LVMWD Report
No. 2389.00

Potable Water Master Plan Update 2007

Engineering Excellence Since 1942

LVMWD Report
No. 2389.00

Potable Water System Master Plan Update 2007

Las Virgenes Municipal Water District

Project Manager	C. Eugene Talmadge

Boyle Engineering Corporation

Project Manager	Dan Ellison, PE
Project Engineers	Ron Herbst, EIT
	Erik Boardman, EIT

23016.00

October 2007

REGISTERED PROFESSIONAL ENGINEER
ROBERT D. ELLISON
No. C 38094
Exp. 3/31/09
CIVIL
STATE OF CALIFORNIA

BOYLE
Engineering Excellence Since 1942

Table of Contents

Section 1
Executive Summary

This Master Plan Update incorporates recent system modifications, lower population forecasts, and new concepts for system operation. The strategies outlined in this study are the culmination of more than a dozen workshops and 30 interim products.

This Master Plan Update addresses the Potable Water System of Las Virgenes Municipal Water District, both as a whole and in parts, examining the ability of the existing facilities to adequately meet the water demands now and over the next 25 years. The expected growth over the next 25 years, while significantly lower than earlier forecasts, will still mean that substantial capital projects will be needed. This Master Plan lists recommendations for the proposed capital facilities and upgrades.

This document updates the Potable Water Master Plan written in 1999 (LVMWD Report No. 2096). A major part of the previous project was the development of a detailed comprehensive computer hydraulic model, which included all mains in the District, 4-inches and larger. Much of the analysis, model, and report from the previous Master Plan has been used in generating this Update, but with the following significant modifications:

- Facilities constructed since 1999 have been added. These include both system improvements, such as new east-west transmission pipelines, and new developments, notably the New Millennium, Mont Calabasas and Indian Springs developments, each of which has resulted in a new pump station, tank, and distribution system.
- Estimates of future "buildout" demands are lower than previous master plans. These lower estimates reflect the fact that a large amount of land has been (and will be) dedicated to parks and other open space. The result of these lower estimates is that fewer and smaller facilities will be needed to meet future demands.
- This Master Plan will have an increased focus on maintenance and quality of service as compared to previous versions.

Because of the foundations laid by the previous Master Plan, this Update has been able to focus more on strategic analysis than on data collection and model building. Through a step-by-step process of developing, presenting, and discussing components of this Master Plan, as well as components of the Recycled Water Master Plan, a thoroughly "integrated" Master Plan of both systems was sought. The result has been a truly collaborative effort where District staff has participated in the analysis and review of 30 interim products through a series of 13 workshop-style project meetings.

The Las Virgenes Municipal Water District (LVMWD) owns and operates a potable water system that serves the cities of Agoura Hills, Calabasas, Hidden Hills, and Westlake Village, as well as unincorporated areas in the western portions of Los Angeles County, near Ventura County. The total service area of the District covers an area of approximately 125 square miles, with topography varying from a few feet above sea level to elevations exceeding 2500 feet. The topography and geography of the District has resulted in a complex delivery system of 22 separate service zones, with the equivalent number of pump stations and storage tank facilities. Despite the complexity of the system, the system operates very well, demonstrating, in part, the experience of District staff.

The difficult geography has resulted in a complex but well functioning system.

This Potable Water Master Plan Update is being prepared as part of an overall Master Plan that will also include the updated Recycled Water Master Plan. Once both master plan updates are adopted, an Integrated Master Plan will be prepared that combines the two plans into one concise, integrated document.

The future demand conditions correspond to projections for the year 2030. This year is considered to be the "buildout" case, or very near buildout, and represents a total service area population 30 percent larger than currently exists. It is doubtful that buildout will actually occur by the year 2030; however it is a convenient frame of reference for the planning purposes used in this Master Plan. If growth occurs at a slower pace, it would not significantly change the recommendations of this report.

There are several key issues currently facing the District. The NPDES permit requirements for Tapia WRF prohibits recycled water discharge to Malibu Creek between April 15 and November 15. This directly affects the Recycled Water System, and indirectly affects the Potable Water System. There is also a potential interconnection with Calleguas Municipal Water District (CMWD), which could prove to be valuable in several ways. The third issue of central importance is meeting demand growth. There are systems that are near or at capacity, and significant investment will be needed over the next few years to meet the potable water demands of an increasing population.

In all, approximately $65 million of new facilities may be needed by year 2030 to meet demands. Of this total, approximately $16 million is needed to meet the near-term demands. Also, approximately $13 million may be triggered by, and should be funded by, new developments.

The previous version of the Master Plan was prepared by Boyle Engineering in 1999. That report laid the basis for various new pressure zones and other projects. Like earlier versions of the Master Plan, it recommended the construction, in phases, of a large-diameter east to west transmission pipeline from Calabasas to Las Virgenes Reservoir, paralleling an existing transmission pipeline that roughly follows the 101 Freeway. This second pipeline has been a part of the District's long-term plans since 1963, when the backbone system was conceived.

Recently constructed transmission upgrades have greatly improved operations during peak demand periods. Additional improvements will be needed, as demands continue to grow.

The first phase of this pipeline system was completed in 2002, consisting of a 42-inch pipeline in Calabasas Road and an 18-inch pipeline in Mureau Road. This project significantly improved the hydraulics of the system, such that meeting maximum demands in the western part of the system is no longer problematic. Additional phases of this pipeline will be necessary, as development occurs and demands increase. This Master Plan shows the District will be able to construct smaller, shorter pipelines than originally planned, particularly if more water is drawn from Las Virgenes Reservoir during the summer.

A connection to Calleguas is recommended. It would lessen the magnitude of transmission upgrades, while improving reliability.

A connection to Calleguas Municipal Water District is highly recommended. The LVMWD/CMWD Intertie Study (LVMWD Report No. 2256.00, October 2003) indicated that there is excess supply available from Calleguas during the wintertime. This supply in the western portion of the District could aid in the refill of Las Virgenes Reservoir. The reservoir capacity is 9500 acre feet, however the current amount of storage available from Las Virgenes is limited by the amount of winter refill available. This connection would also serve as a valuable emergency supply to both LVMWD and CMWD. A reliable, continuous source of potable water on the west end of the District, in addition to providing an additional supply, would decrease the need for expensive backbone improvements.

There may also be a need to improve the Jed Smith subsystem, where current demands have grown beyond previous estimates. This system serves areas in Hidden Hills and Mountain View Estates. A recent upgrade of the Jed Smith Pump Station has solved the problem for now, but additional storage and pumping facilities may be needed.

Upgrades to the pumping, storage and pipeline facilities serving the Seminole/Latigo area will be needed. Because planning for this area is difficult, improvements should be constructed in phases, as the demands increase.

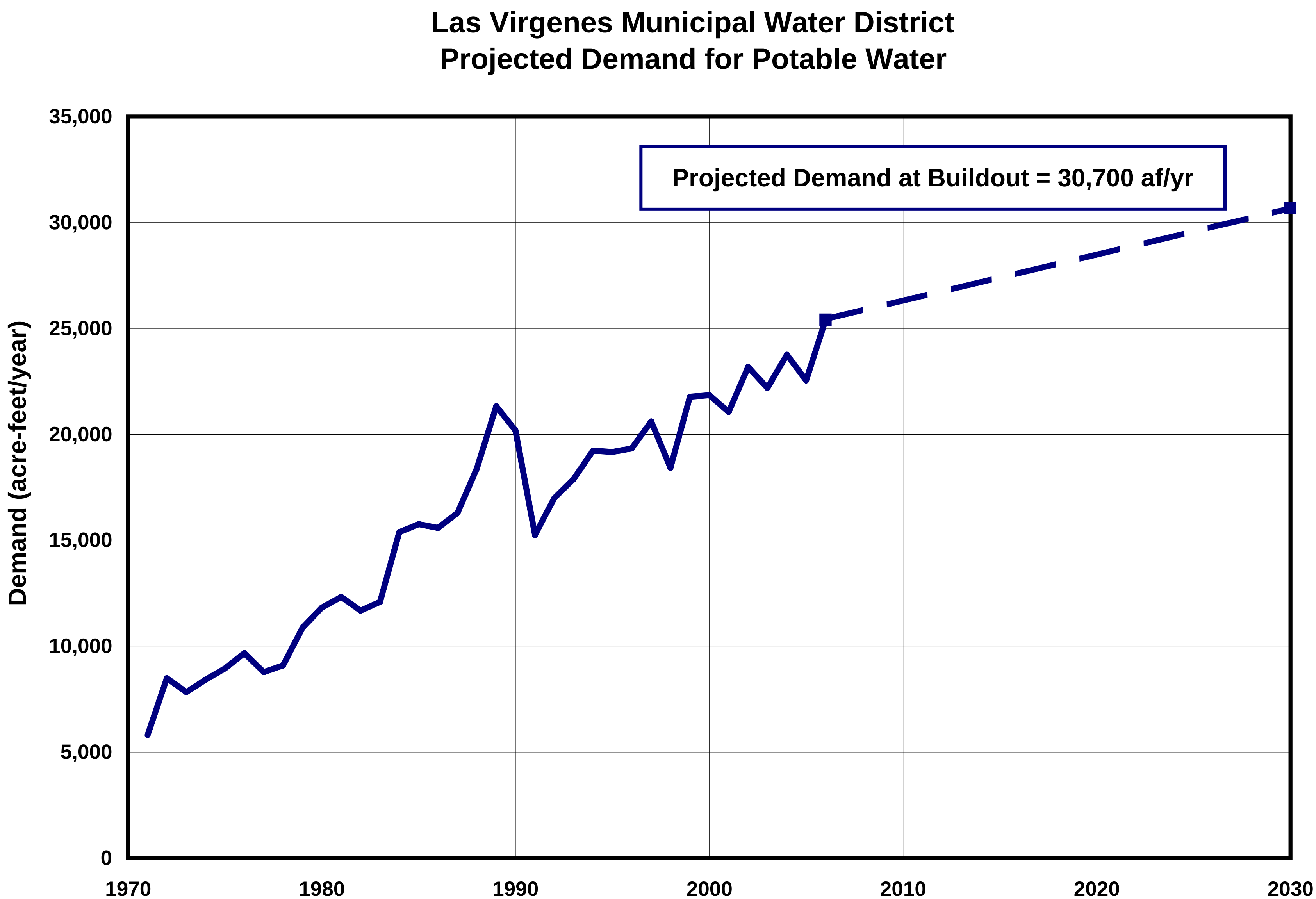
Figure 1-1 illustrates the historical demand for potable water and the demand that is projected to buildout.

As the demands in the District increase, new pumping, storage and pipelines will be required to maintain the high quality of service to District customers. Many of the recommendations will be determined by “trigger points”, the criteria or events that would determine when a new or upgraded facility will be needed. Also, by District policy, it would be expected that a substantial portion of these new facilities be built and paid for by developers or property owners requesting connections to the system.

There is potential for a very substantial investment in the Seminole/Latigo pressure zone, in the southwest portion of the District. This potential exists due to the large number of undeveloped parcels in this area. Data suggests that the demands could quadruple over the next 25 years. The planning in this area is difficult, as more and more parcels are being set aside for open space and parks. There is also lack of infrastructure and development has been slow, partly due to the difficult terrain. However, there will be a point in time where the demand will exceed the capacity of the current facilities, requiring important decisions about what type of facilities will need to be constructed. This point has already been reached when it comes to pumping.

There are several factors that induced the preparation of this Master Plan:

- **Changes in Population Projections:** Much open space has been eliminated from potential development. This has reduced the projected population within the District. The previous version of the Master Plan estimated buildout population to be about 113,000 and this version estimates approximately 91,000. With a lower population, demands will be lower, requiring fewer and smaller facilities.



Boyle Engineering Corporation
Figure 1-1 Section 1.xls\Projected Demand Chart-Fig 1-1

Figure 1-1

- **Las Virgenes Reservoir Storage:** The current amount of available storage used from Las Virgenes Reservoir is limited by the system's ability to refill during winter months. Also, the capacity is limited by the capacity of the treatment plant and operating policy. The treatment plant was planned and constructed to have additional treatment capacity available by adding additional filter beds. This Master Plan includes recommendations that would make more effective use of this reservoir.

- **Time Period Since the Last Master Plan:** It is typical for water utilities to update master plans every 5 to 10 years. Master plans rely on land planning activities involving zoning and land use densities. These often change as a result of economical and political forces, requiring new analysis of water delivery facilities. Also, regulations, standards and requirements can change, as do the utility's objective and financial capabilities. This Master Plan reflects the most current land use planning efforts of the four cities as well as the Santa Monica Mountains North Area Plan and the Malibu Coastal Zone. This Potable Water Master Plan Update is part of the normal District planning process.

- **Increase in Recycled Water Use:** It is prudent to increase the amount of recycled water use in order to maximize beneficial re-use and maintain compliance with the discharge prohibition. To meet this requirement, expansions of the recycled water system to serve more customers may be needed, resulting in an increase of potable supplement to the recycled water system during periods of high demand. Additional potable water infrastructure may be needed to maximize the potable supplement.

This Master Plan has several key premises:

- This document takes advantage of more detailed and more accurate population growth data, incorporating this information into a computer model. Projections of population and demands come from the recently completed 2005 Urban Water Management Plan (LVMWD Report No. 2340.0) by others.

- The preparation of this Master Plan was aided by the use of a complex computer model and GIS software. The hydraulic analysis was performed with WaterCAD computer modeling software (formerly "Cybernet"). The model from the previous version of the Master Plan was updated to include new developments and changes in demand patterns.

- The plan was prepared as a "fresh look". In general, the criteria applied for the 1999 Master Plan were reviewed, evaluated and re-applied. A comparison was made with criteria used at other respected Southern California water utilities.

The following is a brief introduction to each section included in this report, and key findings:

Section 2 – Purpose and Scope

A comparison with other water utilities confirmed that LVMWD design criteria are appropriate.

The Purpose and Scope section of this Master Plan presents a summary of the project purpose and the contract scope or work. The scope generally includes identifying sources of new demands and determining which subsystem components will require upgrades in order to meet both current and future demands. Included in the scope of work is a fire flow analysis to verify that the District meets Los Angeles County Fire Department regulations for storage, pressure and duration. The analyses were performed at maximum day demands.

Section 3 – Evaluation Criteria

The Evaluation Criteria section describes the evaluation criteria that were used in the modeling and analyzing of the potable water system. It also describes the planning period to year 2030, how pumping and storage capacity are to be evaluated, and details on parameters used in the model, such as peaking factors, pump operations and pipeline velocities. Included in Section 3 are the cost estimating factors used to create the opinions of probable cost for capital projects.

Section 4 – Potable Water System – Existing Facilities

Potable Water System – Existing Facilities describes LVMWD's existing facilities within the service area. There are 22 defined pressure zones, with 2 being served from Ventura County. Discussion is also provided for Las Virgenes Reservoir. Section 4 further describes the existing infrastructure of over 400 miles of pipeline greater than 4-inches in diameter within LVMWD, and itemizes features of the existing pump stations, tanks/reservoirs, potable supplements to the recycled water system and pressure reducing stations, with capacities and operating parameters for each.

Section 5 – Demand and Peaking Factors

Peaking factors were calculated for seven zones representing a cross-section of development and climate characteristics in the District.

The Demand and Peaking Factors section of this Master Plan discusses existing demand for potable water in the LVMWD service area. It describes how historical demand for potable water was determined in this study, and how peaking factors for each pressure zone were determined for Maximum Day Demand (MDD). Section 5.1 discusses the land use designations for each area in the District, as each area is unique in terms of population, demand patterns and developments. **Tables 5-1 through 5-6** display the land use designations for each respective area. **Table 5-7** summarizes the population projections to buildout and **Table 5-10** lists the peaking factors used in the analysis of the LVMWD subsystems. Unlike earlier master plans, this study calculated different peaking factors for seven zones. The maximum-day peaking factor used for the entire service area was approximately 2.1, and is believed to be conservative.

Demand patterns over a 24-hour period were reanalyzed and updated to more accurately model the distribution system. These patterns were modeled in runs of up to 96 hours, to verify system stability. In the hydraulic analysis, potable supplement was assumed to be at the design maximum for the system. The peak-hour peaking factor for the system as a whole was estimated at 2.7. For individual zones, this peaking factor was calculated between 2.15 and 3.7.

Compared with industry norms, very little water in the District is lost to theft, leakage, or inaccurate metering.

Section 6 – Evaluation of Unaccounted for Water

The Evaluation of Unaccounted for Water section provides a discussion and evaluation of water that enters the LVMWD system, but is not recorded by a usage meter. There are many sources of unaccounted for water, such as leaks, theft, fire hydrant use, poor meter accuracy and net seepage or evaporation from Westlake

Reservoir. The Las Virgenes system as a whole has very little water loss. Since 2000, the yearly average was 4.5% and the largest loss was recorded at 7% while smallest was less than 1%. It should be noted that losses less than 10% are considered reasonable and acceptable. This low percentage of losses can be attributed to newer meter installation, and increase in change-out cycle by District staff. The low percent loss also provides justification for the capital outlay for the new meters.

Section 7 – Evaluation of Existing System

Evaluation of Existing System presents an evaluation of the potable water system as it exists today, with existing demands. The existing pump stations and tanks/reservoirs were evaluated for capacity to meet existing MDD under 18 hour maximum pumping criteria. The hydraulic capacities of the pipelines were also evaluated, and recommendations for replacements or improvements are made. The major conclusions reached include:

A storage deficit in the Jed Smith Zone is overcome by extra pumping capacity constructed last year. Pumping deficits at Twin Lakes, Mulwood, and Seminole also need attention, due to higher demands arising from development.

- A significant storage deficit in the western part of the main (1235 ft) zone, results in sharp drops in the water levels at Morrison and Equestrian Trails Tanks.
- Some subsystems have significant storage deficits at maximum day demands, particularly Jed Smith tanks as shown in **Table 7-1**. Some of this deficit can be made up by added pumping during peak demands or pumping more than 18 hours. There are small storage deficits in other subsystems, however construction of facilities to increase storage by a small amount is not economically feasible.
- Las Virgenes Reservoir is a valuable asset to provide storage for peak demands and during MWDSC outages.
- The Warner/Cold Canyon and Twin Lakes pump stations have pumping deficits under 18 hour criteria as shown in **Table 7-4**. (Expansion of the Twin Lakes Pump Station is currently underway.)
- Additional east-to-west transmission improvements may be needed soon.

- The potable supplement to the recycled water system cannot operate at capacity due to restrictions on the potable side, so upgrades are needed, particularly if the Decker Canyon and Thousand Oaks Boulevard extensions to the recycled water system are constructed.
- Demands in the Seminole/Latigo Zone currently exceed the pump station capacity. The rebuilding of pumps has helped relieve short-term problems, but additional capacity is needed very soon.
- Additional pumping is recommended for the Mulwood Zone. A pressure-reducing station that was intended to be largely for peaks and emergencies, now operates most of the day during the summer months.

Section 8 – Evaluation of Future System

Evaluation of Future System examines the potable water system's ability to meet the projected buildout demands. The deficiencies are noted and the possible upgrades are discussed. Notable deficiencies include:

The storage deficit in the 1235-ft system will grow worse as demands increase. A new tank near Las Virgenes Reservoir would enable more effective use of the filtration plant.

- Modeling results show that storage tanks in the west drop rather quickly during maximum day demands, indicating that more storage may be needed to help maintain hydraulic gradients.
- The Jed Smith and Seminole Zones do not have enough storage capacity to operate in less than 24-hours at buildout maximum day demands, and other storage facilities have small deficits.
- Many subsystems have pumping deficits that must be addressed for buildout conditions.
- East-west transmission pipelines should be updated to improve suction pressures at many pump stations, and move more water to the west during periods of peak demands.
- Seminole pump station and tank have large deficits for buildout conditions.

Section 9 – Water Supply Options

Water Supply Options examines the overall balance of supply and demand and discusses the possible options for improving the reliability of potable water supply to the District. Possible improvement projects include facilities to connect Twin Lakes, Box Canyon and Woolsey Canyon to the rest of the LVMWD system. (A project to connect Twin Lakes to the system is already underway.) Also, a connection to Calleguas MWD is discussed, as is expansion of the Las Virgenes Reservoir Filtration Facility to include two new filter beds.

Section 10 – Proposed Pumping, Storage and Distribution Facilities

Proposed Pumping, Storage and Distribution Facilities describes the distribution and transmission facilities that are needed in order to meet buildout demands. The description includes why and when the improvements are needed and the possible alternatives. This section includes project descriptions divided by pressure zone and is built upon information discussed in Sections 8 and 9, as well as discussion with district staff. The proposed upgrades include:

Phased improvements are recommended for the Jed Smith and Seminole Zones, where the future demands are difficult to estimate.

- East-west transmission upgrades and upgrades to the potable supplement facilities at Morrison Tank.
- Expansion of Las Virgenes Reservoir Filtration Facility to include two new filters.
- Connection of Box Canyon, Woolsey Canyon and Twin Lakes to the remainder of the LVMWD system.
- Increase pumping in Warner/Cold Canyon, Twin Lakes, Mulwood, Jed Smith/Mountain Gate, and Seminole pressure zones.
- Possibly increase storage in Jed Smith/Mountain Gate and Seminole pressure zones.
- Possible facilities to improve water quality in Morrison, Saddle Peak and Latigo Tanks during periods of low demand.

- New storage facilities for Three Springs and a new 5MG reservoir in western portion of backbone system.

Section 11 – Summary of Recommendations and Opinions of Probable Cost

Summary of Recommendations and Opinion of Probable Cost is a summary of all the recommendations that have been discussed in previous sections of the Master Plan. There are also tabulated recommendations providing details with regard to probable project costs. These include capital facilities as wells as certain operational improvements.

Section 2

Purpose and Scope

2.1 Introduction

A continuing trend toward dedicating land as open space results in declining forecasts of future population.

Now is an important time for Las Virgenes Municipal Water District (LVMWD) to look strategically to the future. Many significant changes have occurred, and new issues have arisen, calling for a fresh look at how the system should be designed, constructed, and operated, to best serve its customers. This Potable Water System Master Plan Update is one part of an overall Master Plan that also includes a Recycled Water System Master Plan Update that was prepared by Boyle Engineering Corporation earlier this year. Both the Potable Water and Recycled Water Plans will be combined into an Integrated Master Plan. The Integrated Plan will further refine the interrelationships between the two systems, e.g., the use of recycled water lowers the demand for potable water, while the recycled water systems create a need for supplemental potable water during the peak summer months.

In December 1999, Boyle Engineering completed the last LVMWD Master Plan. In addition, several contemporary studies had looked at specific District subsystems and issues from a planning perspective. Issues such as how to best utilize recycled water, how to most effectively use Las Virgenes Reservoir, and how to best serve an expanding population, were addressed.

