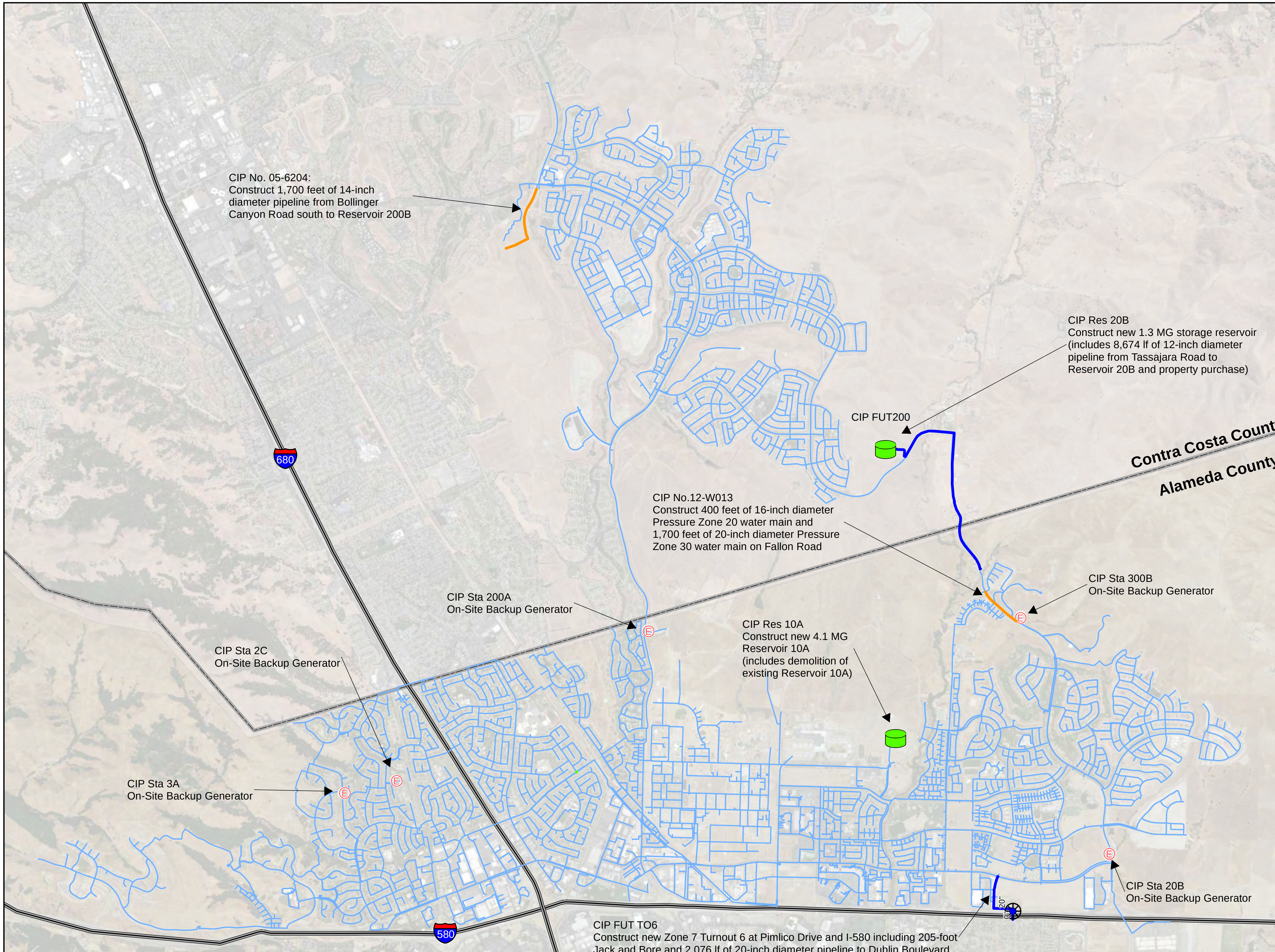
FIGURE 7-1

Dublin San Ramon Services District Water System Master Plan

RECOMMENDED CAPITAL IMPROVEMENT PROGRAM



N

0 1,750 3,500

Scale in Feet

LEGEND

2020 Storage Improvement

On-site Backup Generator

Pipeline Improvements

Near-Term

Buildout

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