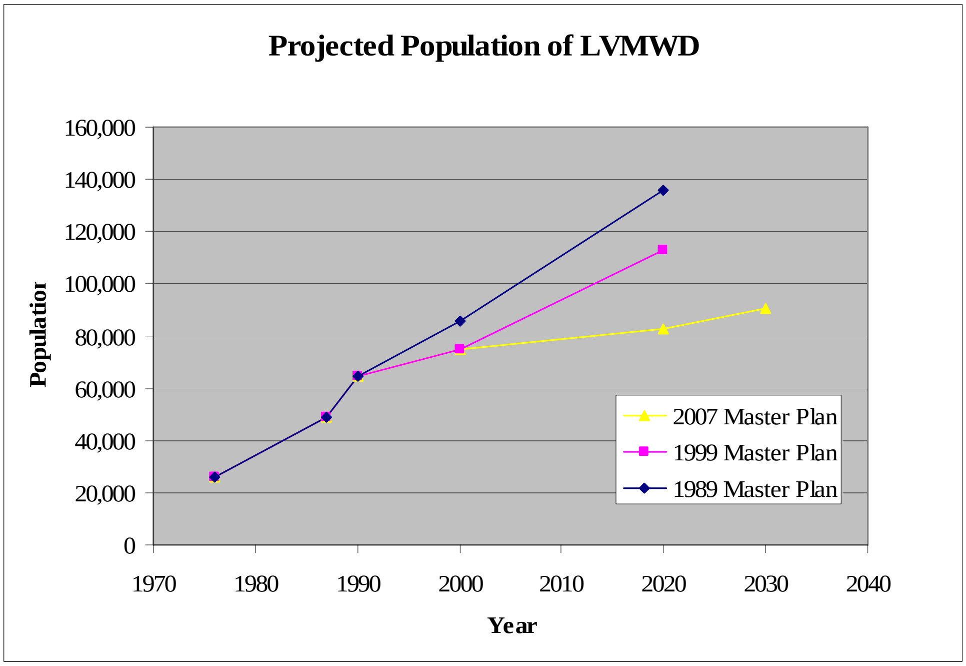
The studies laid the basis for the sizing of the new and expanded pump stations, pipeline extensions/upgrades and new pressure zones. The 1999 Master Plan documents are far from obsolete; they continue to be consulted when determining the demands, peaking factors, maximum and minimum gradients, and other information needed for designing system expansions and are the basis for this update. But changes have occurred, calling for new analysis and new thinking.

The most significant change that has occurred is the population projection and reduction of land available to development. All across the LVMWD service area, population densities permitted for undeveloped land were reduced, particularly land in unincorporated areas. At the same time, efforts have been underway to conserve more and more areas as National and State parkland and other open space, thus removing the land from development potential.

Overall, these changes have resulted in a population projection for the District that is lower than the one used a decade ago (see chart below)[1]. Naturally, this affects how the LVMWD system should be planned—with such a reduction in projected population, one expects a reduction in the number and size of facilities needed. Notwithstanding this reduction, the projected population is still 30 percent higher than currently exists, and when and where, and at what rate the growth may occur is debatable. Meeting these demands will require judicious capital budgeting in the next few years.

In spite of the lower population projection, the District must still plan for substantial increases in demand.

Figure 2-1



An issue that has taken on a different importance for the District is the use of recycled water. In the 1980s and 1990s, the recycled water system was viewed as a means of utilizing a valuable resource, the effluent from the Tapia Water Reclamation Facility.[2] The recycled

[1] Population projections used throughout this Master Plan are based on a detailed study commissioned by the District called "Potable and Recycled Water Master Planning Forecasts" (Psomas, March 2007, LVMWD Report No. 2340.01) and analysis of current land use plans of the County and Cities.

[2] Among the alternatives considered at that time was a 1600 acre feet (AF) seasonal storage reservoir. Such a facility would have reduced demands on the potable water system, and decreased District dependence on MWDSC supplies. While seasonal storage has never been ruled out, environmental considerations make such a facility much less likely to occur.

The importance of recycled water use has increased as restrictions on Tapia discharges have increased. The use of recycled water generally relieves demands on the potable system, but may increase the demands on the potable system (for peaks), if the recycled water is used outside the District.

water system is no longer just a means of using a resource, but is also viewed as a means of meeting changing regulatory requirements. An order by the Los Angeles Regional Water Quality Control Board prohibits the discharge of recycled water into Malibu Creek during the months of April through November. This order is the culmination of increasing restrictions over the years and has far-ranging implications on how the District might design and operate its Recycled Water System, which in turn affects the way its Potable Water System will be operated.[3] The Potable Water System Master Plan Update incorporates as inputs, decisions and recommendations from the Recycled Water System Master Plan; although it does not directly address issues pertaining to avoiding the discharge of unused recycled water to Malibu Creek. This issue of recycled water use will also be examined in the Integrated Report.

One of the activities in preparing this Master Plan was the updating of the WaterCAD (formerly "Cybernet") model produced as part of the 1999 Mater Plan. This update to this model included refining the demands for each zone as well as updating peaking factors such that each individual pressure zone was evaluated by its own specific factor. The updated model also included new pressure zones and potable supplements to the recycled water system and the new pipelines, pump stations and tanks constructed since 1999.

An issue of vital importance to the District is cost. The District faces two major challenges when it comes to costs: supply source and geography. On the supply side, the cost of water purchased in the summer from Metropolitan Water District of Southern California (MWDSC) has risen dramatically in the last few years, from about $250 per acre ft (AF) in 1990 to $430 in 1999, to a current average rate of about $460 per AF.[4] Although rates have leveled off in the past few years, the current drought and recent court decisions could result in sharp escalations in costs.

---

[3] Options for addressing this issue were evaluated for the District in a "Creek Discharge Avoidance Study" and more currently the "Tapia Effluent Alternatives Study" (TEA Study). While some options can be implemented in the very near future, others will require further studies and discussions.

[4] Rates now vary, depending on how much water is purchased at the Tier 1 rate ($453/AF) vs. the Tier 2 rate ($549/AF), with the structure of the charges intended to encourage conservation.

Since a majority of potable water consumed in the District is purchased from MWDSC, this price increase has had a significant impact on customers. On the geography side, the District is committed to serving a far-flung area, stretching from the northern end of the San Fernando Valley through the Santa Monica Mountains to the Los Angeles/Ventura County line. In between are hills, mountains, and canyons—not much which is flat. Much of the area is lightly populated, but with many large, estate-size homes, demands can be high. Providing reliable water delivery to such an area is an engineering challenge. Finding economic solutions is one of the goals of this Master Plan.

2.1.1 Specific LVMWD System Issues

This Master Plan is intended to provide a reliable potable water capital improvement plan that can be used in determining water rates, along with trigger points that will signal when a facility is needed. Among the issues addressed by this Master Plan are:

The judicious use of Las Virgenes Reservoir reduces peak demands on the transmission system and help reduce peaking charges assessed by MWDSC.

- **Las Virgenes Reservoir:** Water purchased from MWDSC during the fall and winter is no longer priced lower than water purchased during the spring and summer. However, the judicious use of the reservoir allows the District to minimize peaking charges and (more importantly) meet peak demands in the western portion of the District with fewer upgrades to the backbone transmission system. Currently, the District's ability to use the reservoir is limited by the capacity of the Filtration Facility and the backbone system's capacity to refill the reservoir in the winter time. This Master Plan examines alternatives for increasing these capacities. An interconnection with Calleguas MWD is a key component. Refill analyses were performed both with and without the proposed Calleguas connection.

- **Calleguas Municipal Water District (CMWD) Connection:** The District has had preliminary discussions with the staff of CMWD regarding an interconnection on the west end of the District. In the current concept, which is analyzed in this Master Plan, this interconnection would provide the District with up to 20 cfs during the winter, to help fill Las Virgenes Reservoir. In turn, the interconnection would provide CMWD with an alternate supply for emergencies.

A connection to Calleguas MWD would improve the overall reliability of both systems as well as aid in the refilling of Las Virgenes Reservoir.

- **Potable Water Supplement to Recycled Water System:** Several alternatives were discussed in the Recycled Water System Master Plan for meeting peak demands that exceed supply. The impacts of these supplements on the Potable System are analyzed in this Potable Water System Master Plan Update.

- **East-West Transmission:** The 1999 Master Plan recommended the construction of several new transmission mains to meet rising demand and improve operations. The most significant was a pipeline paralleling the freeway, starting near Calabasas Tank, and continuing nearly to Las Virgenes Reservoir. The size of the pipe was envisioned as 42-inches at the east end, diminishing in stages to 24-inches at the west. With a smaller projected population and the possibility of a CMWD interconnection, this recommendation has been reexamined and evaluated.

- **1235-foot System Storage:** The 1999 Master Plan recommended additional storage capacity in the backbone system, particularly a tank near Cornell Pump Station. The need and trigger points for such a storage addition is examined in this report. Alternate locations for additional storage in this zone are also discussed, particularly a finished water reservoir near the Las Virgenes Reservoir Filtration Facility.

- **Jed Smith/Mountain Gate System Improvements:** This subsystem has had difficulty in meeting demands during peak summer months. Recent upgrades have alleviated problems, but this may only be temporary, if demands from existing developed areas continue to grow. Also, as currently operated, there is no backup for the pumps at Mountain Gate Pump Station. This report provides recommendations for eliminating these problems and improving service to LVMWD customers in the area.

Ventura County is investigating alternatives to improve service to Bell Canyon. One of these alternatives involves a joint project to serve Woolsey Canyon.

- **Woolsey Canyon and Upper Box Canyon:** Two small areas in the hills west of the San Fernando Valley are currently supplied by Ventura County Water Works District No. 17 and the City of Simi Valley. The agreement under which these areas are supplied is subject to a one-year cancellation. This Master Plan looks at the facilities necessary to connect these customers to the rest of the LVMWD system and provide services for increased demands. A joint project with VCCWWD No. 17 is a possibility.

- **Nitrification Potential:** Since chloramines are used for secondary disinfection, potential exists for nitrification if water stagnates, particularly for tanks. Our analysis highlights tanks where stagnation may be a concern, and includes recommendations for increasing circulation for new and existing tanks. This analysis should include findings and data from the District's Nitrification Control Plan.

- **State 2 Disinfection By-Products Rule:** The Rule requires compliance with total trihalomethanes (TTHM) and haloacetic acids (HAA5) maximum contaminant levels (MCLs) at every sampling location in the water distribution system. Monitoring is scheduled to begin in October 2007 with the final report due by January 2009. TTHM and HAA5 may be elevated in the western part of the system when Westlake Filtration Plant is in operation but it is anticipated that LVMWD will still be in compliance.

- **Long-Term 2 Enhanced Surface Water Treatment Rule:** The Rule provides additional protection from cryptosporidium and other pathogens in drinking water sources. Restricted access and no development in the watershed around Las Virgenes Reservoir provides an excellent protection for this contamination. As long as these conditions are maintained, it is anticipated that LVMWD will be in compliance with the Rule.

- **System Expansion**: The report provides a plan to expand the potable water system to serve future users**.** Expansion includes the new pipelines, pump stations, and tanks (reservoirs) to reach new users, as well as improvements required in the backbone systems to support those extensions.

2.2 Project Goals

The project goals are to:

- Provide an update of the previous version of the Potable Water Master Plan. The computer model is significantly updated, including new pressure zones, new pump stations, new pipelines larger than 4-inches in diameter and updated demand information. The land-use and demand information have been developed from current population projections, consumption and production records, and planning documents, incorporating demand forecasts produced by others for the recent Urban Water Management Plan.

- Reflect the most current information regarding population projected to the year 2030. This reflects current General Plans for the Cities of Agoura Hills, Calabasas, Hidden Hills, and Westlake Village, County of Los Angeles, Santa Monica Mountains North Area Plan, and Malibu Local Coastal Plan Land Use Plan. This condition reflects an approximate ultimate or buildout condition.

- Model the potable water system, using the WaterCAD model, including pipelines 4-inches and larger, pump stations, storage reservoirs, and pressure regulating stations.

- Determine demands and peaking factors based on historic billing records, District operational records (SCADA), and calibration data gathered for this study.

- Incorporate information from the Recycled Water Master Plan into the Potable Water Master Plan. These, in essence, are the point demands for potable water supplement.

- Evaluate infrastructure improvements to accommodate existing requirements and future needs. Match improvement requirements with "trigger points" such as demands and system operation.

- Address systematic and operational improvements using information provided by the District.

- Examine existing and proposed interconnections with other water utilities and agencies which will provide the District with greater flexibility and reliability and provide water sources close to where and when they are most needed.

2.3 Scope of Work

The contract scope of work for this project is described by the production of various deliverables. The following is a brief listing and description of the specific deliverables and work associated with both the Potable and Recycled Water Master Plans:

No.	Description of Deliverable
1a	**Work Plan Summary.** This is a schedule of meetings, discussion topics and deliverables which was periodically revised to reflect feedback from District staff and other team members, and became the basic plan for execution of this project. The plan was updated, when needed. Boyle also maintained a **Decision Log** documenting the actions and decisions of all meetings.
1b	**Comparison of Criteria**. Boyle's Subconsultant, Psomas prepared a chart comparing the design/analysis criteria used in the previous RW and PW Master Plan with criteria used by other water systems: Irvine Ranch, City of Thousand Oaks, City of Anaheim, the City of San Juan Capistrano, Trabuco Canyon Water District, and Rancho California Water District.
1c	**Unit Cost Table.** Boyle examined the aggregate bid prices from various projects in the Southern California area, and updated the unit costs for construction of pipelines, pump stations and tanks in various sizes, and under various construction conditions.
1d	**List of data needed.** A list of requested data was provided to the District prior to Meeting No. 1. This list was reviewed and periodically updated, as needed.
1e	**Recommended software conversion.** (This task was superseded by District action in separately awarding a contract for a new model.)

No.	Description of Deliverable
2a	**Unit Demands and Demographics.** **Planning Agency Meetings.** Gene Talmadge and Mike Swan of Psomas interviewed the planning staffs of Calabasas, Agoura Hills, Westlake Village and LA County to determine what changes are anticipated to their General Plans. Electronic files will be obtained, as available. No meeting with Hidden Hills occurred. **Unit Demand Updates.** Based on this information and the information and analysis generated for the Urban Water Management Plan, Psomas provided tables showing total average daily demands for each zone. Psomas also tabulated demands per capita and per dwelling unit. Unit demands for various land uses were taken from the previous master plans.
2b	**Peaking Factor Analysis.** Based on the information and analysis generated for the Urban Water Management Plan, past District studies and additional SCADA information provided by the District, Psomas analyzed peaking patterns, and recommended appropriate patterns and factors to use in modeling for maximum-day demand (MDD) and peak-hour demand (PHD). These recommended peaking factors were system-wide and also for the following subsystems: Jed Smith, Seminole, McCoy, Warner, backbone (1235-ft), Twin Lakes, and Saddlepeak.
2c	**Water Loss Analysis.** The water loss analysis was taken from a 2006 report prepared by District Staff.
2d	**MDD Comparison – New and Previous Master Plans.** Using information from the Urban Water Management Plan and from Tasks 2a and 2b, Boyle computed Maximum Day Demands for each zone for current, 2015 and 2030 conditions. The 2030 "build out" projections were compared to estimates prepared for the previous master plan. Significant increases in the projections indicated increased consumption rates that warranted additional investigation (e.g., Jed Smith Subsystem). Significant decreases in consumption were also investigated, but often reflected the removal of land from potential development.

No.	Description of Deliverable
3a	**Potential RW Customers.** Maps and water consumption estimates will be prepared to facilitate a discussion with District staff regarding potential RW customers. **1. Los Angeles Extension.** Boyle assembled and reviewed information generated for a LADWP Recycled Water Master Plan for the San Fernando Valley. Particular emphasis was placed on potential customers in Woodland Hills and adjacent communities. **2. Thousand Oaks (Westlake) Extension**. Boyle assembled and reviewed information gathered by Kennedy-Jenks Consultants for the Tapia Effluent Alternatives Study (TEA), showing demands regarding estimated demands and locations of potential customers in the Thousand Oaks area. Boyle also reviewed information from a Boyle study (January 2003) that investigated a main extension in Thousand Oaks Boulevard, to Westlake High School, Baxter Pharmaceutical, and others in the Cal Water Service area. Additionally, Boyle arranged a meeting with the Public Works Directory and City Engineer to discuss possible system extensions to various portions of Thousand Oaks. **3. Residential Use in JV area**. Boyle assembled and reviewed information that it produced for the TEA study, regarding residential use in the Hidden Hills, Old Agoura, Saddletree, and Morrison Ranch areas. **4. Other RW customers in JV area**. Boyle reviewed proposed RW main extensions in Calabasas and Agoura that were uncompleted from the previous master plan.
3b	**Unit RW Demands.** Psomas sampled usage records from 15 existing RW customers, and estimated average consumption (AF/acre/year) based on landscaping acreage taken from aerial photos furnished by the District. These consumption rates were compared with rates calculated using evapotranspiration data and typical landscaping application rates for reasonableness.
3c	**RW Model Calibration.** This task remains uncompleted, pending completion of the new model by MWH Soft.
4a	**Proposed RW Extension Upgrades.** Based on target customers identified in Meeting No. 3, Boyle analyzed proposed system improvements, and prepared graphics and tables showing the proposed extensions and their approximate costs per acre feet of water delivered annually.
4b	**Outline of RW Report.** Boyle prepared and submitted an outline of the Recycled Water System Master Plan Update Report for District review and comment.
4c	**PW Model Calibration.** This task remains uncompleted, pending completion of the new model by MWH Soft.

No.	Description of Deliverable
5a	**Demand Sensitivity Analysis (Part 1)** **Seminole / Latigo Subsystem – Parcel-by-Parcel Analysis**. With the assistance of knowledgeable District Staff and Boyle's PM, Psomas assigned relative values to each undeveloped parcel within the zone: "0" = no development potential (dedicated open space, land owned by conservancy, state, or federal government "1" = low development potential (steep topography or difficult access) "2" = moderate development potential "3" = high development potential In addition to topography, the following characteristics of the parcels were considered: • Environmental impact • Coastal Zone Boundary • Proximity to other developments, or other developable land Proximity to roads and other infrastructure The assignment of these values occurred during a half-day meeting held at District HQ, attended by Psomas' GIS Engineer and Mike Swan. After the relative values were assigned, Psomas computed 2030 demands in the Seminole /Latigo Zone for: **Case 1: High likelihood**. (Includes all parcels assigned "3".) **Case 2: Moderate likelihood**. (Include both "2" and "3" parcels.) **Case 3: Worst-case scenario**. (Includes demand for all parcels, excluding "0".) **Demand Sensitivity Analysis (Part 2)** **Jed Smith Subsystem (and possibly others)** Boyle used the results of Task 2d (MDD Comparison) along with LVMWD Report No. 2202.10 which examined increasing demands in the Jed Smith Zone, and prepared a chart and table showing the various projections of demand. This information was the focus of discussion during Meeting No. 5.
5b	**Pumping and Storage Analysis.** Boyle updated the analysis of pumping and storage needs for each subsystem, based on the current and 2030 demands, and utilizing new evaluation criteria. Boyle also examined current SCADA information for each pump station and tank, and compared this actual performance during a week of high demands with performance predicted by this analysis. Differences between actual and predicted performance, if significant, were investigated. Where discrepancies exist, for instance, they may indicate errors in estimates, or the need to rebuild pumps.
6a	**Subsystem Descriptions.** Boyle utilized its knowledge of the system and interviews with District staff to update the facility and system descriptions found in Section 4 of the previous PW and RW Master Plans.

No.	Description of Deliverable
6b	**Description of Known Problem Areas.** For each subsystem, Boyle described known problems and deficiencies, derived from its knowledge of the system and interviews with District staff.
6c	**Fire Flow Deficiencies.** Using the PW hydraulic model, Boyle identified all hydrants in the District that deliver less than 1250 gpm at 20 psi residual pressure. This is the minimum for single family homes in a high-fire risk area (per LACFD Regulation No. 8). For major commercial areas in the District (Agoura Road, Calabasas City Center, Lindero Canyon Road, Thousand Oaks Boulevard and Canwood St.), the analysis was for 2000 to 5000 gpm. A graphical presentation and table was provided.
7a	**Transmission / Supply Modeling Scenarios.** Boyle provided a description of approximately eight cases, which were modeled to test the existing system and proposed improvements. Included were scenarios investigating emergency outages, planned outages, phasing of transmission improvements, CMWD interconnection, etc.
8a	**Transmission / Supply Analysis Results.** Boyle presented graphically (schematically) the results of its analysis for Task 7a.
9a	**Seminole Subsystem Alternatives.** Using the results of the Demand Sensitivity Analysis (Task 5a), Boyle outlined various alternatives for increasing the pumping, pipeline, and storage capacities with the Seminole Subsystem.
9b	**Outline of PW Report.** Boyle prepared and submitted for District review and comment, an outline of the Potable Water System Master Plan Update Report.
9c	**RW System CIP.** Boyle provided a map location and description of proposed Recycled Water System capital improvements, including budgetary costs, estimate of year when needed, justification for project, and trigger.
10a	**Infrastructure Condition Assessment Report.** The need for this task was superseded by other studies by District Staff.
10b	**Draft Recycled Water System Report.** Boyle submitted a draft report for District review, which included the various deliverables and analysis results, along with appropriate narrative, figures and appendices.
10c	**Asset Management Options.** The need for this task was superseded by other studies by District Staff.
11a	**PW System CIP.** Boyle will provide a map location and description of proposed Potable Water System capital improvements, including budgetary costs, estimate of year when needed, justification for project, and trigger.
12a	**Draft Potable Water System Report.** Boyle will submit a draft report for District review, which will include the various deliverables and analysis results, along with appropriate narrative, figures and appendices. Ten copies will be provided.
12b	**Outline of Integrated RW / PW System Master Plan Update Report.** Boyle will prepare and submit an outline of the Integrated Recycled / Potable Water System Master Plan Update Report for District review and comment. This report will serve as an "executive" report, using pertinent information from the other reports.

No.	Description of Deliverable
12c	**Final Recycled Water System Report.** Boyle will incorporate District comments and submit copies of a final report and CD versions, in PDF format.
13a	**Recycled Water System Model.** Boyle will provide data files for the completed model, including the various scenarios that were tested. **As an optional item, Boyle will instruct District staff on the Model's use.**
14a	**Draft Integrated RW/PW System Report.** Boyle will submit a draft report for District review, which will include the various deliverables and analysis results, along with appropriate narrative, figures and appendices. Five copies will be provided.
14b	**Final Potable Water System Report.** Boyle will incorporate District comments and submit copies of a final report and CD versions, in PDF format.
15a	**Potable Water System Model.** Boyle will provide data files for the completed model, including the various scenarios that were tested. **As an optional item, Boyle will instruct District staff on the Model's use.**
15b	**Final Integrated Water System Report.** Boyle will incorporate District comments and submit copies of a final report and CD versions, in PDF format.

Section 3

Design Criteria

3.1 Planning Period

The planning period for this Master Plan is through the year 2030.[5] The dynamics of growth in the District service area have changed. Portions of the area have been put into conservation, and in other areas the development has slowed. The most current population projections have been addressed in *Potable and Recycled Water Master Planning Demand Forecasts* (Psomas, October 2006, LVMWD Report No. 2340).

3.2 Trigger Points

The term "trigger points" is contained in this document to schedule proposed improvements and the costs associated to conditions or other identifiable events including demand level, percent of capacity, and others. For most cases, this is used rather than an estimated year due to continuing experience indicating that time alone is not the predominant factor. The rate of growth, development, and subsequent timing for additional water system capital improvements and/or operational changes may vary greatly.

3.3 Supply

Las Virgenes Municipal Water District is a member of the Metropolitan Water District of Southern California (MWDSC). LVMWD is one of 26 participating agencies that receive potable water service from MWDSC, purchasing most of their potable water supply from MWDSC. Other sources of supply are: (1) water purchased from Ventura County Waterworks District No. 17 for Woolsey Canyon residents and (2) water purchased from the City of Simi Valley for residents in Box Canyon. These two purchases are to serve residences that are hydraulically separated from the balance of LVMWD. This water is indirectly supplied from MWDSC by means of Calleguas Municipal Water District. There is also a small quantity of water that enters Las Virgenes Reservoir from storm runoff flows, and periodically water is supplied by the Los Angeles Department of Water and Power, when the MWDSC system is out of service.

[5] The previous version of the Master Plan used 2020 as the approximate buildout year in the LVMWD service area and was based on the report *Las Virgenes Municipal Water District Population Growth, Residential Development and Employment Activity Report* (Bauer Environmental Services, March 1996, LVMWD Report No. 2041).

3.3.1 Peaking Charges and MWDSC Rates

To minimize the demands on their distribution system, MWDSC discourages member agencies from "peaking" off their system. The principal way this is done is through the "Capacity Charge", which is assessed when demands during the May 1 though September 30 period exceed the peak flow experienced during a recent three-year period.[6] Currently, LVMWD would be assessed an additional $6,800 for each cubic-ft per second that the highest daily on-peak flow rate exceeds the 2004 peak flow rate of 46.9 cfs.

Because this penalty could be quite costly, it provides strong incentives for the following:

- **Increase purchases during the off-peak** (October through April) period, which raises the maximum flow allowed without extra charge.

- **Reduce (or levelize) purchases during the peak period** (May through September), such that demands are lower than the off-peak.

The MWDSC rate structure encourages off-peak purchases and the levelizing of on-peak purchases. Greater use of Las Virgenes Reservoir would help in this regard.

Both of the above goals are aided by using Las Virgenes Reservoir to shave the summer peaks, with the reservoir being refilled during off-peak periods.

Other features of the MWD rate structure produce the following incentives:

- **Reduce or slow the growth in demands**: The faster that demands in the District grow, the higher the portion of water that must be purchased at the Tier 2 rates, which are 22 percent higher than Tier 1 rates.

- **Reduce or minimize overall water purchases**: MWDSC's "Readiness to Serve" charge, distributes the cost of various capital expenditures, based on the total amount of water that is purchased over a 10-year average.

---

[6] The milestone upon which the charge is based is the peak flow for the three-year period which ends one year earlier.

The water delivered to LVMWD is billed at two different rates. For consumption up to 90 percent of the “base firm demand”, Tier 1 rates apply. Tier 2 rates apply to water purchases above this amount.

The “base firm demand” is calculated as the greater of a 10-year rolling average, or the “Initial Base Firm Demand”. The “Initial Base Firm Demand” was the maximum annual firm demand from the FY 1989/90 through FY 2001/02 period.

In the case of LVMWD, Tier 1 rates apply to the first 20,565 acre-feet of water purchased each year.

Table 3-1
MWDSC Fees Summary

Water Rates Based on Volume		
Water Rate ($/AF)	**2005**	**2006**
Full Service, Treated		
Tier 1 Rate	$443	$453
Tier 2 Rate	$524	$549
Tier 1 Allocation	20,565 acre ft.	

Issues of drought pose concerns because LVMWD has no available groundwater resources. However, Las Virgenes Reservoir could lessen the drought impact. It has been policy for the District to use up to 3000 acre-feet per year of storage from Westlake, with another 3000 acre-feet available for drought conditions, although this has been re-evaluated as part of this Master Plan, as discussed in Section 8.

3.4 Peaking Factors

The term “peaking factors” refers to calculated ratios that are used to relate the Average Day Demand to the larger Maximum Day or Peak Hour Demands. Definitions are as follows:

Average Day Demand (ADD) =	The yearly use divided over 365 days. For most days during the year, the actual consumption will be substantially larger or smaller than the ADD. Primarily this term is expressed in gallons per minute (gpm). ADD may be expressed for a system or for a single user in a system.
Maximum Day Demand (MDD) =	The maximum consumption that can be presumed on any day, and generally occurs in the late summer. The peaking factor for MDD is the ratio of MDD/ADD.
Peak Hour Demand (PHD) =	The maximum consumption presumed during the largest demand hour of the maximum demand day. The peaking factor for peak hour is the ratio PHD/MDD.

For most potable water systems, peaking factors are derived for the system as a whole, not for specific subsystems. This is generally used because most systems contained differences that are insignificant, however LVMWD has exceptions. Specifically, the Jed Smith/Mountain Gate, McCoy and Saddle Peak systems have peaking factors that are acutely higher, as discussed in Section 5.

Both the existing and future demands have been calculated for each area of the District. These demands are based on population projections, land use, billing/consumption records, and production records. These demands are discussed in greater detail in Section 5.

The peaking factors used to analyze the potable water system of the District are included in the discussion in Section 5. The current peaking factors used in this Master Plan are shown in **Table 5-10**. For systems that have higher than normal peaking factors, that factor was applied to the respective system for the analysis.

3.5 Fire Flows

Fire flows within the LVMWD service area are governed by Los Angeles County Fire Prevention Regulation No. 8, and are determined by the largest dwelling unit served by the facility. The most recent

Fire flow requirements depend on the size of the buildings, the type of construction, where the building is located, and other factors. Water utilities are not obligated to upgrade their systems in response to changes in the Fire Code.

update of these requirements occurred on December 15, 2004. The highest of fire flow requirements for single family residences are for the mostly rural Fire Zone 4. This zone is more prone to wildfires than Fire Zone 3, which is more urbanized. The fire flow requirements for structures such as multi-family housing and non-residential buildings are not affected by the fire zone classification. It must be noted that rarely is the required fire flow specified by Los Angeles County Fire Department less than 1250 gpm. The developer or property owner is responsible for upgrades that are necessitated by construction of larger structures; the District is not responsible for upgrades where facilities meet regulatory requirements at time of construction (but may not meet current requirements). Pertinent data from Regulation No. 8 are shown in **Table 3-2**, and the document in whole is shown in the Appendix.

The fire flows specified are required at a minimum of 20 psi residual pressure at the fire hydrant. If a pressure other than 20 psi is measured, it will be converted mathematically to determine compatibility. These fire flows are required under Maximum Day Demand conditions, under gravity flow. This assumes that pump stations are off and reservoir storage is down to minimum regulatory level (Section 3.7). Where an area is not served by a tank, a fire pump or emergency generator must be available. The system is modeled with these parameters and results of the analysis are described in Section 7.9

Only one large fire flow event is assumed in each zone at a given time, with the only exception being the 1235-foot zone. This zone was designed to serve two 5000-gpm requirements for 5 hours. This zone regularly functions as two separate zones, with the Cornell Pump Station dividing the zone. Two fire events will be considered concurrently on opposing sides of the pump station, providing storage in both the eastern and western sections of the LVMWD 1235-foot zone.

Table 3-2 Fire Flow Requirements			
Residential			
Building	**Fire Flow (gpm)**	**Flow Duration (hours)**	**Hydrant Spacing (max ft.)**
Single family dwelling and detached condominiums 1 to 4 Units less than 5,000 sq. ft.	1,250	2	600
Detached Condominiums 5 or more units less than 5,000 sq. ft	1,500	2	300
Two family dwellings (duplexes)	1,500	2	600
Multi-family dwellings, hotels, high-rise commercial, industrial	5,000	5	300
Other Structures and For Single Family Dwellings Greater Than 5,000 sq. ft.:			
Building Size (1st Floor Area)			
First Floor Area under 3,000 sr. ft.	1000 gpm	2 hours	300
3,000 to 4,999 sq. ft.	1250 gpm	2 hours	300
5,000 to 7,999 sq. ft.	1500 gpm	2 hours	300
8,000 to 9,999 sq. ft.	2000 gpm	2 hours	300
10,000 to 14,999 sq. ft.	2500 gpm	2 hours	300
15,000 to 19,999 sq. ft.	3000 gpm	3 hours	300
20,000 to 24,999 sq. ft.	3500 gpm	3 hours	300
25,000 to 29,999 sq. ft.	4000 gpm	4 hours	300
30,000 to 34,999 sq. ft.	4500 gpm	4 hours	300
35,000 or more sq. ft.	5000 gpm	5 hours	300

Conditions Requiring Additional Flow:

1) Each story above ground level - add 500 gpm per story

2) Any exposure within 50 feet - add a total of 500 gpm

3) Any high rise building (as determined by the jurisdictional building code) - fire flow shall be minimum of 3,500 gpm for 3 hours at 20 psi

4) Any flow may be increased by up to 1,000 gpm for hazardous occupancy.

5) Reductions in fire flow requirements can be achieved with fire resistive construction and/or fully sprinkled buildings.

Table 3-3 Number of Flowing Hydrants	
Fire Flow	**No. of Hydrants**
<1251 gpm	1
1251-3500 gpm	2
3501-5000 gpm	3

3.6 Modeling Parameters and Criteria

Hydraulic modeling requires the use of consistent units, parameters and criteria. The following parameters were adopted in consultation with District staff. For reader convenience and ease of use, equivalent units such as acre-feet (AF) and million gallons per day (MGD) are also sometimes used in the report text and graphics.

Table 3-4 Dimensional Units	
a. Pipeline Length	feet (ft)
b. Pipeline Diameter	inches (in)
c. Pipeline Flow Rate	gallons per minute (gpm)
d. Pipeline Headloss	feet (or ft/1000 ft of pipe)
e. Junction (node) Head	feet
f. Junction (node) Elevation	feet
g. Junction (nod) Pressure	pounds/square inch (psi)
h. Pipeline Velocity	feet/second (fps)
i. Junction (node) Demand	gallons per minute (gpm)

Table 3-5 Pipeline Friction Factors (Hazen-Williams "C")	
a. Polyvinyl Chloride Pipe	140
b. Asbestos Cement Pipe	120
c. Ductile Iron Pipe	120
d. Cement Lined Steel Pipe	120
e. Unlined Steel or Cast Iron Pipe	Determined per case, based on model calibration data

Table 3-6 Pump Operations	
a. Pump Curves	Use existing pump curves furnished by district
b. Pump Sequencing	As existing, described by district staff, or improved where warranted
c. Time-of-Use Pumping (i.e., off-peak)	As existing, or to be considered for new/upgraded facilities
d. Number of Operating Units	As existing, or improved where warranted

The existing and future potable water systems were generalized using the criteria presented in **Table 3-7**. As part of this master plan study, these criteria were compared with the criteria of six other water utilities.[7] Through this analysis it was determined that District criteria were consistent with these other systems.

[7] City of Thousand Oaks, Trabuco Canyon Water District, Rancho California Water District, Irvine Ranch Water District, City of Anaheim, and City of San Juan Capistrano.

For this study, the criteria employed by Las Virgenes were compared to criteria used by other leading Southern California water utilities. The LVMWD criteria were found to be reasonable and consistent with the others.

Table 3-7
Computer Simulation Conditions

	Average Day Demand ADD	Peak Hour Demand PHD	Maximum Day Demand MDD	Fire Flow (Max Day) FF+MDD
Pump Stations	on-off (cycle)	on-off (cycle)	on-off (cycle)	off
Turnouts	on-off (cycle)	on-off (cycle)	on-off (cycle)	off
Reservoir Level	varies	varies	varies	Minimum Regulatory
Minimum Pressure	43 psi (60 desired)	43 psi (60 desired)	43 psi (60 desired)	20 psi at hydrant
Maximum Pressure (at meter)	150 psi (static)	150 psi (static)	150 psi (static)	n/a
Pipeline Flow Velocity, maximum*	5 fps (new) 10 fps (existing)	5 fps (new) 10 fps (existing)	5 fps (new) 10 fps (existing)	15 fps
Pipeline Headloss, maximum*	5 ft/100 ft or 2.2 psi/1000 ft (new pipes)	5 ft/100 ft or 2.2 psi/1000 ft (new pipes)	5 ft/100 ft or 2.2 psi/1000 ft (new pipes)	n/a

*Note: The criteria of 10 fps for velocity and 10 feet of headloss per 1000 ft of pipe were generally applied to existing pipelines. If these velocities or headlosses did not cause problems, the existing pipelines were not improved. The criteria of 5 fps and 5 ft/1000 ft for headloss were applied to new piplines.

For pressure regulation valves (PRV's), the modeled settings correspond to existing operational settings, as provided by District staff. Also,

Headloss "k" factor ($k\ v^2/2g$) = 5.0

The reduced pressure zones are modeled simultaneously with the zones from which they receive flow.

The 43-psi minimum pressure is based on District Code and corresponds to 100 feet of "head." Current new homes are larger, with many being two stories. The modern home and lifestyle desire multiple, simultaneous water uses. A more desired minimum pressure for design is 60 psi. This higher pressure results in less customer dissatisfaction and should be applied to new projects where it is physically possible; however the 43 psi minimum pressure requirement is the standard (per District Code).

3.7 Storage Tanks/Reservoirs

There are three specific categories of water that the tanks and reservoirs are designed to store in the LVMWD system:

- **Operational Storage –** This storage allows the system to be operated daily for the given consumer demand for that system. This storage reduces the need for pumps to vary greatly with the variety of customer demands (thus, increasing efficiency). The wide variation in demands are generally met by gravity flows from the tanks, such that the pump stations or turnouts can be designed to be approximately constant.

- **Emergency Storage –** This storage allows for limited customer service when a pump station or turnout is off-line in an emergency. The total emergency storage required is 5 hours of MDD, the approximate amount of time that it takes to take emergency measures (like connecting a generator).

- **Fire Storage –** This is the volume of water needed for the maximum fire duration and flow rate requirement in a zone lacking emergency pumping provisions, such as a fire pump or emergency generator.

For emergencies involving pump stations or turnouts being inoperable for longer than 5 hours, such as an earthquake, larger reservoir storage is desired. In those circumstances, it is not unreasonable to assume all water storage is available. The situation is less critical if the emergency occurs at times of the year when consumption is typically low (cooler weather).

Although the District system is often used to fight wild fires, such events can quickly deplete storage volumes and overtax pipelines and pump stations. The numerous hydrants that may be flowing and the many domestic systems that may be broken or left abandoned with sprinklers and hoses operating create demands on the system that are far in excess of the criteria used for system design. It is recognized within the industry that it is absolutely not practical to design and build a system that can be fully functional under such catastrophic circumstances. Facilities would need to be sized for many times the current standards, which would be both costly and would also adversely affect water quality through stagnation. However, conservatively sized facilities, including the use of mid-peak and off-peak pumping criteria will provide a much higher level of service during a wild fire than systems designed for 24-hour pumping and little or no redundancy.

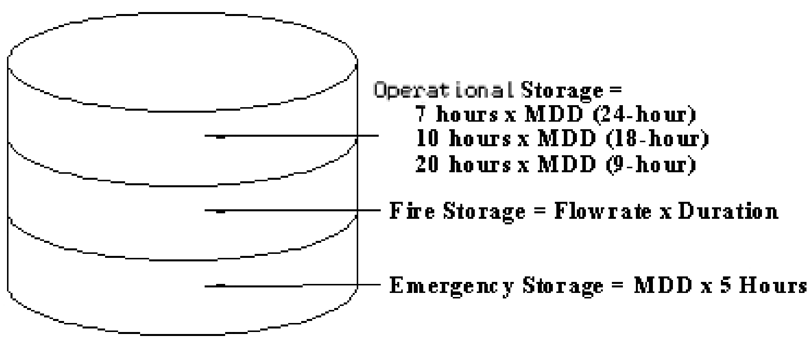
The operational storage needed for diurnal variations in demands were formerly based on an assumption that the demands could be approximated as 14 hours of 150 percent of average demand and 10 hours of 30 percent of average demands. For this Master Plan, a more detailed analysis was performed, based on the diurnal curves that are currently being experienced within the district's system. In recent years, higher and earlier peak demands have been experienced in the morning hours, and evening peaks have virtually disappeared as automatic sprinkler systems have supplanted manual operations of landscape irrigation by homeowners.

Because peak demands are experienced before 8:00 a.m., a greater portion of demands can be met with pumping rather than storage, even when using 9-hour off-peak pumping.

Figures 3-1, 3-2, and 3-3 illustrate how the required operational storage was calculated for the three different pump station operation scenarios that are used: 24-hour pumping, 18-hour pumping, and 9-hour pumping (see discussion later in this section for how these are defined). The method applied in this analysis is the result of field-collected data from the actual systems being evaluated. For the 24-hour pumping scenario, the previous method is closely matched to the detailed analysis, so either method would be acceptable. That is not the case for 9-hour and 18-hour pumping scenarios, where the storage requirements are slightly reduced, using the more detailed analysis.

This analysis results in a required storage capacity that is better matched to each pumping scenario, as shown in **Table 3-8**.

Table 3-8 Reservoir (Tank) Volumes	
Operational Storage	7 Hours of MDD (24 hour, continuous pumping)
	10 Hours of MDD (18-hour, mid-peak pumping)
	20 Hours of MDD (9-hour, off-peak pumping)
Fire Storage	Required Flow Rate x Duration
Emergency Storage	5 Hours of MDD
General	Provision for removing steel tanks from service for recoating: Two tanks or room for Baker type tank



It can be seen in **Table 3-8**, that a much larger volume of storage is required operating in an off-peak pumping mode. In contrast, less storage is required when pumps are running 24-hours per day because a larger portion of the daily demand is being supplied directly by pump, without entering a tank. The difficulty arises when reservoirs or tanks are designed for 24 or 18-hour pumping modes, and the operation is shifted to a mode with less hourly pumping per day (either intentionally or unintentionally). In these situations, tank storage will be undersized for MDD conditions, as storage is insufficient.

The primary advantage of using mid-peak or off-peak pumping, as discussed later in this section, are greatly reduced costs for electricity. These pumping modes also result in larger facilities that are therefore more capable of overcoming unexpected problems such as equipment failures or demands that exceed forecasts.

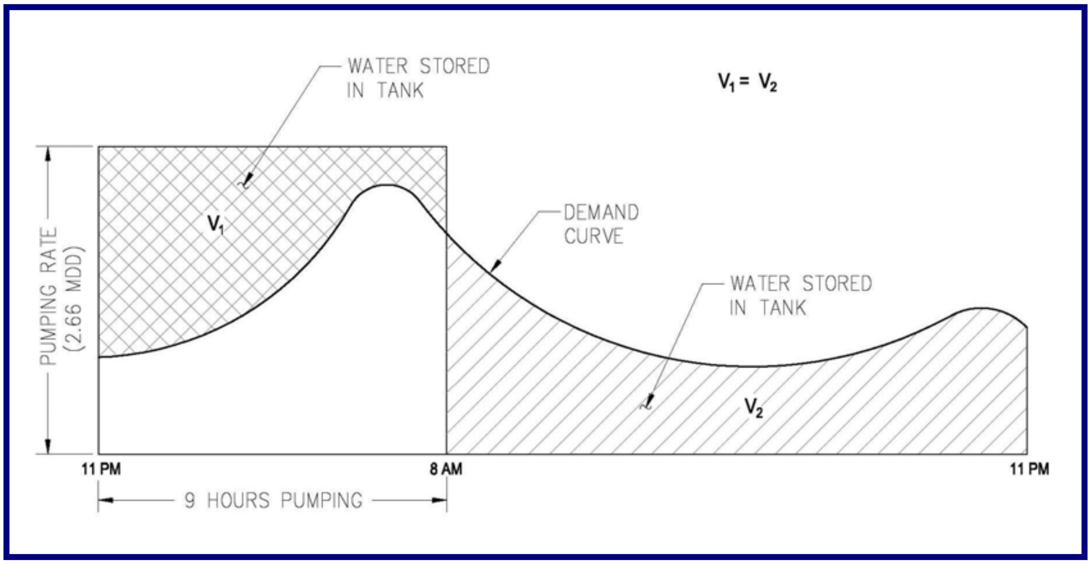


Figure 3-1
LVMWD
Master Plan Update
Off-Peak Pumping

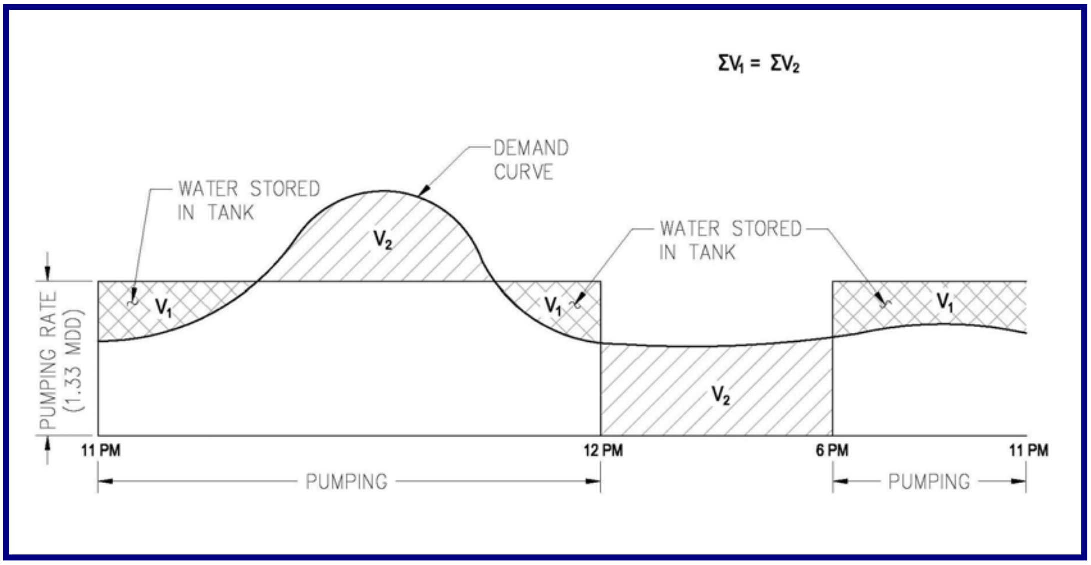


Figure 3-2
LVMWD
Master Plan Update
18-Hour/Mid/Peak
Pumping

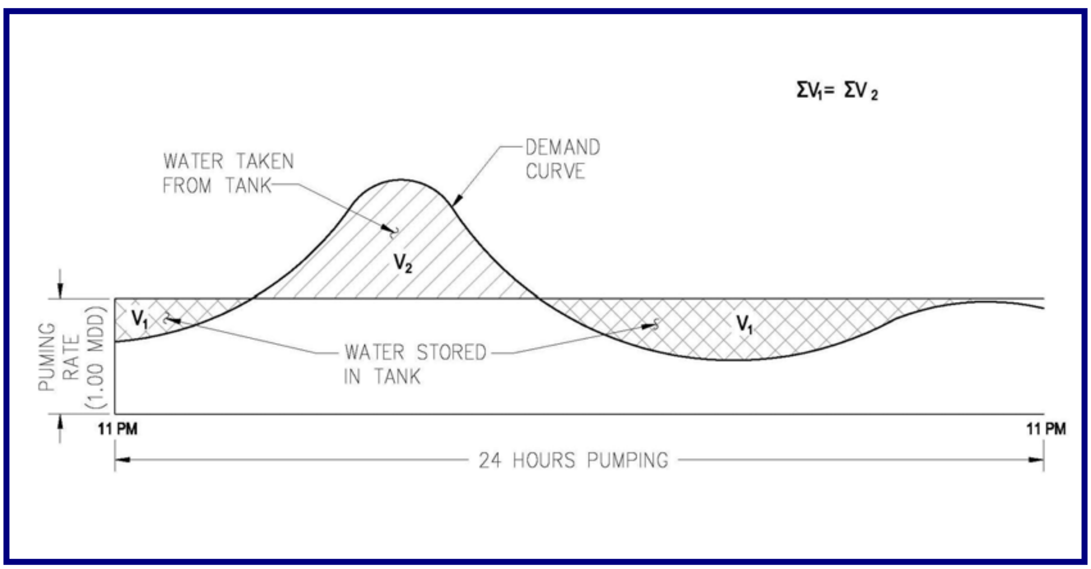


Figure 3-3
LVMWD
Master Plan Update
Peak Hour Pumping

It is therefore recommended for future improvements to assume off-peak pumping modes and larger volumes of storage.

As applicable to operating criteria:

- High water levels (HWL) or high hydraulic gradient levels (HGL) for tank design should be between 3 and 1 foot below the lowest roof level to improve safety from waves caused by earthquakes.

- The lowest of normal operating levels (omitting fire conditions) should be at a level equal to the level of fire flow plus emergency storage.

- **Table 3-9** and text following, provides recommendations for various tanks. It should be noted that typical municipal water systems contain storage volumes ranging from 0.3 to 2 times the MDD plus fire storage.

Table 3-9
Recommended Tank / Reservoir Storage

Storage For:	Fire	Emergency	Regulatory	Total
Existing Tank (excluding Main Zone)	Yes	5 hours	10	15 hours (.63 MDD)
Existing Tank (Main Zone)	Yes	5 hours	7	12 hours (0.5 MDD)
Future Tank	Yes	5 hours	20	25 hours (1 MDD)

3.8 Pump Station Sizing

It is recommended to design, build and operate pump stations such that the following criteria are met:

- A pump station should be able to pump a volume of water that is equal to the Maximum Day Demand in a period of 18 hours or less, however if the pump station is/was designed to operate in off-peak conditions the Maximum Day Demand should be pumped in 9 hours. The General Manager must approve new facilities where pumping Maximum Day Demand takes more than 9 hours. 18 hours is desired for existing because operations staff

New pump stations should be designed for off-peak pumping, unless otherwise approved by the General Manager. In no case, should a pump station be designed to operate more than 18-hours in a day.

would prefer to not rely on continuous pumping. 18 hour pumping also provides flexibility (6 hours worth) to refill storage removed for fire fighting events and provides a margin for pump wear and demands that may exceed forecasts.

- Pump stations must be able to replace Maximum Day Demand plus either emergency storage or fire flows, whichever is larger in volume, in 24 hours. It is acceptable to meet the criteria by aid of a standby pump.

- When a certain zone contains no reservoir storage, the pump station must be able to meet Peak Hour Demands without the use of a standby fire pump *and* to meet Maximum Day Demands plus fire flow - with the use of a standby fire pump. There are two hydropneumatic zones in the District without the use of storage tanks: Agoura and JBR, a soon-to-be-constructed zone also does not have a dedicated tank, but will have an emergency generator and also can serve fire flows without pumping.

- Pump stations should be able to meet or exceed all above criteria with a standby pump that is not normally operated.

3.9 Pump Stations and Off-Peak Pumping

On-peak or time-of-use energy rates are designed to shift the load of consumption from the times of high usage. Southern California Edison and other various energy providers provide substantial discounts for consumers who agree to avoid energy use during on-peak time, currently providing an economic advantage for pump stations designed and operated as off-peak. **Table 3-10** shows the operational criteria currently used for pump stations based on time-of-use rates. This rate schedule begins the first Sunday in June at midnight and ends the first Sunday in October at midnight. The operations always have exceptions for fire or emergency.

It is difficult at best to attempt to predict future energy rates. It is also difficult to determine the total economic benefit of design and operation for strictly off-peak pumping. However, there can be substantial penalties for using a station designated as off-peak during peak periods, so pump stations designed with off-peak schedules should be programmed to operate in that manner.

Pump stations designed for off-peak (9-hour) pumping must have a capacity 2.66 times greater than that of a station designed for 24-hour use. Comparatively, tank/reservoir storage for an off-peak system must have operational storage nearly 3 times larger, as shown in **Figures 3-1 – 3-3**.

Stations designed for mid-peak (18-hour) pumping must have pumping capacities 1.33 times larger, and require operational storage that is 40 percent larger than 24-hour pumping use.

Table 3-10
Las Virgenes Time of Use (TOU) Pump Stations

Facility	Rate Schedule	Operating References
Agoura	PA-2	Hydropneumatic runs all day.
Cold Canyon	TOU	Designed to run as needed due to suction pressure at Stunt Road PS. Will run all day.
Conduit	TOU	Do not run between noon and 6:00 p.m.
Cornell	TOU	Electric motor needs to be turned off by 11 a.m., switch from electric motor to gas engine.
Dardenne*	TOU	Do not run between noon and 6:00 p.m.
JBR	PA-1	Hydropneumatic runs all day.
Jed Smith*	TOU	Must run all day, due to high demands.
Kimberly	TOU	Do not run between noon and 6:00 p.m.
LV-2	TOU	Will run all day.
McCoy	TOU	Do not run between noon and 6:00 p.m.
Morrison	PA-1	OK to run as needed.
Mountain Gate	TOU	Do not run between noon and 6:00 p.m.
Mulwood	TOU	Will run all day, ok to run.
Oakridge	TOU/GS-2	Do not run between noon and 6:00 p.m.
Lower Oaks	TOU	Do not run between noon and 6:00 p.m.
Upper Oaks	TOU	Do not run between noon and 6:00 p.m.
Ranchview	PA-1	Do not run between noon and 6:00 p.m.
Saddletree	PA-2	Do not run between noon and 6:00 p.m.
Seminole*	TOU	Do not run between noon and 6:00 p.m.
Stunt Road	TOU	Do not run between noon and 6:00 p.m.
Three Springs	PA-2	Will run all day.
Twin Lakes	LA DWP TOU	Do not run between 11 a.m. and 6:00 p.m.
Upper Twin Lakes	PA-2	Do not run between noon and 6:00 p.m.
Warner	TOU	Do not run between noon and 6:00 p.m.

* Facilities where TOU pumping is exceeded.

3.10 Replacement Schedules/ Economic Lives

Specific facilities associated with potable water distribution have approximate useful lives. These lives depend on many factors, such as amount of use, maintenance, overall capacity, construction techniques, and others. **Table 3-11** provides a rough estimate of operational life that can be expected of certain facilities before large-scale repair, replacement or refurbishment.

Table 3-11
Useful Life of Fixed Assets

Asset Description	Useful Life	
	Months	Years
Major Buried Pipelines		
Sewers, all materials	1,200	100
Potable and Recycled, all materials	900	75
Tanks and Buildings		
Concrete reservoirs	600	50
Welded steel storage tanks (except coating)	600	50
Pump Stations (except pumps & electrical)	600	50
Sanitation concrete tanks, buildings	600	50
Headquarters construction	600	50
Construction of Westlake Filtration Plant	600	50
Construction of Rancho Compost Plant	600	50
Construction of Tapia Plant	600	50
Facility Piping, Appurtenances, Services, Roads		
Piping, valves & fittings/buried valves	420	35
Site work/roads/small structures	420	35
Potable water meter boxes, services, vaults, fire hydrants	420	35
Recycled water meter boxes, services, vaults, fire hydrants	420	35
Large Equipment		
Potable and recycled water pumps	300	25
Sanitation pumps, conveyors, centrifuges, large electrical	300	25
Sanitation control systems, electrical, chemical, grinders	300	25
Electrical & control facilities at pump stations & storage facilities	300	25
Small Equipment & Miscellaneous		
Design and engineering	300	25

Table 3-11 Useful Life of Fixed Assets		
	Useful Life	
Asset Description	Months	Years
Master plans, general EIRs and studies	60	5
Tank coatings	180	15
Potable and recycled water meters	180	15
Special vehicles, portable generators & pumps	120	10
Sanitation meters, lab equipment, small tools, radios, SCADA equipment	120	10
Furniture, carpet, blinds, phones	120	10
Vehicles, general use	72	6
Shop and garage equipment	60	5
PCs, software, meter readers	36	3

3.11 Pipe Sizing

The governing factor for pipe sizing in the Las Virgenes Municipal Water District is hydraulic considerations to meet pressure requirements at anticipated flow rates, however, there are some guidelines to the minimum size of pipes in specific locations or in certain conditions. The minimum size for service laterals shall be 1-inch. For mains, a minimum of 4 inches is required on a dead end, beyond the last hydrant. When the main is feeding a hydrant, the minimum is 6-inches, and looping is required where it is feasible.

3.12 Opinion of Probable Cost / Economic Factors

Unless specifically noted otherwise, all cost and economic figures used in this report are based on applicable current rates in 2006 dollars.

Shown in **Table 3-12,** is the opinion of probable construction costs for estimating purposes. The values shown in **Table 3-12** are based on previous construction bid costs. It should be noted that generally, smaller pipelines are PVC or HDPE, where the larger (12-inches and larger) pipelines are generally steel. The previous costs per pipe material were plotted to determine the estimated cost per foot of each material based on size. These estimates were then evaluated to determine the most probable pipe material for each size, and the cost associated with that size and material were used for **Table 3-12**. **Figure 3-4** shows the construction cost estimating criteria for pump stations, and is also based on previous construction. Pump station estimates do not include associated pipelines that are outside of buildings.

The cost associated with right-of-way acquisition will vary for facilities that are not in current public right-of-way. An allowance estimated between $5 and $40 per square foot should be allocated for the fee parcels. For easements, allow approximately one-third the value of the fee title easement.

An estimate of 20 percent of the opinion of probable cost has been made for engineering, administration, and construction services for pipelines and reservoirs, where 30 percent for pumping stations has been estimated. Allowances for surveying and geotechnical investigations have been allocated. Also, a contingency of 15 percent has been allowed on the overall project cost.

The unit costs shown here are based on aggregate costs for typical pipeline projects in Southern California, and include appurtenances, traffic control, repaving, etc.

Table 3-12 Construction Cost Estimating Criteria for Potable Water System Facilities		
Item/Description	**Unit Price Existing Development**	**Unit Price New Development**
4-inch pipelines	$ 150/LF	$ 75/LF
6-inch pipelines	$ 175/LF	$ 90/LF
8-inch pipelines	$ 190/LF	$ 100/LF
10-inch pipelines	$ 210/LF	$ 105/LF
12-inch pipelines	$ 225/LF	$ 110/LF
14-inch pipelines	$ 240/LF	$ 115/LF
16-inch pipelines	$ 250/LF	$ 130/LF
18-inch pipelines	$ 270/LF	$ 150/LF
20-inch pipelines	$ 280/LF	
24-inch pipelines	$ 300/LF	
30-inch pipelines	$ 340/LF	
36-inch pipelines	$ 370/LF	
42-inch pipelines	$ 385/LF	
Welded Steel Water Tanks	$ 0.80/gal + $0.40/gal for site work	
Concrete Reservoirs	$0.90/gal + $0.45/gal for site work	
Pump Stations	See **Figure 3-5** for $/HP	

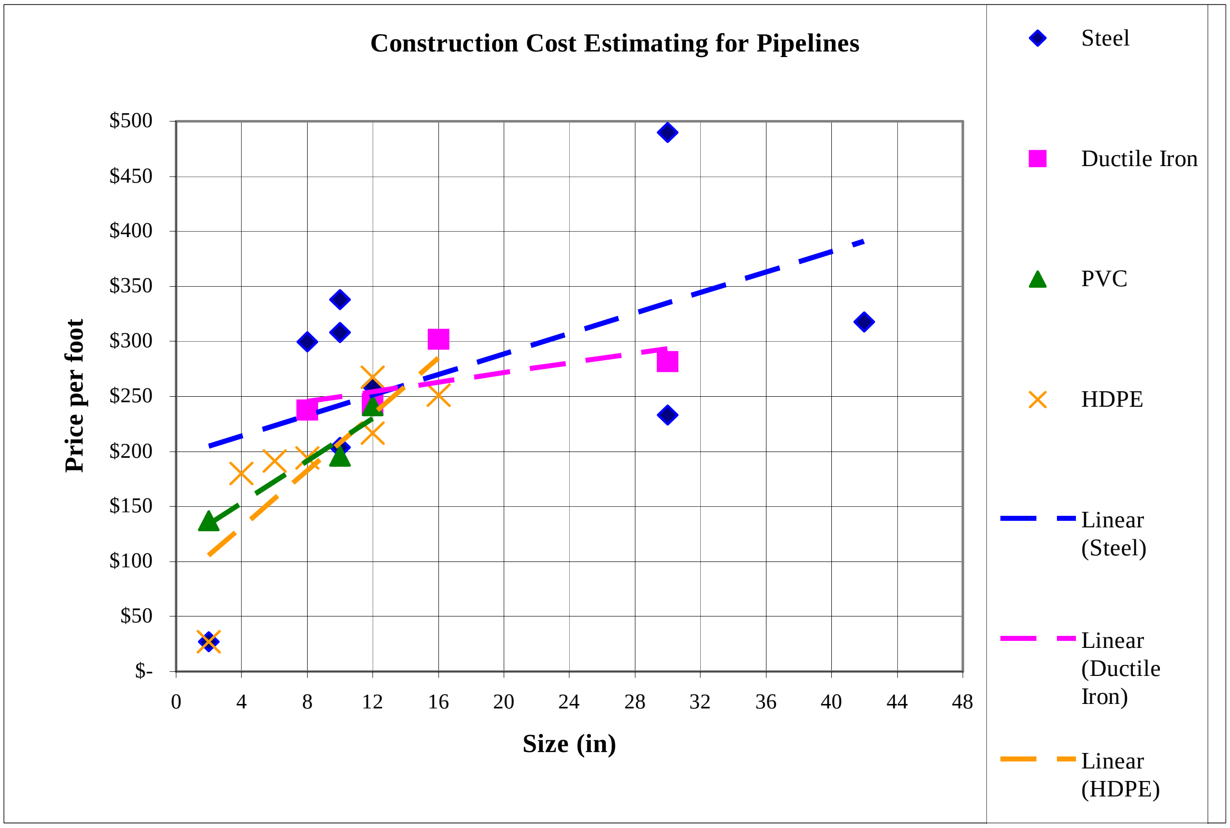
Notes:

1) All costs are 2007 dollars (ENR Construction Cost Index/Los Angeles = 8871)

2) Pipeline costs are for developed areas based on analysis of historic costs for publicly bid projects in California, and include all pipeline related items including: mobilizations, excavation, backfill, appurtenances, services, casings and paving.

3) Pipeline costs for undeveloped areas are based on industry estimating guides and include an allowance for normal appurtenances, but do not include paving and mobilization.

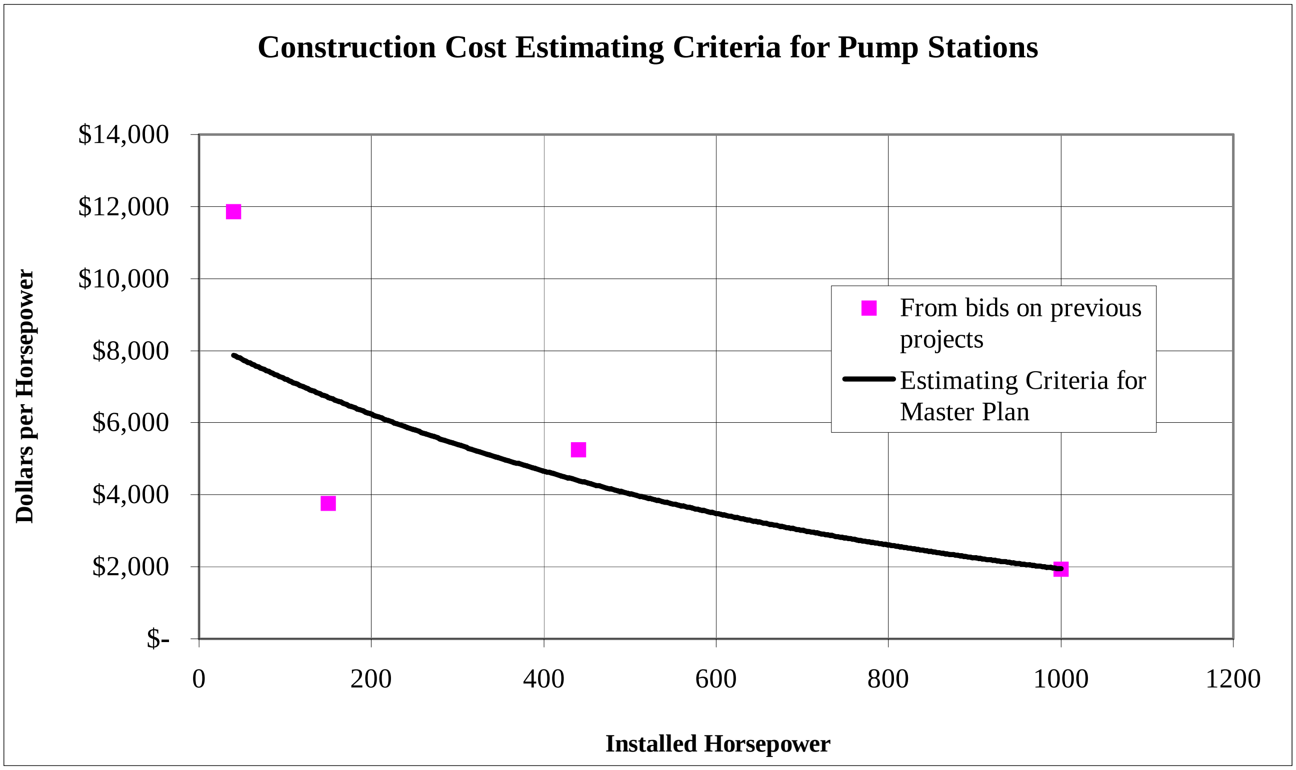
Figure 3-4



It should be noted that steel tanks generally have a lower initial investment cost than concrete reservoirs. Both types of storage may, however, have equal life cycle costs due to little or no recoating costs for concrete. These coatings may be restricted by future air-quality restrictions, as coal tar has been previously used in LVMWD, with concrete providing an advantage. Also, concrete reservoir can be either partially or entirely buried. This may aid in community approval in certain situations, as sites for above ground tanks to be unobtrusive become difficult to find.

Cost estimation data for this Master Plan was derived from **Figure 3-5**. This figure presents previous bid amounts on pump station projects. The data was used to create a trend line to estimate future pump station costs based on design horsepower.

Figure 3-5



Construction Cost Estimating Criteria for Pump Stations
$14,000
$12,000
$10,000
$8,000
$6,000
$4,000
$2,000
$-
Dollars per Horsepower
0
200
400
600
800
1000
1200
Installed Horsepower
From bids on previous projects
Estimating Criteria for Master Plan

Section 4

Potable Water System – Existing Facilities

The Las Virgenes Municipal Water District potable water system consists of an elaborate system of pumps, pressure zones, supply connections and reservoirs/tanks. There are 22 main pressure zones created by numerous facilities. Within these main zones are multiple sub-zones created by pressure regulation, containing no independent storage facilities. The topography plays a large role in the complexity of the water delivery system of the District. The complex nature of the current system is derived from the rugged topography and the east to west linearity of the District. The system as a whole provides dependable water service while maintaining the careful balance of capital, maintenance, and energy use.

A brief overview of the major components of the District is outlined in **Table 4-1**. Also the data used in modeling of the current tanks, pumps and pressure regulating stations are contained in **Appendices A, B and G**. **Plate 1** and **Figure 4-1** display the facilities in plan and schematic profile (hydraulic grade included).

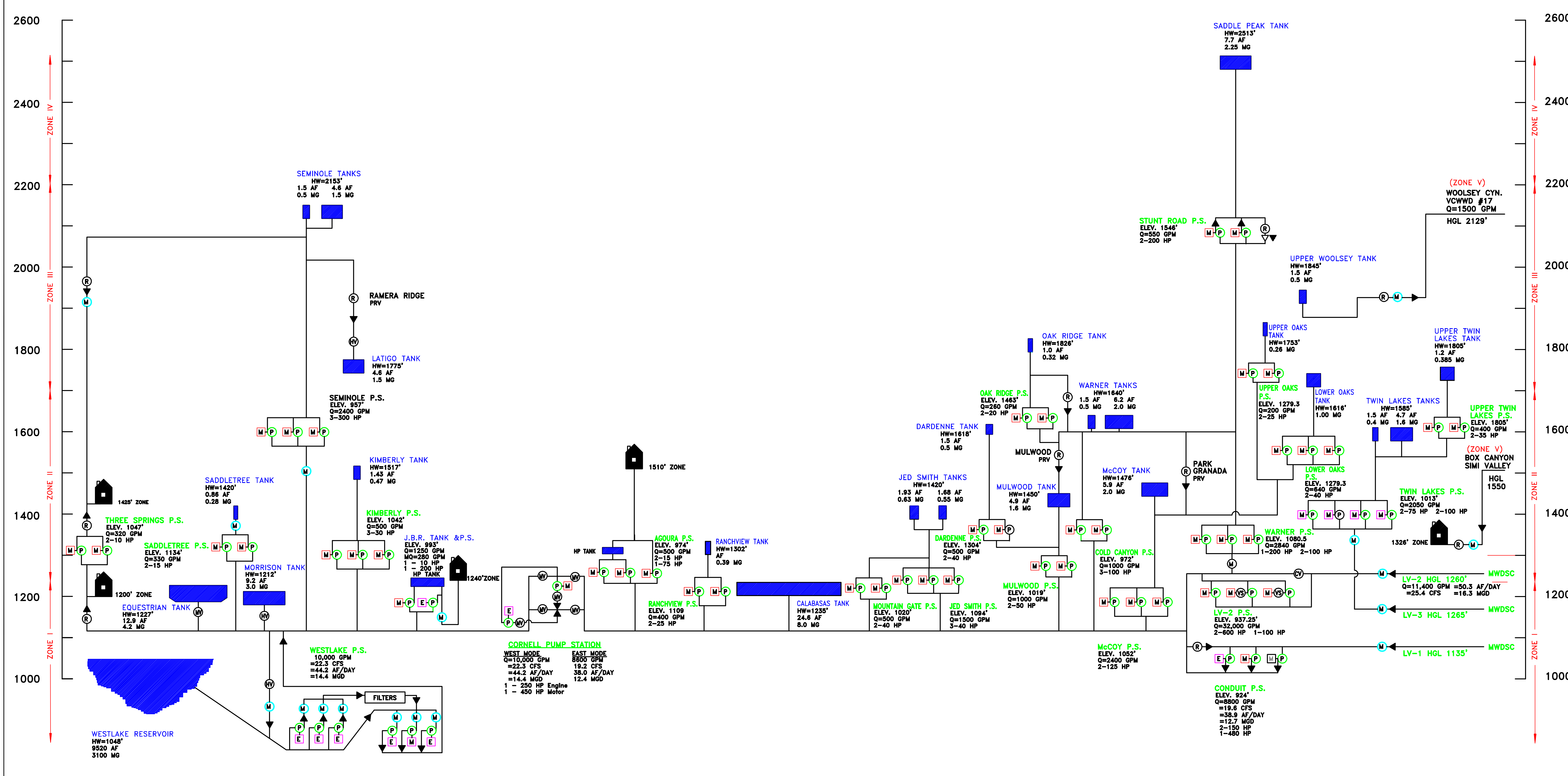
4.1 1235-foot Main Zone

The 1235-foot main zone is also considered the "backbone" system. This system is responsible for conveyance and transmission of potable water from MWDSC turnouts on the eastern portion of the District through the Ventura Freeway Corridor to the far west of the District and Las Virgenes Reservoir. This main system serves approximately 90 percent of the District's customers either directly or by distribution to smaller subsystems within the District. The Cornell Pump Station has the ability to move water east or west, boost pressures and maintain the balance between supply and demand. This pump station is important during peak demands and when supplies are low, such as Las Virgenes Reservoir filling or when MWDSC is not delivering. West of Cornell, the backbone system is sometimes referred to as the 1227 zone, based on the high water level of Equestrian Trails Tank.

Seasonal storage for the District is provided by Las Virgenes Reservoir, which has a pump station and filtration plant to deliver the water back to the 1235 zone. This zone also has operational storage in Calabasas, Equestrian Trails and Morrison Tanks.

Table 4-1
Existing Pressure Zones

Zone / HWL	Tanks / Capacity	Supplied by	From Zone	Comments
1135 ft	--	MWD LV-1 Turnout	n/a	Can be Fed From 1235 ft
Main 1235 ft	Calabasas 8 MG (1235 ft) Morrison 3 MG (1212 ft) Equestrian Trails 4.2 MG (1227 ft)	Conduit Pump Station MWD LV-2 Turnout LV-2 Pump Station Cornell Pump Station Las Virgenes Reservoir, Pump Station and Filtration Plant	1135 ft n/a n/a	LV-2 PS is an in-line booster Cornell PS is an in-line booster (east or west) Las Virgenes Reservoir contains seasonal and emergency storage
JBR 1240 ft	Hydro-Pneumatic	JBR Pump Station	1235 ft	Used when gradient is low in 1235 ft zone
Box Canyon 1236 ft	None	City of Simi Valley	1550 ft	Serves upper Box Canyon, most can be fed by LVMWD if needed. Existing old pump fixtures could be re-installed
Ranchview 1302 ft	Ranchview 0.39 MG	Ranchview Pump Station	1235 ft	
Agoura 1350 ft	Hydro-Pneumatic	Agoura Pump Station	1235 ft	
Saddletree 1420 ft	Saddletree 0.3 MG	Saddletree Pump Station	1235 ft	
Jed Smith/Mtn. Gate 1420 ft	Jed Smith (2) 1.2 MG	Jed Smith Pump Station Mountain Gate Pump Station	1235 ft	
Three Springs 1425 ft	None	Three Springs Pump Station Westlake Blvd PRV from Seminole Zone	1235 ft 2153 ft	1235 fed from 1200 ft gradient
Mulwood 1450 ft.	Mulwood 1.6 MG	Mulwood Pump Station Mulwood PR Station	1235 ft 1640 ft	Supplies Dardenne PS
McCoy 1475 ft	McCoy 2.0 MG	McCoy Pump Station Various PR Stations	1235 ft 1640 ft	
Kimberly 1517 ft	Kimberly 0.5 MG	Kimberly Pump Station	1235 ft	
Twin Lakes 1585 ft	Twin Lakes (2) 2 MG	MWD LV-3 Turnout Twin Lakes Pump Station	1265 ft	Isolated from rest of LVMWD system
Lower Oaks 1616'	Lower Oaks 1.0 MG	Lower Oaks PS	475 ft	
Dardenne 1618 ft	Dardenne 0.5 MG	Dardenne Pump Station	1450 ft	
Warner/Cold Canyon 1640 ft	Warner (2) 2.5 MG	Warner Pump Station Cold Canyon Pump Station	1235 ft	Supplies many other zones Cold Canyon PS Supports Stunt Road PS
Upper Twin Lakes 1805 ft	Upper Twin Lakes 0.385 MG	Upper Twin Lakes Pump Station	1585 ft	Fed from Twin Lakes System
Upper Oaks 1753 ft	Upper Oaks 0.26 MG	Upper Oaks Pump Station	1475 ft	
Latigo 1775 ft	Latigo 1.5 MG	Seminole Subsystem Ramera Ridge PR Station	2153 ft	
Oak Ridge 1826 ft	Oak Ridge 0.32 MG	Oak Ridge Pump Station	1640 ft	
Woolsey 1845 ft	Upper Woolsey 0.5 MG	Ventura County WWD #17 Woolsey PR Station	2129 ft	Isolated from rest of LVMWD system
Seminole 2153 ft	Seminole (2) 2.0 MG	Seminole Pump Station	1235 ft	Largest Single Lift in District, Supplies Latigo Tank and Three Springs Zone
Saddle Peak 2513 ft	Saddle Peak 2.25 MG	Stunt Road Pump Station	1640 ft	Highest Elevation Zone in District



LEGEND

- P E — ENGINE DRIVE PUMP
- P M — ELECTRIC MOTOR DRIVE PUMP
- (M) — METER
- (MV) — MOTOR CONTROLLED VALVE
- (VS) — VARIABLE SPEED DRIVE
- (CV) — CHECK VALVE
- HP — HYDRO-PNEUMATIC
- (HV) — HYDRAULIC CONTROL VALVE
- (R) — REGULATOR STATION
- ZONES WITHOUT TANKS
- EXISTING FACILITY
- FUTURE FACILITY

SCALE

VERTICAL GRADIENT SCALE
1 UNIT = 100'
(2 — 200', 1 — 100', 0 — 0')

HORIZONTAL TANK VOLUME SCALE
1 UNIT = 3 MG
(0 MG, 1 MG, 2 MG, 3 MG)

LAS VIRGENES MUNICIPAL WATER DISTRICT
POTABLE WATER MASTER PLAN

EXISTING SYSTEM GRADIENT SCHEMATIC

23016.00	DEC. 2006	FIGURE 4-1

DWG: F:\LVMWD\23016.00 - Potable & Recycled Water MP Update\0001\CAD\Exhibits\Potable\FIGURE 4-1.DWG
DATE: Oct 03, 2007 11:59am

4.1.1 LV-2 Turnout (Calabasas Flow Control Station) and Pump Station

The majority of the potable water supply that enters the District from MWD enters the system via the LV-2 turnout. This turnout has historically been known as the Calabasas Flow Control Station. This particular facility is located at the boundary between the Cities of Los Angeles and Calabasas, on the south side of the Ventura Freeway.

This MWDSC feeder has the ability to deliver a maximum of 105 cfs to the LV-2 turnout, which is designed for a maximum of 75 cfs. If the turnout is operated by gravity, it can deliver up to 25 cfs. For most cases, the LV-2 pump station must be turned on, and can boost flows up to 75 cfs. At the LV-2 pump station are two variable-speed motor-driven pumps and one constant speed unit.

District Identified Problems/Deficiencies:

- *A permanent emergency generator would be useful to allow the use of more pumps during an outage, as only the 150 hp pump can be run at this time with a portable emergency generator.*

4.1.2 LV-1 Turnout (Andora Metering Station) and Conduit Pump Station

Another location where the District receives water for the backbone system is through the LV-1 turnout. This facility delivers water from MWDSC West Valley Feeder No. 1 to a 30-inch LVMWD pipeline. The flow from West Valley Feeder No. 1 is currently limited to 93 cfs and the metering station capacity is limited by MWDCS to 24.5 cfs. This LV-1 Turnout is located near Topanga Canyon Boulevard and Andora Avenue in the San Fernando Valley. A small number of customers on the west side of the San Fernando Valley are also served from this pipeline.

This 30-inch pipeline also delivers water to the Conduit Pump Station, which pumps into the 1235 foot system. At this pump station are two electrically driven pumps and a single gas driven pump backup. With the two electric pumps running, the station formerly provided up to 19 cfs.

District Identified Problems/Deficiencies:

- *The 100-psi rated 30-inch conduit may require upgrading if the LV-1 turnout is moved to West Valley Feeder No. 2.*
- *The system lacks supply redundancy in the Lake Manor area, causing concerns.*
- *Only one pump can be operated at Conduit Pump Station due to the installation a small, 20-inch pipeline. The flow is limited to about 8 cfs.*
- *Occasional operation of the pump station is needed to reduce water stagnation.*
- *Flows from LADWP during MWDSC shutdown have been reduced to half (18 cfs) since the replacement of a portion of the 30-inch pipeline with a 20-inch pipeline.*
- *It was necessary to install a PRV in the Kittridge area when taking water from LADWP due to backpressure.*
- *The operation of LV-1 is labor intensive, based on a large valve being closed by hand.*
- *There is no connection for an emergency generator for the electric pumps, as the engine pump serves as the standby. The only generator connection is to run lights and controls for the natural gas engine.*

4.1.3 Cornell Pump Station

The Cornell Pump Station moves water across the District through the 1235 zone. If Westlake Pumping Station is not in operation, all the water the District acquires, is from the east. During the summer months, water is moved from the extreme east boundary of the District to the extreme west. When water is taken from Las Virgenes Reservoir during MWDSC shutdown, the Cornell Pump Station moves water from the reservoir to the eastern portion of the District through the 1235 zone. This pump station is required to have this type of flexibility because this zone has little elevation change across it. This facility maintains the hydraulic balance throughout the 1235 zone. This pump station is operated depending on system requirements. Many portions of this transmission system are undersized for demands, often resulting in substantial energy losses, and low pressures near the outer limits.

This facility is located just east of Cornell Road on Agoura Road. This station divides the 1235 zone into eastern and western portions, with slightly differing hydraulic gradients at operation. Control of this pump station is available from the District Headquarters. The pump station consists of one electrically driven pump and one natural gas engine driven pump. The pumps are not operated simultaneously. The capacity of Cornell Pump Station is 22.3 cfs if pumping west, and 19.2 cfs if pumping east.

This pump station is operated with check valves to maintain the difference in hydraulic gradient required to move water east or west, keeping the pump discharge from entering the suction side of the pump. When pushing water to the east, a motor-operated valve is closed in Argos Street. **Figure 4-2** shows the valves that separate the suction and discharge sides of the pump station.

The design and operation of Cornell is such that discharge pressure is limited to 1250 feet, with an override to maintain constant suction pressure. The minimum discharge gradient is 1210 feet (east or west), with a minimum suction gradient of 1165 feet.

The various check valves and closed valves that prevent recirculation of water when Cornel Pump Station is operating are shown in Appendix I.

District Identified Problems/Deficiencies:

- *Isolation of the station is very labor-intensive due to the lack of automated valves.*
- *Low suction pressures are experienced at Seminole, JBR and Agoura Pump Stations when Cornell is pumping east.*

4.1.4 Las Virgenes Reservoir, Pump Station and Filtration Plant

Las Virgenes Reservoir is a very important facility, as it provides both seasonal and emergency storage capabilities. This storage allows LVMWD to purchase water from MWDSC in the winter and store it for summer. The storage capacity for this reservoir is 9500 acre-feet. Pertinent operational and design values are shown below in **Table 4-2**. More detailed statistics can be found in Appendix.

Table 4-2
Westlake Reservoir Storage Data[8]

Water Level	Water Surface Elevation	Storage (AF)	Refill Volume (AF)
High Water	1048	9500	none
Typical Year Minimum[8]	1020	6500	3000
Normal Operating Minimum	1002	3600	5900
Extreme Minimum (emergencies only)	950	600	8900

In order for Las Virgenes Reservoir to receive water for re-filling, Equestrian Trails Tank must be at a designated high water level. There is a "dump valve" that is programmed such that it is only open when the water in the tank is at this level. With an elevation that is lower than Equestrian Tank, Morrison Tank fills first, then is taken off the system by an altitude valve. In conjunction with the dump valve, there is a pressure-sustaining valve, that maintains a minimum gradient throughout the system, generally set at 1180 feet.

When water is removed from Las Virgenes Reservoir and added into the system, three engine-driven pumps are used to deliver the water to the treatment plant. After treatment, three additional pumps deliver it to the 1235 zone. This filtration plant was designed to operate with lake elevations between 1002 and 1048 feet (normal levels). This

[8] This is to be re-evaluated as part of this study. Historical storage criteria is from previous versions of master plan and is re-evaluated as part of this update.

pump station has the capability to operate at levels as low as 950 feet, but efficiency is greatly affected (about 30% reduction).

The Las Virgenes Reservoir Filtration Plant currently operates with ten filters, with the possibility of an additional two. The nominal capacity (with one filter out of service at a time) flow rate is 15 MGD, with a rated capacity of 16.7 MGD. However, the sustained capacity is significant less – approximately 13 MGD. If the station is furnished with the additional two filters, nominal capacity will be increased to 18 MGD and rated capacity to 20 MGD.

District Identified Problems/Deficiencies:

- *Changing air quality regulations raise concerns about maintaining the required permits for the current engine-driven pumping system. An alternative method of pumping may be needed.*
- *Seasonal storage at Las Virgenes Reservoir is currently limited by the District's ability to refill the reservoir during the winter. Because of MWDSC's "Capacity Charge," the water must be purchased mostly during the period of October through April. The District's ability to refill the reservoir is limited by current pipeline capacity in moving water from east to west, while concurrently meeting customer demands.*
- *Currently, the District draws about 3000 AF/year from the reservoir, but the potential exists to draw as much as ,000 AF/year, provided that timely refill is assured. 5000 AF is considered the practical limit for seasonal storage at the reservoir, since the water quality is rather poor below that point (elevation 1020 feet), and the economic advantage of purchasing MWDSC water in the wintertime is offset by the additional cost of treatment. The pumps also lose efficiency the lower the water level drops.*
- *As identified during previous capacity tests, flow meters for the filtered water pumps may not read flows correctly. Meters were installed in short lengths of pipe that may not meet the meter manufacturer's specifications. The District has particular problems with meter readings when Pumps No. 1 and No. 2 are run simultaneously.*

- *The District has measured pressures as low as 25 psi on Grand Oaks Boulevard (suction side of Three Springs Pump Station) when Las Virgenes Reservoir is refilling.*

- *The 36" inlet/outlet pipeline to the Westlake Filtration Plant and Pump Station is in an easement through backyards of homes along Three Springs Drive.*

4.1.5 Calabasas Tank, Equestrian Trails Reservoir, and Morrison Tank

These three tanks work together to provide the necessary storage for the 1235-foot zone. Equestrian Trails (1227' HWL) and Morrison (1212' HWL) act as one tall tank based on their elevations. This allows the gradient to vary somewhat, while still maintaining storage. The storage for Equestrian Trails Reservoir is 4.2 MG and Morrison Tank can store 3 MG. Equestrian Trails Reservoir is the only covered concrete reservoir in the system, and is partially buried.[9] Calabasas Tank (1235' HWL) is at a higher elevation than Equestrian Trails and Morrison, due to a gradient that is generally higher.

District Identified Problems/Deficiencies:

- *Persistent structural concerns exist at Equestrian Trails Reservoir. Columns and footings exhibit alkali-silica reactivity. Annual inspections are needed.*

- *Low tank levels occur in summer, but are not as severe since the installation of the new 42-inch pipeline east of Las Virgenes Road.*

- *A larger pipeline to Morrison Tank will be needed if the Recycled Water Supplement Facility is to be used at its capacity.*

- *It is difficult to cycle water in Morrison Tank during winter months due to the hydraulic gradients that keep the tank near full.*

- *Calabasas Tank may require recoating, as it has been nearly 20 years since the last inspection. Equestrian Trails is occasionally empty in summer mornings, indicating gradients in the area*

[9] Lower Oaks Tank is also concrete, covered, and partially buried, but unlike Equestrian, it is constructed as a circular tank.

below are 1193 feet. Equestrian Trails Reservoir had previous problems with bearing pads under the roof girders, yearly inspection is recommended.

During Las Virgenes Reservoir refill, when Cornell pumps westward, demands are low. This raises gradients near Morrison Tank, above its high water level, closing its altitude valve. This results in Morrison being offline for extended periods, raising concerns about water stagnation. Past nitrification tests found potential for problems.

- *In the Monte Nido area, the distribution pipelines cannot supply fire flows meeting current standards. However, the system in Monte Nido was designed and constructed many years ago and did meet the fire flow requirements that applied at the time. (It is common to have areas within water systems that don't meet current fire flow standards. Water utilities are not obligated to upgrade such areas.)*

4.2 Woolsey Canyon and Box Canyon Systems

Neither Woolsey Canyon nor Box Canyon receive water from LVMWD, and are the only two systems that operate in this manner. Woolsey Canyon receives water from Ventura County Water Works District No. 17 (VCWWD #17), while Box Canyon receives water from the City of Simi Valley. These two systems have a small number of customers. The areas that these two systems supply lie on the western side of the San Fernando Valley, in the hills. Storage in the Upper Woolsey Tank is 0.5 MG.

The delivery gradient from VCWWD #17 to Woolsey Canyon is a maximum of 2129 feet. The high water level for storage in Upper Woolsey Tank is 1845, so pressure regulators are used. The filling of the tanks is determined by tank level and time of day and is operated by a control valve.

The water is delivered to the Box Canyon system at a maximum gradient of 1326 feet from the City of Simi Valley. This water serves few homes in the area, and the rest of the service is provided by the 30-inch conduit from the LV-1 turnout.

In a 1991 seismic analysis of the LVMWD storage tank, it was determined that the Upper Woolsey Tank should not be operated to its full capacity. It was recommended that the control valve setting be adjusted such that the water level in the tank remains below 19 feet. It was also recommended to anchor the tank to bedrock with grouted rock bolts in order to retain the full capacity of the tank.

District Identified Problems/Deficiencies:

- *Unsecured supply from VCWWD #17 remains an issue. Supply has been interrupted due to problems with the pump stations that pump water from Simi Valley.*
- *The connections to VCWWD #17 and the City of Simi Valley were intended to be temporary, and the agreement allows VCWWD #17 to cancel, with one-year notice.*
- *There is no backup supply for Woolsey Canyon, and a few houses in Box Canyon.*
- *Past nitrification tests indicated a problem in Upper Woolsey Tank.*

4.3 Twin Lakes (1585-foot Zone) and LV-3 Turnout

The Twin Lakes System is isolated from the rest of the main LV System. The water for this and Upper Twin Lakes zones is delivered by the LV-3 turnout. There is also an emergency connection to Los Angeles Department of Water and Power, due to the isolation. The pump station is being upgraded to design capacity of 2500 gpm. This will be accomplished with the use of four 100 HP pumps and one 75 HP pump. The pump station also will have an additional 75 HP pump on standby. The Twin Lakes system has two tanks, the smaller tank has storage capacity of 0.4 MG and the larger has 1.6 MG of capacity. This system also provides flow to the Upper Twin Lakes System and future Deerlake Ranch Hydropneumatic System.

District Identified Problems/Deficiencies:

- *Pump Station Expansion is underway to serve new developments in the area.*
- *A source of supply is needed when MWD service is not available. The plan is to construct an emergency supply*

pipeline from the 30-inch conduit to the pump station. This project is also underway.

- *The emergency intertie with LADWP does not have a check valve which may have resulted in water back flow following the Northridge Earthquake. This problem will be eliminated once the pipe is connected to the 30-inch conduit.*
- *When operating with MWDSC, suction head will be reduced by about 100 feet. Relocating the LV-1 Turnout to West Valley Feeder No. 2 would solve the problem.*[10]
- *Deterioration of water quality sometimes occurs due to low velocities in large pipes in far reaches of the system, such as the main in Comanche Trail.*
- *Access road to the tank is not paved, and sometimes difficult to traverse.*
- *Vandalism at the tank and pump station has been a problem.*

4.3.1 Upper Twin Lakes System (1805-foot Zone)

The Upper Twin Lakes System receives water from the Twin Lakes system and has two 35 HP pumps (one duty, one standby). Nominal capacity is 400 gpm with one pump operating. A 0.385 MG tank provides storage capacity at Upper Twin Lakes.

District Identified Problems/Deficiencies:

- *No particular problems were identified.*

4.4 Jed Smith / Mountain Gate System (1420-foot Zone)

The Jed Smith System serves the Mountain View Estates development and much of the City of Hidden Hills, located in the upper Las Virgenes Valley. The water for this system is pumped from the 1235-foot zone to the pair of Jed Smith Tanks. One tanks has 0.63 MG of storage, and the other has 0.55 MG of storage.

[10] This also requires that portions of the 30-inch conduit be upgraded to withstand higher pressure.

This system has two pump stations, Jed Smith and Mountain Gate. Jed Smith has three 100 HP pumps, providing 1700 gpm of capacity. One pump acts as a standby unit. The Mountain Gate Pump Station has two 40-HP duty pumps, with the capacity to deliver 1000 gpm together.

District Identified Problems/Deficiencies:

- *Problems have been experienced supplying peak demands. These problems have been somewhat relieved by pump and pipeline upgrades in the last 6 years, but additional upgrades may be needed.*
- *The Jed Smith Tank capacity does not meet District criteria.*
- *Fire flows may not meet current standards in certain areas, such as Hidden Hills, but were installed based on standards that existed when developments were built.*
- *LV staff have expressed concerns about the reliability of the electrical supply at Mountain Gate Pump Station.*
- *There is no redundancy for the Mountain Gate pumps. If one pump is inoperable, it is not possible to run all three Jed Smith pumps due to pressure restrictions.*

4.5 Warner / Cold Canyon (1640-foot Zone)

This zone provides flow to two other zones: Oak Ridge and Stunt Road / Saddle Peak. The zone is located south of the Ventura Freeway to the Mulholland Highway and Stunt Road intersection. Warner and Cold Canyon Pump Stations pump from the 1235-foot zone into the two Warner Tanks with a system gradient of 1640 feet. Warner Pump Station is located just south of Calabasas Tank and Cold Canyon Pump Station lies near the intersection of Mulholland Highway and Cold Canyon Road.

There currently are three duty pumps at Warner, with capacity to install a fourth pump. Of the existing pumps, there are two 100-hp units and one 200-hp unit. The total capacity with all three pumps in operation is 2840 gpm. At Cold Canyon are three 100-hp pumps, one of which acts as a standby. Capacity at Cold Canyon is 1000 gpm.

The Warner System supplies the Oak Ridge and Stunt Road/Saddle Peak systems, which are at higher elevations. The system is operated such that Cold Canyon Pump Station is turned on when Stunt Road Pump Station turns on. Cold Canyon will also turn on to maintain water level in Warner Tanks, as does Warner Pump Station. The pressure regulating station at Oak Ridge aids fire flows in the Warner System at higher elevations near the Oak Ridge Pump Station.

Warner also supplies the McCoy System through pressure regulation stations. These stations are located in Park Granada, Park Belmonte, and Parkway Calabasas. Also by pressure regulating station, Mulwood is supplied by Warner. This station is normally on and can be turned off manually if needed.

The Warner Tanks have a combined storage capacity of 2.5 MG, with one 2.0 MG tanks and one with 0.5 MG of capacity. Warner also supplies a maximum of 1200 gpm to the recycled water system. This potable supplement is furnished to Cordillera Tank when demands exceed supply for recycled water.

District Identified Problems/Deficiencies:

- *"Smitty's Line" (10-inch line) continues to be a reliability concern, but serves very few customers.*
- *Demands on the Warner System have increased significantly. Through various PRVs Warner supplies parts of the Mulwood and McCoy zones. The flows at these PRVs are significant during periods of high demands.*
- *The surge tank at Warner may be small for the current size of the system. The pump control valves may suffer damage as a result. (This problem will be investigated when the pump station is upgraded as proposed later in this report.)*

4.5.1 Oak Ridge System (1826-foot Zone)

The Oak Ridge System is supplied by Warner Tanks. At the Oak Ridge Pump Station are two pumps, one duty and one standby, which transfer water to the Oak Ridge Tank. Each pump is 20 HP, and combined can provide a capacity of 260 gpm. The Oak Ridge Tank provides 0.32 MG of storage. This zone operates with a gradient of

1826 feet, delivering water to a small group of homes on the Southeast corner of Calabasas, near the Mulholland Highway.

District Identified Problems/Deficiencies:

- *Low suction pressures sometimes occur at the pump station. Pressure drops as much as 30 psi during peak summer months.*

4.5.2 Stunt Road / Saddle Peak System (2513-foot Zone)

Similarly to Oak Ridge, the Stunt Road Pump Station receives water from the Warner Tanks with one duty and one standby pump. This zone is located in the southeast corner of the District. This area is the District's highest zone (with a gradient of 2513 feet), so the pumps are 225 HP each, with a pump station capacity of 550 gpm. The Saddle Peak Tank contains 2.25 MG of storage capacity, and serves a large, very rugged area.

District Identified Problems/Deficiencies:

- *The pressure on the suction side of the pump station is low, causing the inability to run pumps during peak summer months in early morning hours.*
- *Nitrification may be an issue in this tank due to long periods of inactivity.*
- *Problems have occurred with line breaks in the area. Corrosion and earth movement have been problems on certain pipelines.*
- *Flow into District 29 and flows during Fire Department training exercises have led to short-term pressure complaints.*

4.6 McCoy System (1475-foot Zone)

The McCoy System receives a majority of its water from the 1235-foot zone, but can also receive water from the Warner System through pressure regulating stations. The McCoy Pump Station delivers water to the lower residential areas along Parkway Calabasas. This pump station uses three 125 HP duty pumps. The pump station has no standby pump, but is backed up by the pressure reducing stations. The water is pumped from the 1235-foot zone to a single tank with a capacity of 2 MG. The McCoy System supplies flow to the pump station that feeds Upper and Lower Oaks tanks.

District Identified Problems/Deficiencies:

- *No particular problems were identified.*

4.6.1 Lower Oaks System (1616-foot Zone)

The Lower Oaks System serves approximately 317 homes in the New Millennium development near the end of Parkway Calabasas Road. The water for this zone is pumped from the McCoy system. The capacity of the Lower Oaks Pump Station is designed to be 640 gpm with the use of two 40 HP duty pumps with a third pump for standby. The tank capacity of the Lower Oaks System is 1.0 MG.

District Identified Problems/Deficiencies:

- *Current consumption exceeds original design.*

4.6.2 Upper Oaks System (1753-foot Zone)

Upper Oaks System provides water to 55 residences. These homes are located in the New Millennium development near the end of Parkway Calabasas Road. These homes require a slightly higher gradient than the homes served by Lower Oaks System. This zone has a pump station that utilizes 400 gpm capacity from two 25 HP pumps, one duty and one standby. The Lower Oaks and Upper Oaks Pumping Facilities are housed in a single building. A 0.26 MG tank supplies storage capacity for this pressure zone. The Upper Oaks system also contains a potable water supplement to the recycled water system.

District Identified Problems/Deficiencies:

- *Pump output is significantly less than planned.*
- *Current consumption significantly exceeds original design.*

4.7 Mulwood System (1450-foot Zone)

Mulwood operates in a similar manner to McCoy, in that the water mostly is pumped from the 1235 zone, but has the capacity to receive water by PRV from Warner. The Mulwood Pump Station is located on Old Topanga Canyon Road, near Calabasas High School. This pump station has two duty pumps, each 50 HP, providing 1000 gpm of capacity. The Mulwood PRV is designed to act as a backup pump. The Mulwood System provides water to the Dardenne System. The Mulwood Tank provides 1.6 MG of storage for the system.

District Identified Problems/Deficiencies:

- *Demands exceed the pump station capacity during summer months; the pump station operates 24 hours per day. Mulwood PRV was intended to act as a third pump; however, it is operating every day during summer peaks.*
- *There is a large suction pressure drop (15 psi) on the suction side of the pump.*
- *Low suction pressures have been frequent at Dardenne Pump Station, even with both pumps running at Mulwood and the pressure regulating station running.*

4.7.1 Dardenne System (1618-foot Zone)

The Mulwood System feeds the Dardenne System. The capacity for storage in the Dardenne Tank is 0.5 MG. The pump station in this system has two pumps; one duty and one standby, each are rated at 40 HP. With only one pump in operation, the capacity at this station is 250 gpm. There is a small subdivision at the top of Dardenne and Cairnloch Streets in the City of Calabasas that is served by the Dardenne System.

District Identified Problems/Deficiencies:

- *Low suction occurs during morning peak operating hours.*

4.8 Hydropnuematic Systems

There are two independent hydropneumatic pumping facilities in the LVMWD system. Agoura Pump Station and JBR Pump Station draw water from the 1235-foot zone. Another Hydropneumatic facility, Deerlake Ranch PS (which will be developer funded), has been designed but is awaiting construction. Hydropneumatic Stations operate differently than the rest of LVMWD, in that they do not work against water in an elevated, open tank. They operate with a small, pressurized tank that is generally located at the pump station. The hydropneumatic tank acts as a flow buffer, reducing the number of pump cycles. To provide fire flows in times of power outage, an engine driven pump or generator is required, unless flow can be provided by gravity bypass.

4.8.1 Agoura Pump Station System (1350-foot Zone)

There are two 15 HP duty pumps at Agoura Pump Station, providing 500 gpm. There is also one 75 HP, electrically driven, pump that is dedicated to fire flows that can provide an additional 1000 gpm to the system. The coverage area for the Agoura System is above Balkins Drive in the City of Agoura Hills.

District Identified Problems/Deficiencies:

- *Low suction pressures are common when Cornell is pumping east, particularly when Equestrian Trails Tank is empty.*
- *The bladder tank has failed several times.*

4.8.2 JBR Pump Station System (1240-foot Zone)

JBR Pump Station operates similarly to Agoura Pump Station, in that there is one 75 HP (natural gas powered) pump dedicated to fire flows (1250 gpm). The duty pump for this system is one 10 HP pump that provides up to 280 gallons. This pump station has the ability to receive water, without pumping, from the 1235 zone if the gradients are high. A check valve assures that water does not flow back into the 1235 zone while the pump is in operation.

District Identified Problems/Deficiencies:

- *Low suction alarms have occasionally occurred during peak summer months (generally a 15-30 psi drop).*
- *Suction pressure problems occur when Equestrian Trails Tank is empty; this occurs in particular, when Cornell is pumping east.*

4.9 Kimberly System (1517-foot Zone)

The Kimberly System draws water from the 1235 zone. The system serves the northeast corner of Agoura Hills. The pumping station consists of two duty pumps and one standby pump. All three pumps are rated at 30 HP and the pump station capacity is 333 gpm. The Kimberly Tank has storage capacity of 0.47 MG.

District Identified Problems/Deficiencies:

- *Large pressure drops (generally 25-30 psi) occur on the suction side of the pump station during peak summer months.*

4.10 Seminole System (2153-foot zone)

The Seminole System is the highest lift zone in the District, located in the southwest corner. The Seminole System also delivers water to the Latigo and Three Springs Systems with the use of pressure reducing stations. The Seminole Pump Station is located on Mulholland Highway, west of Malibu Lake. Due to the large head requirements, there are three 300 HP motors, two duty and one standby. The capacity of this pump station is 1600 gpm. There are two tanks in the Seminole System, one that has 0.5 MG capacity and one with 1.5 MG capacity.

District Identified Problems/Deficiencies:

- *Seminole Pump Station is unable to keep up with demand during peak summer months. Consecutive days of tank depletion have been noted.*
- *There are large pressure drops at the top of Latigo Canyon when Latigo Tank is refilling through Ramera Ridge PRV.*
- *There are many long, dead-end pipelines, causing water quality and reliability concerns.*

- *A pipeline at Malibu Golf Course is 60 feet deep. This will be fixed if the Decker Project is built.*
- *Low suction pressures occur at the pump station when Cornell is pumping east.*
- *Pipe corrosion and earth movement problems have occurred in this subsystem. Above the golf course, portions of the pipe are exposed.*

4.10.1 Latigo System (1775-Foot Zone)

The Latigo System contains no pumping facilities; water is delivered from the Seminole System through the Ramera Ridge PRV. Latigo does however, have a tank with a capacity of 1.5 MG. This system serves customers near Malibu.

District Identified Problems/Deficiencies:

- *There are many long, dead-end pipelines, causing water quality and quantity concerns.*
- *There may be nitrification problems within the system.*

4.10.2 Three Springs System (1425-foot Zone)

The Three Springs System has the ability to receive water from multiple sources. At lower flows the Westlake Boulevard Pressure Regulating Station feeds the system from the Seminole System. At higher flows, there are two 10-HP pumps that draw from the 1235 zone. The capacity of this pump station is 320 gpm. The operation of this system allows the use of no tank, but an operating scheme as follows:

1. For small flows, up to 25 gpm, water is supplied by Westlake Boulevard PRS. This PRS also measures the flow rate.
2. When flow surpasses 25 gpm, the lead pump is turned on. The pump operates at a pressure that is slightly higher than that of the PRS, so the PRS is inoperable.
3. When demand causes a significant pressure drop, the PRS opens to again maintain pressure.

4. When flow reaches 80 gpm, the lag pump turns on.
5. If demands increase further, a 3-inch bypass at the PRS opens.
6. For excessively high demands, a valve on the 8-inch main near the PRS will open. The purpose of this valve is for fire flows. The operators receive an alarm notification if maximum flow occurs on the 3-inch bypass.
7. As flows are reduced, the system operates in reverse: lag pump turns off at 75 gpm and the lead pump turns off at 25 gpm.

District Identified Problems/Deficiencies:

- *Peak flow exceeds design flow during summer months. Demand exceeded predicted level of 247 gpm to 600+ gpm.*
- *Pressure drop is seen during peak usage.*
- *A tank may be needed for the Three Springs System.*
- *Three Springs PS has had low suction pressure cutouts when Westlake is being filled.*

4.11 Saddletree System (1420-foot Zone)

There is a small residential area at the top of Saddletree Road in Westlake Village that is served by the Saddletree System. The water for this system is pumped from the 1235 zone by two 15 HP duty pumps. This pump station has the ability to pump up to 330 gpm to Saddletree Tank, which has a storage capacity of 0.28 MG.

District Identified Problems/Deficiencies:

- *No particular problems were identified.*

4.12 Ranchview System (1302-foot Zone)

The Ranchview system serves approximately 84 homes on the west side of Las Virgenes Road, 0.5 miles north of the Ventura Freeway. This system is fed from the 1235-foot zone. The pump station has been designed to run off-peak, with a design capacity of 400 gpm. This is accomplished with two 25 HP pumps, one duty and one standby. The Ranchview Tank has a capacity of 0.32 MG of total storage.

District Identified Problems/Deficiencies:

- *No particular problems were identified.*

4.13 Pressure Regulating Stations

Pressure regulation stations are integral parts of the LVMWD system. These stations provide capacity, redundancy and reliability to the system. These stations decrease the amount of pump stations that are required by allowing two or more different pressure zones to be supplied by a single pumping station. There are 75 pressure-regulating stations in operation. In some particular instances, the District will provide pressure reduction valves at individual service connections (on the District-side) instead of having a pressure reduction in the main.

4.14 Pipelines

The potable water system has pipes of varying degrees of ages. Most of the major facilities have been constructed after 1963. When the original Master Plan of the District's system was devised, most of the pipe would be considered to be relatively young. Some developments however are much older and pipes in these areas are smaller and were designed with different criteria. Specifically fire flow requirements have increased since these buildings were constructed (some as old as the 1930's). Examples of these older areas are Hidden Hills and Monte Nido.

LVMWD Report No. 2358, "Distribution System Performance," July 2006 provides an assessment of these existing assets with recommendations for annual rehabilitation and replacement.

There are nearly 400 miles of pipelines that are 4 inches or greater in size. The largest of these lines are tabulated below:

- 24-inch in Las Virgenes Road
- 24 inch in Triunfo Canyon Road
- 36-inch connecting Westlake Reservoir and Pump Station to West Side of System
- 42-inch from LV-2 to Warner PS, along the Ventura Freeway
- 30-inch from LV-2 to Calabasas Tank
- 30-inch from Calabasas Tank to Cornell PS
- 24-inch from Cornell to system to west

Section 5

Demand and Peaking Factors

Future demands are estimated based on land use maps and consumption rates for various uses. As land is conserved for parks and open space, the estimated demand at build-out has declined.

The current and projected future demands are the most significant factors in the evaluation of the system. As discussed in the 1999 Master Plan, growth rates have declined from what was previously expected. There are many factors contributing to the developmental decline. Large portions of land in the LVMWD service area are now publicly owned or dedicated as open space, eliminating the possibility of future development, and much of what is left undeveloped is very difficult to develop. Reassessment of demands is necessary to fully evaluate the impacts of future development on the potable water system.

Ultimate demand in the District was projected based on an evaluation of existing usage, planning data and land use maps for the various areas within the District. Overall District population expectations have declined since the 1999 Master Plan.

For the most part, the basis for demand and population estimates used in this report is *Potable and Recycled Water Master Planning Demand Forecasts*, LVMWD Report No. 2340.01, March 2007, by Psomas. (This will be referred to as the "Psomas Report.") Other sources were also used, where more detailed analysis had been performed. These were:

- *New Millennium Development, Water System Design Report Addendum*, LVMWD Report No. 2130.01, August 2001, by Boyle Engineering Corporation. This was used for the Upper Oaks and Lower Oaks Zones.

- *Jed Smith / Mountain Gate Subsystem Demand Analysis*, LVMWD Report No. 2202, June 2004, by Boyle Engineering Corporation.

- *Malibu Terrace Development, Water System Design Report*, LVMWD Report No. 2045, May, 1998, by Boyle Engineering Corporation. This was used for the Ranchview Zone.

- *Preliminary Design Report, Twin Lakes Pump Station Expansion*, LVMWD Report No. 2247, January 2005, by Boyle

Engineering Corporation. This was used for the Twin Lakes, Upper Twin Lakes, and (future) Deerlake Ranch zones.

In several cases, the demand forecasts of the 1999 Master Plan and the Psomas Report were compared, and judgment was applied to arrive at conservative but realistic estimates.

The planning period for this Master Plan is through the year 2030. This is merely a point of reference. The year when buildout is achieved is not possible to predict.

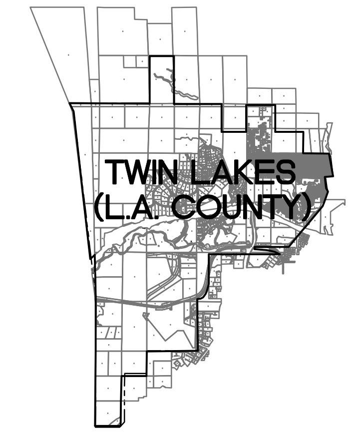
Long-term accuracy of the existing and available planning and land use documents are highly influential on the demand projections deduced in this Master Plan. When planning agencies such as Counties or Cities make significant revisions to general plans, population projections or land use maps, the projected potable water demands can be highly impacted. Master plans should be revised approximately every five to ten years to reflect those changes.

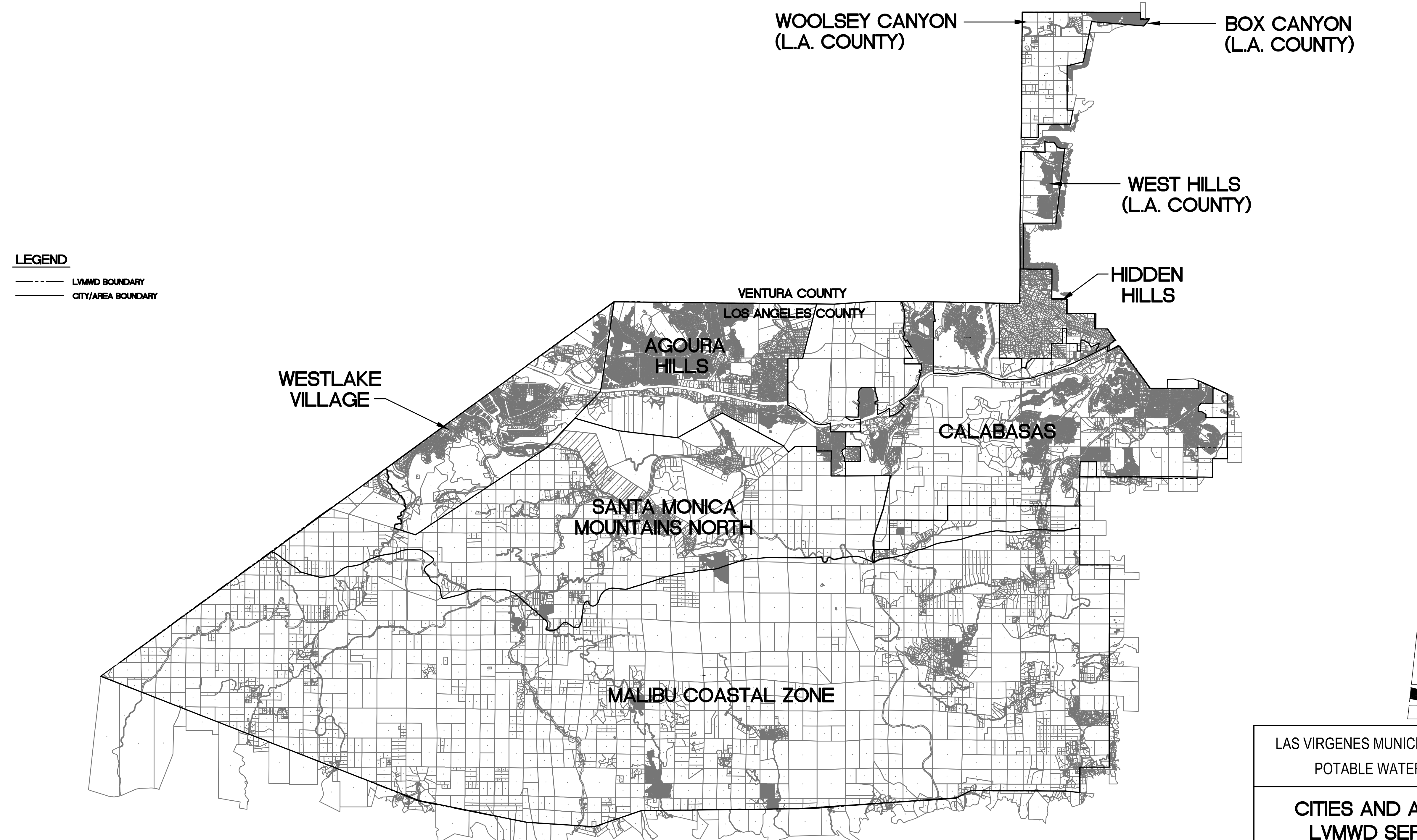
5.1 Land Use

The service area of Las Virgenes Municipal Water District is comprised of four main cities in addition to unincorporated areas of Los Angeles County. These four main cities are Agoura Hills, Calabasas, Hidden Hills and Westlake Village. Unincorporated portions of Los Angeles County can be characterized as the following: Box Canyon, Malibu Coastal Plan area, Santa Monica Mountains North area, Twin Lakes, Westhills, and Woolsey Canyon. These areas can be seen in **Figure 5-1**. Each area has unique features such as population, development, and demand characteristics. Certain developments contain large irrigated acreages or estates and some contain more densely populated areas, largely impacting demand and peaking factors, and other areas are at or nearing current design capacities. Each area was evaluated separately to determine the specific demand factors for both existing and potential future potable water systems.

The most current land use areas are detailed in **Plate 4**. The land use designations for each area were derived, from the District's GIS, which had taken the information from general plans and land use maps. A description of each city or area is provided in the following sections.

LAS VIRGENES
MUNICIPAL WATER DISTRICT





LAS VIRGENES MUNICIPAL WATER DISTRICT POTABLE WATER MASTER PLAN		
CITIES AND AREAS WITHIN LVMWD SERVICE AREA		
23016.00	JULY 2007	FIGURE 5-1

BOYLE ENGINEERING CORPORATION

DWG: h:\mills\l0217104\cybernet\backup\city-boundaries User: frizzo Job #: VTL0217104
Time: 12-22-99 2:47:13 PM XRef Files: basemap_no-data

5.1.1 City of Westlake Village

The City of Westlake Village is located at the western edge of the District's service area, bordering Ventura County. The land use designations of Westlake Village and associated densities (dwelling units per acre) are presented in **Table 5-1**.

Table 5-1
City of Westlake Village Land Use Designations

Category	Description	Density (DU/acre)
R-LD	Low Density	0 - 0.4
R-MD	Medium Density	4.1 - 7.0
R-ID	Intermediate Density	7.1 - 10.0
R-HD	High Density	10.1 - 18.0
R-VHD	Very High Density	18.1 - 25.0
R-MH	Mobile Home Residential	
GC	General Commercial	
CR	Commercial Recreation	
OC	Office Commercial	
BP	Business Park	
PU	Public	
SC	Schools	
PU	Park	
IN	Institutional	
OS	Open Space	
C	Cemetery	

Note: From City of Westlake Village General Plan, July 14, 1993.

5.1.2 City of Agoura Hills

The City of Agoura Hills is located on the northern border of the District service area, between the Cities of Westlake Village and Calabasas. These land use designations and associated densities (dwelling units per acre) are shown in **Table 5-2**.

Table 5-2
City of Agoura Hills Land Use Designations

Category	Description	Density (DU/acre)
RR	Rural Residential	0.05 - 0.2
RV	Very Low Density	0.2 - 1
RL	Low Density Residential	1 - 2
RS	Single Family Residential	2 - 6
RM	Medium Density Residential	6 - 15
RH	High Density Residential	15 - 25
CS	Shopping Center Commercial	
CV	Commercial - Visitor Serving	
CG	Retail Service Commercial	
BP-O/R	Business Park Office Retail	
BP-M	Business Park Manufacturing	
OS-R	Open Space-Restricted	1 DU/acre
OS-R/DR	Open Space Restricted/Deed Restricted	
P	Local Park	
PR	Regional Park/Recreation	
CR	Recreational Commercial	
OW	Open Water	
PF	Public Facility	
T	Transportation	

Note: PF includes City, County, other Government, Post Office, Civic Center, public schools, playgrounds, fire stations.

5.1.3 City of Calabasas

The City of Calabasas lies at the eastern edge of the District's service area and is the location of the District's administrative headquarters. The City's land use designations and associated densities (dwelling unit per acre) that were used for determining demand are shown in **Table 5-3**.

Table 5-3
City of Agoura Hills Land Use Designations

Category	Description	Density (DU/acre)
R-SF	Residential - Single Family	2 - 6
R-MF	Residential - Multiple Family	2 - 16
R-MH	Residential - Mobile Home	2 - 8
B-LI	Business - Limited Intensity	
B-R	Business - Retail	
B-PO	Business - Professional Office	
B-BP	Business Park	
B-OT	Old Town	
MU	Mixed Use	
UH	Urban Hillside	
PF-I	Public Facilities - Institutional	
PF-R	Public Facilities - Recreational	
HM	Hillside - Mountainous	0.1
RR	Rural - Residential	1
RC	Rural - Community	2
OS-R	Open Space - Recreational	1/lot of record
OS-RP	Open Space - Resource Protection	1/160 ac or 1/buildable lot

5.1.4 Santa Monica Mountains North

The land use along the Ventura Freeway corridor north of the Malibu Coastal Zone (Section 5.1.5) was taken from the Santa Monica Mountains North Area Plan, which was adopted October 2000. (The 1999 Master Plan took land use from the draft form of this document.) Previously, this plan was referred to as the Ventura Freeway Corridor Land Use Policy.

The land use designations and densities (dwelling unit per acre) used for demand projections in this area are presented in **Table 5-4**.

Table 5-4
County of Los Angeles – Santa Monica Mountains North Area Land Use Designations

Category	Description	Density (DU/acre)
OS	Open Space	
OS-P	Open Space Parks	
OS-DR	Open Space Deep Restricted	
OS-W	Open Space Water	
N20	Mountain Lands 20	1 DU/20 acres
N10	Mountain Lands 10	1 DU/10 acres
N5	Mountain Lands 5	1 DU/5 acres
N2	Rural Residential 2	1 DU/2 acres
N1	Rural Residential 1	1 du/acre
U2	Residential 2	2
U4	Residential 4	4
U8	Residential 8	8
C	Commercial	
CR	Commercial Recreation - Limited Intensity	
P	Public and Semi-Public Facilities	
TC	Transportation Corridor	
TC	Specific Plan	
SEA	Significant Ecological Areas	

5.1.5 Malibu Coastal Zone

Land use in unincorporated Los Angeles County within the Malibu Coastal Zone was taken from the Malibu Local Coastal Plan Land Use Plan, as prepared by the California Coastal Commission on September 13, 2002. Land use designations and densities (dwelling units per acre) that were used as a basis for determining demand within the Malibu Coastal Zone boundary are summarized in **Table 5-5** below.

Table 5-5
County of Los Angeles – Malibu Local Coastal Zone
Land Use Designations

Category	Description	Density (DU/acre)
RR1	Rural Residential 1	1 DU/1 acre
RR2	Rural Residential 2	1 DU/2 acres
RR5	Rural Residential 5	1 DU/5 acres
RR10	Rural Residential 10	1 DU/10 acres
RR20	Rural Residential 20	1 DU/20 acres
RR40	Rural Residential 40	1 DU/40 acres
SFL	Single Family - Low	0.25 - 2
SFM	Single Family - Medium	2 - 4
MHR	Mobile Home Residential	
MF	Multi-Family Residential	
PRF	Private Recreational Facilities	
CR	Commercial Recreation	
OS	Public Open Space	
RVP	Recreational Vehicle Park	
PD	Planned Development	
CG	Commercial General	
CV	Commercial Visitor Serving	
CC	Community Commercial	
CN	Commercial Neighborhood	
I	Institutional	

Note: I includes City, County, other Government, Post Office, Civic Center, public schools, fire stations, religious buildings.

5.1.6 Los Angeles County

The unincorporated portions of Los Angeles County that are north of Hidden Hills, including Twin Lakes, Woolsey Canyon, Box Canyon and West Hills are covered in the County of Los Angeles General Plans. The land use designations and densities used to determine demand factors in unincorporated Los Angeles County are shown in **Table 5-6**.

Table 5-6
County of Los Angeles – Twin Lakes, West Hills, Woolsey Canyon, etc., Land Use Designations

Category	Description	Density (DU/acre)
1	Low Density Residential	6
2	Low/Medium Density Residential	12
3	Medium Density Residential	22
4	High Density Residential	22+
C	Major Commercial	
I	Major Industrial	
P	Public and Semi-Public Facilities	
R	Non-Urban	
O	Open Space	
SEA	Significant Ecological Area	
SP	Specific Plan	

5.2 Population Projections

Population projections have declined since the 1999 Master Plan as shown in **Figure 5-2**. This Master Plan uses data provided in *Potable and Recycled Water Master Planning Demand Forecasts* (Psomas, March 2007, LVMWD Report No. 2340.01). The LVMWD Master Plan of 1989 projected a total buildout population of 135,600 at the year 2020 and the 1999 Master Plan projected a population of 112,930 at the same year. Based on the Psomas report, the new projected buildout population is approximately 90,000, at year 2030. Also, the location of growth in the District has changed.

For the most part, large developments of 100 homes or more are a thing of the past in the District. Future growth will more likely take the form of in-fill development involving only a few parcels. Much of the population growth will result from an increase in density along the 101 Freeway, with multi-family residential units often replacing single-family units. However, much of the growth in water demands will occur in the southern portion of the District (particularly the Saddlepeak, Seminole, and Latigo Zones), where development is sparse and densities will remain low (one residence for every 5 to 40 acres), but steady development could eventually result in large demands.

Exceptions, where large developments are still possible are:

- **Deerlake Ranch**: a development of approximately 325 homes, in the northeast corner of the District, has been approved by Los Angeles County. Construction is expected to start fairly soon.
- **Lady Face:** A rugged area on the south side of Lady Face Mountain, south of Agoura Hills, has a development potential of perhaps 100 homes.
- **Udell:** A similarly rugged area south of Agoura Hills, east of Lady Face Mountain, has a development potential of approximately 50 homes.
- **Kittridge:** A proposed development of 30 homes, in the West Hills area, for which a preliminary water system design report was prepared last year.
- **Upper Agoura:** An area along the Ventura County boundary, with a development potential of approximately 50 homes.
- **Southern Woolsey:** This area, south of Woolsey Canyon, has a development potential of up to 500 homes, but difficult topography will likely result in many fewer homes.

Table 5-7 displays the population projections for each geographic location throughout the District.

Table 5-7 Population Projections by Location from Potable and Recycled Water Demand Forecasts (Psomas, March 2007, LVMWD Report No. 2340.01)						
Location	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
Agoura Hills	23,445	23,749	24,053	24,357	24,661	24,965
Calabasas	22,664	23,481	24,298	25,115	25,933	26,750
Hidden Hills	2,074	2,106	2,139	2,171	2,203	2,235
Unincorporated Los Angeles County Canoga Park	962	1,106	1,250	1,393	1,537	1,681
Unincorporated Los Angeles County Chatsworth	2,184	3,047	3,191	3,248	3,306	3,364
Unincorporated Los Angeles County West Hills	788	913	1,037	1,162	1,286	1,411
Unincorporated Los Angeles County (excluding Chatsworth, Canoga Park and West Hills)	8,382	10,978	13,575	16,172	18,768	21,365
Westlake Village	8,856	8,897	8,937	8,977	9,017	9,057
LVMWD Service Area Totals	69,355	74,277	78,480	82,595	86,711	90,828

5.3 Historical Demand

Overall, the demand for potable water within the LVMWD service area has increased over the last 35 years, as shown in **Figure 5-3**. A brief decline occurred in 1989 but demands are now at historic highs. In general the demand has not grown as rapidly in the last 15 years as it did in the early history of the District. This is due to a decline in the rate of development and increased customer awareness of conservation. Also, recycled water use has increased, relieving demand from the potable water system. Shown in **Figure 5-4** is the large variation in seasonal demands for the District.

Figure 5-5 shows the history of the monthly peaking factors for LVMWD. This figure shows that the peaking factors for the summer months are significantly higher than for the winter months. Also, the more recent peaking factors are not as high as earlier, but it is impossible to tell whether this reflects a change in usage or the effect of weather.

These variations in demand are important in order to size facilities such as pump stations, pipelines and storage. These facilities must be designed to accommodate Maximum Day Demands and peak hour flows, which generally occur in summer months. Also, the same facilities must accommodate flows that are associated with the refill of Las Virgenes Reservoir in the winter, when demands are generally lower. The refill of Las Virgenes Reservoir is described in more detail in later sections of this Master Plan.

5.3.1 Average Day Demand

In order to calculate the Average Day Demand for the entire LVMWD potable water system, daily flow data were analyzed from the three turnouts, LV-1, LV-2 ad LV-3, as well as Las Virgenes Reservoir Pump Station. For the analysis, the storage tank levels were not taken into consideration, as it is assumed that they are refilled each day. The total demand measured for 2005 was 20,946 acre feet. This results in an average day demand of 57.4 acre-feet per day.

Table 5-8 illustrates the changes in average day demand from 1999 to 2005. It should be noted that not all subsystems existed in 1999, so no comparison is available.

Table 5-8
Comparison of Actual Demands

Subsystem	1999 ADD (gpm)	2005 ADD (gpm)	Change (%)
1235 Zone	8267	8075	-2.3%
Box Canyon	88	45	-48.9%
Dardenne	131	125	-4.6%
JBR/Agoura		49	
Jed Smith	900	925	2.8%
Kimberly	120	104	-13.3%
Latigo	115	118	2.6%
Lower Oaks			
McCoy	1079	895	-17.1%
Mulwood	714	643	-9.9%
Oakridge	71	69	-2.8%
Ranchview		73	

Table 5-8 Comparison of Actual Demands			
Subsystem	**1999 ADD (gpm)**	**2005 ADD (gpm)**	**Change (%)**
Saddlepeak	133	174	30.8%
Saddletree	77	61	-20.8%
Seminole	428	403	-43.2%
Three Springs		105	
Twin Lakes	355	347	-2.3%
Upper Oaks		7	
Upper Twin Lakes		28	
Warner Tanks	442	663	50.0%
Woolsey	67	76	13.4%
Total (gpm)	12,987	12,985	-0.2%
Total (AF)	20,950	20,946	

Demands based on analysis of billing records.

5.4 Peaking Factors

The term "peaking factors" refers to the ratio of one flow to another. Most generally, peaking factors are calculated for Maximum Day Demand (MDD) and Peak Hour Demand (PHD). MDD is the highest total daily demand during the year, and Peak Hour Demand is the highest demand during a single hour. When the peaking factor for MDD is discussed, it is simply the ratio of MDD to Average Day Demand (ADD), where ADD is the total annual demand divided by 365 days. The peaking factor for PHD is likewise the ratio of Peak Hour Demand to MDD.

In general, previous Master Plans used system-wide peaking factors. This version of the updated Master Plan presents the peaking factors based on each subsystem. This is warranted due to the varying topography, populations, and demographics between differing subsystems.

5.4.1 MDD Peaking Factor

Prior Master Plans have calculated and applied a system-wide peaking factor for Maximum Day Demand of 2.1. Statistical analyses were conducted for the 1989 Master Plan to prove that this was a reasonable (and conservative) value. However, with more refined data available

Peaking factors were calculated for the backbone system and six major subsystems representing a cross section of District customers and micro climates.

through the District's SCADA system, a more detailed analysis was possible for this Master Plan. The demand patterns of each subsystem are different. Dwelling type, size, lot acreage and location all play a role in the demand for a pressure zone. For this reason, the analysis used in the Master Plan, provides Maximum Day Demand Peaking Factors that were determined based on usage data, previous Master Plan projections, system design reports and current zoning to apply subsystem specific peaking factors.

In addition to the backbone (1235-ft) system, peaking factors were calculated for six major subsystems. These were: Jed Smith, McCoy, Saddlepeak, Seminole, Twin Lakes and Warner. These systems were selected because they are all relatively large systems, and because they are believed to represent the varying topography, customer base, and climatic zones of the District.

Daily production data were obtained from the District's meter readings at the turnouts, pump stations, storage tanks, and pressure reducing stations throughout the system. These data were analyzed for a one-year period, from October 2005 to September 2006.

System-wide, the maximum demand day for this period was determined to have occurred on July 25, 2006, with a demand of 36.3 MGD. For that year and that specific day, the maximum day peaking factor was calculated as 1.7. However, it should be understood that for planning purposes, a peaking factor taken from a single year's calculation would likely underestimate the peak demands for which the system must be designed. As illustrated earlier in **Figure 5-4**, the demands peaking patterns can vary greatly from year to year. Thus it is recommended that the system-wide peaking factor of 2.1 continue to be used.

For the six subsystems, a similar analysis was performed, and MDD peaking factors were found to vary from 1.4 (near the coast) to 3.2 (inland at Twin Lakes). These factors have been applied in the analysis of the various systems, although it needs to be recognized that these, too, are single-day, single-year calculations, and may vary significantly from year to year.

5.4.2 Peak Hour Demand Peaking Factors

The calculation of peak hour demands is more difficult. It requires that all flows into and out of a system be monitored, calculated, and added together simultaneously. This includes tank levels, pump flows, turnouts, and major PR station flows between zones. Difficulties arise, because the data are often recorded for different time intervals, and tank levels are recorded in 0.1 ft changes, which can often represent large quantities of water.

To determine PHDs for the systems and subsystems, 15-minute flow data was evaluated for peak demand summer days. Rising water levels in tanks were converted to negative demand, and decreasing water levels converted to positive demand. **Table 5-9** describes the flows into and out of certain subsystems.

Table 5-9
Peak Hour Demand Criteria

Subsystem	Inflow	Outflow	Storage Tank
Jed Smith	Jed Smith PS Mountain Gate PS	None	Jed Smith 1: D = 70 ft Jed Smith 2: D = 65 ft
Seminole / Latigo	Seminole PS	Three Springs PRV	Seminole 1: D = 110 ft Seminole 2: D = 52.6 ft Latigo: D = 92 ft
McCoy	McCoy PS Park Belmonte PRV Park Granada PRF	Lower Oaks PS Upper Oaks PS	McCoy Tank: D = 106 ft
Warner	Warner PS Cold Canyon PS	Oak Ridge PS Stunt Road PS Mulwood PRV Park Granada PRV	Warner 1: D = 52.5 ft Warner 2: D = 105 ft

For the 1999 Master Plan, the PHD factor was calculated as 2.5 for all subsystems except Jed Smith, which used 3.3. For this Master Plan, the system-wide PHD factor was calculated as 2.5, with factors for the 6 subsystems varying from 2.15 to 3.5.

Table 5-10 shows the MDD and PHD peaking factors used for analysis of each zone.

Table 5-10 Updated Peaking Factors				
Subsystem	**MDD Peaking Factor**	**PHD Peaking Factor**	**Combined**	**Comments, Sources**
1235 Zone	2.1	2.5	5.3	Calculated
Box Canyon	2.3	2.3	5.3	Estimated per Twin Lakes
Dardenne	1.5	3.5	5.3	Estimated per McCoy
Deerlake Ranch (future)	3.2	2.65	8.5	Estimated per Twin Lakes
JBR/Agoura	1.8	3.5	6.3	Estimated per Jed Smith
Jed Smith	1.8	3.5	6.3	Calculated
Kimberly	1.8	3.5	6.3	Estimated per Jed Smith
Latigo	1.4	3.7	5.2	Estimated per Saddlepeak
Lower Oaks	1.5	3.5	5.3	Estimated per McCoy
McCoy	1.5	3.5	5.3	Calculated
Mulwood	1.5	3.5	5.3	Estimated per McCoy
Oakridge	1.5	3.5	5.3	Estimated per McCoy
Ranchview	1.8	3.5	6.3	Estimated per Jed Smith
Saddlepeak	1.4	3.7	5.2	Calculated
Saddletree	1.5	3.5	5.3	Estimated per McCoy
Seminole	3.4	2.15	7.3	Calculated
Three Springs	1.5	3.5	5.3	Estimated per McCoy
Twin Lakes	3.2	2.65	8.5	Calculated
Upper Oaks	1.5	3.5	5.3	Estimated per McCoy
Upper Twin Lakes	3.2	2.65	8.5	Calculated
Warner Tanks	2.4	3.1	7.4	Calculated
Woolsey	3.2	2.65	8.5	Estimated per Twin Lakes

(1) MDD = Maximum Day Demand

(2) PHD = Peak Hour Demand

5.4.3 Sizing of Storage Facilities for Peak Demands

The demand curve in previous master plans has been simplified such that it was modeled as two constant values, 14 hours of 1.5 X MDD and 10 hours of 0.3 MDD. This assumption was, and still is a reasonable and conservative approach. This curve is used to determine the required storage, based on the demand. Since demand characteristics have changed over time, and are not constant across the District, a re-evaluation is appropriate.

Previous discussion in Section 3 detailed the criteria for sizing of storage facilities. For pumps operated 18-hours per day, 10 hours of storage is needed; and for off-peak pumping, 20 hours of storage is required. This recommendation is based on evaluations of Seminole, Warner, Jed Smith and Twin Lakes subsystems.

5.5 Projected Future Demand

This Master Plan projects demands through the year 2030. This is assumed to be buildout. The 1999 Master Plan determined the buildout corresponding to year 2020 to be approximately 30,800 acre-feet per year. This Master Plan, with updated demand information and peaking factors has determined the demands for 2030 to be 30,700 acre-feet per year. The historical demand and projected future demands are shown on **Figure 5-6**. Items to be noted from **Figure 5-7**:

- The projected growth is significant in terms of current facility capacities, however, it is reduced from previous versions of the Master Plan. The rate of growth is also projected to be slower than previously expected.
- The large demand seen in 1989 and 1990 was not seen again until 1997, and decreased again in 1998 due to wet weather. It has since steadily increased.
- The projected population growth and projected increase in potable water demand are not proportional. That is due to the projected type of growth. It is expected that future development will include large, estate size homes with large irrigated lots. It would be expected that this type of development would use more water per capita than moderately sized homes on smaller lots. The larger estates can use 600 to 700 gallons per day per capita, while higher density developments use potable water in the range of 100 to 200 gallons per day. This is reflected in **Table 5-11**, which shows estimated future average per capita winter use for each zone.

Table 5-11 Average per Capita Water Use (gallons per day)			
Pressure Zone	**2005**	**2015**	**2030**
1235-foot Main	319	323	336
Dardenne	332	331	328
Jed Smith	528	529	531
Kimberly	218	218	217
Latigo	193	322	392
Lower Oaks	0	351	743
McCoy	320	319	318
Mulwood	262	263	266
Oakridge	531	509	486
Ranchview	944	943	941
Saddle Peak	547	546	545
Saddletree	344	343	341
Seminole	691	596	560
Twin Lakes	436	258	218
Upper Oaks	200	303	408
Upper Twin Lakes	424	353	294
Ventura County	114	147	161
Warner	257	259	262
Woolsey	133	139	147

Table 5-12 (following page) shows how the future (2030) MDD used in this Master Plan Update compares with the future (2020) MDD used in the prior Master Plan.

Table 5-12
Comparison of Buildout Demand Projections

Subsystem	2020 Buildout MDD (gpm)(1)	2030 Buildout MDD (gpm)(2)	MDD Peaking Factor(3)	Other Buildout MDD (gpm)	Notes, Sources
1235 Zone	19,920	23,480	2.10		
Box Canyon	88	129	2.30	45	Receives water from City of Simi Valley, 45 gpm is current MDD.
Dardenne	270	198	1.50		
JBR/Agoura	210	140	1.80		
Jed Smith	2,030	1,735	1.80	2,455	LVMWD Report No. 2202, Jed Smith/Mountain Gate Subsystem Demand Analysis.
Kimberly	310	187	1.80	250	250 is average of 1999 MP MDD and 2005 UWMP MDD
Latigo	1,240	934	1.40	407	407 is from Sensitivity Analysis, see Section 5.6
Lower Oaks	440	156	1.50	621	Calculated from 2007 LVMWD SCADA information
McCoy	2,650	1,491	1.50	2,000	2000 is average of 1999 MP MDD and 2005 UWMP MDD
Mulwood	1,500	1,056	1.50		
Oakridge	200	135	1.50		
Ranchview	110	153	1.80	107	LVMWD Report No. 2045, Ranchview WSDR, May 1998
Saddlepeak	850	448	1.40		
Saddletree	430	92	1.50		
Seminole	5,040	3350 (4)	3.40	4,025	4,025 is from Sensitivity Analysis, see Section 5.6
South Woolsey		840	2.30		From land use data
Three Springs	300	251	1.50		
Twin Lakes	1,200	2,652	2.30	2,199	From LVMWD Report 2297.00, but using new MDD peaking factor. Includes Deerlake Ranch.
Upper Oaks	70	42	1.50	239	Calculated from 2007 LVMWD SCADA information
Upper Twin Lakes	220	112	2.30	205	Preliminary Design Report: Twin Lakes Pump Station Expansion, May 2004
Warner Tanks	1,490	2,470	2.40		
Woolsey	320	223	2.30		
Ladyface	190	190	1.50		Possible future system
Udell	90	90	1.50		Possible future system
Total	**39,168**	**37,203**	**1.85**	**Average**	

(1) From 1999 Master Plan, which used a MDD peaking factor of 2.1 for all subsystems
(2) From 2005 Urban Water Management Plan, and based on MDD peaking factor shown
(3) Peaking factors are based on 2007 analysis (see Table 5-10))
(4) 680 gpm for Malibu Golf Course has been assumed to be on recycled water at buildout.

Table 5-13 summarizes the estimated future MDD demands used in this Master Plan Update compiled from various sources and indicates the source of the estimate. These estimates are important, because they form the basis of the hydraulic modeling and other analysis found in Section 8, which are then reflected in the improvement recommendations found later in this report. The estimates differ from those shown in **Table 5-12**, reflecting additional data and analysis performed.

Table 5-13
Future Demand Projections Used in This Master Plan

Zone	2030 MDD (gpm)	Basis of Demand Forecast
1235 Zone	22,640	2005 Urban Water Management Plan
Box Canyon	88	1999 Master Plan
Dardenne	198	2005 Urban Water Management Plan
JBR/Agoura	140	2005 Urban Water Management Plan
Jed Smith	2,455	LVMWD Report No. 2202, Jed Smith/Mt. Gate Subsystem Demand Analysis Report, June 2002
Kimberly	250	250 is average of 1999 MP and 2005 Urban Water Management Plan
Latigo	407	Sensitivity analysis (medium probability), see Section 5.6 of this MP.
Lower Oaks	621	Calculated from 2007 LVMWD SCADA information
McCoy	2,000	2000 is average of 1999 MP and 2005 Urban Water Management Plan
Mulwood	1,100	2005 Urban Water Management Plan
Oakridge	135	2005 Urban Water Management Plan
Ranchview	153	2005 Urban Water Management Plan
Saddlepeak	448	2005 Urban Water Management Plan
Saddletree	92	2005 Urban Water Management Plan
Seminole	4,025	Sensitivity analysis (medium probability), see Section ___ of this MP.
South Woolsey	840	Land Use Data
Three Springs	251	2005 Urban Water Management Plan
Twin Lakes	2,199	From LVMWD Report 2297.00, but using new MDD peaking factor. Includes Deerlake Ranch.
Upper Oaks	231	Calculated from 2007 LVMWD SCADA information
Upper Twin Lakes	112	2005 Urban Water Management Plan
Warner Tanks	1,700	1999 Master Plan, but with new MDD peaking factor
Woolsey	320	1999 Master Plan
Total	**40,405**	

5.6 Seminole and Latigo Zones - Demand Sensitivity Analysis

A different analysis of the demands projections for the Seminole and Latigo pressure zones was conducted. As discussed in Section 4, these zones are widespread, with sparsely developed parcels. The terrain is rugged and development is not likely to occur everywhere that it is permitted. Conventional analysis, where the amount of undeveloped but developable vacant land is multiplied by land-use based demand factors produces very high demands for these two zones. This is important, because the cost of new facilities to serve these demands is expected to be high.

For this Master Plan, a parcel-by-parcel analysis of the development potential of the Seminole and Latigo Zones was estimated, based on topography and other factors.

The process that was employed is as follows: Boyle, Psomas and District staff met to analyze the potential for new development. Prior to meeting, a 1000-scale map of the area was created showing all parcels and their general plan land-use code from the Santa Monica Mountains Local Coastal Program Land Use Policy map for the North and South Areas obtained from the County of Los Angeles Department of Regional Planning dated June 9, 2006. The map also had overlays for the pressure zone boundaries, topography and existing roads. All open space and existing development was color coded so the undeveloped space that was not restricted from development was evaluated.

Potentially developable parcels were classified by the group as "high", "medium" or "low" in terms of their potential for development. This was done purely using the judgment of the participants, and was based on features like adjacency to roadways, adjacency to designated open space, and number of sides adjacent to either, the steepness of the terrain, and whether a suitable area existed for a house "pad". Where disagreements occurred, the parcels were discussed until consensus or compromise was reached.

After each developable parcel in the zones had been categorized, the number of dwellings that could be developed on each parcel was evaluated based on zoning and acreage. These potential dwelling units were grouped by probability category. Demands were then generated for the zones representing the high probability, medium probability, and low probability cases. **Table 5-14** shows how the demands were calculated, based on development potential of each parcel.

Table 5-14 Seminole / Latigo Zones Demand Sensitivity Cases			
	High Probability	**Medium Probability**	**Low Probability**
Development Potential of Parcels	High	High & Medium	High, Medium, and Low

Because a large number of undeveloped parcels still exist, future demands in the Seminole and Latigo Zones will likely be significantly higher than current demands.

For the Latigo Zone, the sensitivity analysis produced estimates that were slightly higher for the Latigo Zone than did the Psomas Report. This is because the Psomas Report did not account for the many small parcels with "Rural Village" designations. These include the Malibu Bowl, Malibu Mar Vista, Malibu Vista, Vera Canyon, and El Nido developments. Generally, few homes have been built in these areas, as the parcels are small and the terrain is rugged and remote. For this analysis, it was assumed that at most 45 percent of these parcels would develop (Low Probability Case). For the Medium and High Probability Cases, it was assumed that 30 percent and 15 percent of the parcels would be developed, respectively. However, due to the high number of such parcels in these zones (560), even 15 percent development can produce significant demands.

Table 5-15 show the results of the demand sensitivity analysis and compares it to the Psomas Report. The complete analysis is displayed in the Appendix.

Table 5-15 Future Seminole/Latigo Demands Sensitivity Analysis Results				
Zone	**Low Probability Case (gpd)**	**Medium Probability Case (gpd)**	**High Probability Case (gpd)**	**Demand Analysis Results from Psomas Report**
Seminole	4472	4254	2946	2708
Latigo	578	407	281	934
Totals	**4821**	**4431**	**3048**	**3412**

5.7 Demand Factors

Las Virgenes Municipal Water District serves potable water to many different types of customers, including golf courses, parks, schools, large, estate-style homes, smaller single family homes, condominiums, apartments, business parks, and other uses. It is not a simple matter to determine the distribution of potable water demand over the District's service area. Demand factors—factors used to estimate the demand for potable water, in gallons per minute (gpm) on an acreage basis—were developed by analyzing billing records, meter route maps, land use maps, and other planning documents. The demand factors were developed for the prior Master Plan and are retained here for use in planning future development.

5.7.1 Methodology Used to Derive Demand Factors

The District's billing records include a "meter route" number, which can be correlated to a map that breaks the District into meter routes. By using these meter routes, it was determined which city or area each customer is in.

There is also a "water rate code" assigned to each customer. This code is used to determine a customer's billing rate each month, and identifies the type of use for that customer. There are three broad categories: water, sewer, and recycled water. For purposes of this study, the potable water rate codes were used. Each code also identifies whether the use is residential, multi-family, irrigation, school, commercial, or temporary. It also identifies the base rate, plus the rate for each tier within a billing zone.

The following steps summarize the procedure by which demand factors for specific land use designations within each city/area were determined:

1. The customer billing records were subtotaled based on the city or area they are in, meter route and, in cases where the meter route crosses City or area boundaries, on service address.

2. The billing records were also subtotaled based on LVMWD pressure zone (subsystem), meter route and service address. The existing demand used in the analysis for each subsystem was shown earlier in **Table 5-8**.

3. Land use categories were summarized as described in Section 5.1.

4. The populations for each city and area were summarized as described in Section 5.2.

5. Within each city/area, the billing records were subtotaled by usage type, as identified by the “water rate code” and, in certain cases, by customer name and service address (typically in the case of schools and parks).

6. Large users were identified and assigned to a specific node in the hydraulic model as a point demand. (Large users were generally considered to be those users who purchased over 5,000 hundred cubic feet (HCF) of potable water per year.) Since these users were being considered separately, their total usage was subtracted out of the subtotaled consumption to avoid skewing the average demand factors overly high; in other words, if the large users had been analyzed as a point demand and also considered in calculating demand factors, the overall demand factors would have been artificially high.

7. Initial demand factors were calculated by dividing the demand, subtotaled by city/area and by usage type, either by population (in the case of residential uses) or by estimated total acreage (in the case of commercial, park, and school use). Demand factors were calculated in terms of gallons per day (gpd) per capita for residential uses; and gallons per day per acre for commercial, park, and school uses.

8. Demand factors for gpd/capita and gpd/acre were combined with land use designations for each city/area in a table. Initial demand factors on a gallon per day per acre basis for residential use were calculated by using the housing densities (dwelling units per acre) from the land use maps and general plans, household densities (population per dwelling unit) from the Bauer Report, and estimated demand determined in Step 7 above. The initial estimates for residential demand factors (gpd/acre) were calculated by the following equation:

   Demand (gpd/acre) = [Density (du/acre)] x [Population/du] x [gpd/capita]

9. A land use “coverage” for existing land use was developed in the computer model. (A “coverage” simply refers to a layer, drawn in a CAD program such as AutoCAD on the computer, which has land use or other designations within closed polygons.)

10. A coverage for demand areas was developed in the computer model. Each demand area was assigned to an appropriate junction on a pipeline in the hydraulic model of the potable water system. The demand areas generally conformed to land use and parcel boundaries, and were used for assigning specific demands to a specific location on the pipeline.

11. Another coverage was created to represent “percent developed.” These areas were used to represent how much an area had been developed; for example, if an area is completely built-out (no additional development likely or possible), it was assigned a value of 1.0 (100%). Areas not yet developed were assigned a value of 0. Areas that were partially developed were assigned estimated values (for example, 0.50 if 50% developed, 0.75 if 75% developed, etc.).

12. A series of GIS (Geographical Information System) routines run, which intersected city/area boundaries with the land use, demand area, and percent developed coverages (this procedure is sometimes called “polygon processing”). These routines broke each area into a series of small areas, each with a value assigned from each of the coverages (city/area, land use designation, demand area number, percent developed).

13. The population and demand for each city/area were calculated using the results of the polygon processing (Step 12) and the initial demand factors (Step 8). The equation used to calculate demand is:

    Demand (gpm) = Demand Factor (gpm/acre) x Demand Area (acres) x Percent Developed

14. The calculated populations for each area from Step 13 were compared to the populations contained in the Bauer Report. Since most of the land use designations contain a range for housing density—for example, medium density in the City of Agoura Hills is designated 6 to 15 dwelling units per acre (see

Table 5-2)—the initial calculated population was not expected to correlate exactly to the "Bauer Report," the planning study used for the prior Master Plan.

15. The housing densities were adjusted to arrive at populations in each area more closely matching the populations in the Bauer report.

16. The initial demand factors calculated in Step 8 were revised using the new housing densities.

17. The GIS polygon processing was performed again using the revised demand factors.

18. The calculated demands for each city/area were compared to the subtotaled demands for each pressure zone from Step 2. As with the population, these were not expected to correlate very closely at this point, since the residential demands were estimated for each area, with no adjustment for whether they were for single family home, condo, estate style home, etc.

19. The demand per capita was refined, on a gpd/capita basis, using the factors developed in Step 7 as a starting point. Demand factors for each residential land use category in each city/area were revised until the calculated demand in each pressure zone was close to those calculated in Step 2.

20. These final demand factors were subtotaled by demand area number, each of which corresponds to a specific junction number on a pipe in the hydraulic model. The demands for large users were then added to the demand for each junction.

21. The demands for each junction were imported into the model and used for hydraulic analysis.

The calculated demand factors represent Average Day Demand, since they are based on the annual billing records tabulated on a bi-monthly basis. The demands are multiplied by the hourly peaking factors when the hydraulic model is run.

5.7.2 Summary of Demand Factors by Land Use

Table 5-16 shows the results of demand analysis, presenting demand factors that may be used for estimated potable water demand for future development in the District.

During the "calibration" steps (Steps 15 and 19), some land use designations were developed to allow different demand factors for areas with identical designations on the land use maps. These are italicized in **Table 5-16** to indicate that they are not labeled on the land use maps. Examples include RS-K (single family residential – Kimberly in Agoura Hills), which has a different demand factor and density (du/acre) than RS; and R-SF-NM (residential single-family – New Millennium Development), R-SF-Mc (residential-single family-McCoy), and R-SF-CCW (residential-single family-Cold Canyon/Warner), which have different densities and/or demand factors than other R-SF areas in Calabasas.

Table 5-16
Las Virgenes Municipal Water District
Potable Water Master Plan
Demand Factors by Land Use

City/Area	Land Use	Description	Demographics: Density for Analysis	Demographics: Pop/du	Demand Factors for Existing ADD: gpd/capita	Demand Factors for Existing ADD: gpd/acre	Demand Factors for Existing ADD: Estimated gpm/acre
Agoura Hills	RR	Rural Residential	0.2	3.15	325	204.75	0.14
Agoura Hills	RV	Very low density	0.5	3.15	325	511.88	0.36
Agoura Hills	RL	Low density residential	0.5	3.15	325	511.88	0.36
Agoura Hills	RS	Single family residential	3.7	3.15	190	2,214.45	1.54
Agoura Hills	*RS-K*	*Single family residential-Kimberly (added by Boyle)*	3.0	3.15	325	3,071.25	2.13
Agoura Hills	RM	Medium density residential	8.0	3.15	190	4,788.00	3.33
Agoura Hills	RH	High density residential	13.0	3.15	190	7,780.50	5.40
Agoura Hills	CS	Shopping center commercial	-	-	-	870.00	0.60
Agoura Hills	CV	Commercial – Visitor serving	-	-	-	870.00	0.60
Agoura Hills	CG	Retail service commercial	-	-	-	870.00	0.60
Agoura Hills	BP-O/R	Business park office retail	-	-	-	870.00	0.60

Table 5-16
Las Virgenes Municipal Water District
Potable Water Master Plan
Demand Factors by Land Use

City/Area	Land Use	Description	Demographics: Density for Analysis	Demographics: Pop/du	Demand Factors for Existing ADD: gpd/capita	Demand Factors for Existing ADD: gpd/acre	Demand Factors for Existing ADD: Estimated gpm/acre
Agoura Hills	BP-M	Business park manufacturing	-	-	-	870.00	0.60
Agoura Hills	OS-R	Open space-restricted	0.2	3.15	325	204.75	0.14
Agoura Hills	OS-R/DR	Open space-restricted/deed restricted	0.2	3.15	325	204.75	0.14
Agoura Hills	P	Local park	-	-	-	50.00	0.03
Agoura Hills	PR	Regional Park/Recreation	-	-	-	50.00	0.03
Agoura Hills	CR	Recreation commercial	-	-	-	50.00	0.03
Agoura Hills	OW	Open water	-	-	-	-	-
Agoura Hills	PF	Public Facility	-	-	-	275.00	0.19
Agoura Hills	SP	Specific Plan	-	-	-	-	-
Agoura Hills	T	Transportation	-	-	-	-	-
Calabasas	R-SF	Residential – Single Family	2.8	2.80	250	1,960.00	1.36
Calabasas	*R-SF-NM*	*Residential – Single Family-New Millennium Development (added by Boyle)*	0.9	2.80	300	756.00	0.53
Calabasas	*R-SF-Mc*	*Residential – Single Family-McCoy (added by Boyle)*	2.8	2.80	325	2,548.00	1.77
Calabasas	*R-SF-CCW*	*Residential – Single Family-Cold Cyn/Warner (added by Boyle)*	2.8	2.80	175	1,372.00	0.95
Calabasas	R-MF	Residential – Multiple Family	7.0	2.80	200	3,920.00	2.72
Calabasas	R-MH	Residential – Mobile Home	5.0	2.80	150	2,100.00	1.46
Calabasas	B-LI	Business – Limited Intensity	-	-	-	2,000.00	1.39
Calabasas	B-R	Business – Retail	-	-	-	2,000.00	1.39
Calabasas	B-PO	Business – Professional Office	-	-	-	2,000.00	1.39
Calabasas	B-BP	Business Park	-	-	-	2,000.00	1.39
Calabasas	B-OT	Old Town	-	-	-	2,000.00	1.39
Calabasas	MU	Mixed Use	-	-	-	2,000.00	1.39

Table 5-16
Las Virgenes Municipal Water District
Potable Water Master Plan
Demand Factors by Land Use

City/Area	Land Use	Description	Demographics: Density for Analysis	Demographics: Pop/du	Demand Factors for Existing ADD: gpd/capita	Demand Factors for Existing ADD: gpd/acre	Demand Factors for Existing ADD: Estimated gpm/acre
Calabasas	PF-I	Public Facilities – Institutional	-	-	-	450.00	0.31
Calabasas	PF-R	Public Facilities – Recreational	-	-	-	40.00	0.03
Calabasas	HM	Hillside – Mountainous	0.1	2.80	300	84.00	0.06
Calabasas	RR	Rural Residential	0.8	2.80	300	630.00	0.44
Calabasas	RC	Rural Community	1.5	2.80	200	840.00	0.58
Calabasas	OS-R	Open Space – Recreational	-	-	-	40.00	0.03
Calabasas	OS-RP	Open Space – Resource Protection	0.0	2.80	300	5.25	0.00
Calabasas	RR-UH	Rural Residential - Urban Hillside	0.8	2.80	300	1,624.00	1.13
Calabasas	T	Transportation	-	-	-	-	-
Hidden Hills	R-A-S	Residential-Agricultural, suburban	0.6	3.50	660	1,339.80	0.93
Hidden Hills	R-A-S 2	Residential-Agricultural, suburban	0.6	3.50	660	1,339.80	0.93
Hidden Hills	C-U	Community Use	-	-	-	900.00	0.63
Hidden Hills	R-1	Single family residential	2.0	3.50	660	4,620.00	3.21
Hidden Hills	C-R	Commercial Restricted	-	-	-	2,000.00	1.39
Hidden Hills	T	Transportation	-	-	-	-	-
LA County	1	Low Density Residential	4.0	2.95	100	1,180.00	0.82
LA County	2	Low/Medium Density Residential	3.0	2.95	100	885.00	0.61
LA County	3	Medium Density Residential	15.0	2.95	100	4,425.00	3.07
LA County	4	High Density Residential	15.0	2.95	100	4,425.00	3.07
LA County	C	Major Commercial	-	-	-	1,275.00	0.89
LA County	I	Major Industrial	-	-	-	1,275.00	0.89
LA County	P	Public and Semi-Public Facilities	-	-	-	1,500.00	1.04
LA County	R	Non-Urban	2.0	2.95	100	590.00	0.41
LA County	O	Open Space	-	-	-	-	-
LA County	SEA	Significant Ecological Areas	-	-	-	-	-

Table 5-16 Las Virgenes Municipal Water District Potable Water Master Plan Demand Factors by Land Use							
			Demographics		Demand Factors for Existing ADD		
City/Area	Land Use	Description	Density for Analysis	Pop/du	gpd/capita	gpd/acre	Estimated gpm/acre
LA County	SP	Specific Plan	-	-	-	-	-
LA County - 101 Corridor	OS	Open Space	-	-	-	-	-
LA County - 101 Corridor	OS-P	Open Space Parks	-	-	-	-	-
LA County - 101 Corridor	OS-DR	Open Space Deed Restricted	-	-	-	-	-
LA County - 101 Corridor	OS-W	Open Space Water	-	-	-	-	-
LA County - 101 Corridor	N20	Mountain Lands 20	0.1	2.95	250	36.88	0.03
LA County - 101 Corridor	N10	Mountain Lands 10	0.1	2.95	250	73.75	0.05
LA County - 101 Corridor	N5	Mountain Lands 5	0.2	2.95	250	147.50	0.10
LA County - 101 Corridor	N2	Rural Residential 2	0.5	2.95	250	368.75	0.26
LA County - 101 Corridor	N1	Rural Residential 1	1.0	2.95	250	737.50	0.51
LA County - 101 Corridor	U2	Residential 2	2.0	2.95	250	1,475.00	1.02
LA County - 101 Corridor	*U2-MG*	*Residential 2—Mountain Gate Development (added by Boyle)*	1.5	2.95	463	2,076.00	1.44
LA County - 101 Corridor	U4	Residential 4	4.0	2.95	250	2,950.00	2.05
LA County - 101 Corridor	U8	Residential 8	9.0	2.95	150	3,982.50	2.77
LA County - 101 Corridor	C	Commercial	-	-	-	1,275.00	0.89
LA County - 101 Corridor	CR	Commercial Recreation–Limited Intensity	-	-	-	1,275.00	0.89
LA County - 101 Corridor	P	Public and Semi-Public Facilities	-	-	-	-	-
LA County - 101 Corridor	T	Transportation Corridor	-	-	-	-	-

Table 5-16
Las Virgenes Municipal Water District
Potable Water Master Plan
Demand Factors by Land Use

City/Area	Land Use	Description	Demographics: Density for Analysis	Demographics: Pop/du	Demand Factors for Existing ADD: gpd/capita	gpd/acre	Estimated gpm/acre
LA County - 101 Corridor	SP	Specific Plan	-	-	-	-	-
LA County - Malibu	M-2	Mountain Land	0.1	2.95	400	59.00	0.04
LA County - Malibu	3	Rural Land I	0.1	2.95	400	118.00	0.08
LA County - Malibu	4	Rural Land II	0.2	2.95	400	236.00	0.16
LA County - Malibu	5	Rural Land III	0.5	2.95	400	590.00	0.41
LA County - Malibu	*3 4*	*Added by Boyle for Consolidation*	*0.2*	2.95	400	177.00	0.12
LA County - Malibu	*3 4 5*	*Added by Boyle for Consolidation*	*0.3*	2.95	400	315.06	0.22
LA County - Malibu	*3 5*	*Added by Boyle for Consolidation*	*0.3*	2.95	400	354.00	0.25
LA County - Malibu	*4 5*	*Added by Boyle for Consolidation*	*0.4*	2.95	400	413.00	0.29
LA County - Malibu	6	Residential I	1.0	2.95	400	1,18000	0.82
LA County - Malibu	M-2-S	Mountain Land—Seminole & Latigo	0.1	2.95	550	81.13	0.06
LA County - Malibu	3-S	Rural Land I—Seminole & Latigo	0.1	2.95	550	162.25	0.11
LA County - Malibu	4-S	Rural Land II—Seminole & Latigo	0.2	2.95	550	324.50	0.23
LA County - Malibu	5-S	Rural Land III—Seminole & Latigo	0.5	2.95	550	811.25	0.56
LA County - Malibu	*3 4-S*	*Added by Boyle—Seminole & Latigo*	*0.2*	2.95	550	243.38	0.17
LA County - Malibu	*3 4 5-S*	*Added by Boyle—Seminole & Latigo*	*0.3*	2.95	550	433.21	0.30
LA County - Malibu	*3 5-S*	*Added by Boyle—Seminole & Latigo*	*0.3*	2.95	550	486.75	0.34
LA County - Malibu	*4 5-S*	*Added by Boyle—Seminole & Latigo*	*0.4*	2.95	550	567.88	0.39

Table 5-16
Las Virgenes Municipal Water District
Potable Water Master Plan
Demand Factors by Land Use

City/Area	Land Use	Description	Demographics: Density for Analysis	Demographics: Pop/du	Demand Factors for Existing ADD: gpd/capita	Demand Factors for Existing ADD: gpd/acre	Demand Factors for Existing ADD: Estimated gpm/acre
LA County - Malibu	6-S	Residential I—Seminole & Latigo	1.0	2.95	550	1,622.50	1.13
LA County - Malibu	7	Residential II	2.0	2.95	250	1,475.00	1.02
LA County - Malibu	8A	Residential IIIA	5.0	2.95	250	3,687.50	2.56
LA County - Malibu	8B	Residential IIIB	5.0	2.95	250	3,687.50	2.56
LA County - Malibu	9A	Residential IVA	5.0	2.95	250	3,687.50	2.56
LA County - Malibu	9B	Residential IVB	14.0	2.95	250	10,325.00	7.17
LA County - Malibu	9C	Residential IVC	14.0	2.95	250	10,325.00	7.17
LA County - Malibu	11	Institution and Public Facilities	-	-	-	-	-
LA County - Malibu	12	Rural Commercial	-	-	-	1,275.00	0.89
LA County - Malibu	13	General Commercial	-	-	-	1,275.00	0.89
LA County - Malibu	14	Office/Commercial Services	-	-	-	-	-
LA County - Malibu	16	Low-intensity Visitor Serving Commercial Recreation	-	-	-	123.76	0.09
LA County - Malibu	17	Recreation-Serving Commercial	-	-	-	-	-
LA County - Malibu	18	Parks	-	-	-	-	-
LA County - Malibu		Significant Watersheds and Resource Management Areas	-	-	-	-	-
LA County - Malibu	MU	Mixed Use – Specific Plan Required	-	-	-	-	-
Westlake Vlg	R-LD	Low Density	1.5	2.80	550	2,310.00	1.60

Table 5-16 Las Virgenes Municipal Water District Potable Water Master Plan Demand Factors by Land Use							
			Demographics		Demand Factors for Existing ADD		
City/Area	Land Use	Description	Density for Analysis	Pop/du	gpd/capita	gpd/acre	Estimated gpm/acre
Westlake Vlg	R-LDH	Low Density Hillside	1.5	2.80	550	2,310.00	1.60
Westlake Vlg	R-LD-3S	Low Density	0.8	2.80	600	1,260.00	0.88
Westlake Vlg	R-LDH-3S	Low Density Hillside	0.8	2.80	600	1,260.00	0.88
Westlake Vlg	R-MD	Medium Density	4.5	2.80	220	2,772.00	1.93
Westlake Vlg	R-ID	Intermediate Density	7.0	2.80	220	4,312.00	2.99
Westlake Vlg	R-HD	High Density	12.0	2.80	220	7,392.00	5.13
Westlake Vlg	R-VHD	Very High Density	20.0	2.80	220	12,320.00	8.56
Westlake Vlg	R-MH	Mobile home Residential	3.0	2.80	220	1,848.00	1.28
Westlake Vlg	GC	General Commercial	-	-	-	950.00	0.66
Westlake Vlg	CR	Commercial Recreation	-	-	-	35.00	0.02
Westlake Vlg	OC	Office Commercial	-	-	-	950.00	0.66
Westlake Vlg	BP	Business Park	-	-	-	950.00	0.66
Westlake Vlg	PU	Public	-	-	-	1,300.00	0.90
Westlake Vlg	SC	Schools	-	-	-	1,300.00	0.90
Westlake Vlg	P	Park	-	-	-	1,450.00	1.01
Westlake Vlg	IN	Institutional	-	-	-	1,300.00	0.90
Westlake Vlg	OS	Open Space	-	-	-	-	-
Westlake Vlg	C	Cemetery	-	-	-	762.85	0.53
Westlake Vlg	T	Transportation	-	-	-	-	-

5.7.3 Impact of Recycled Water Use on Potable Water Demands

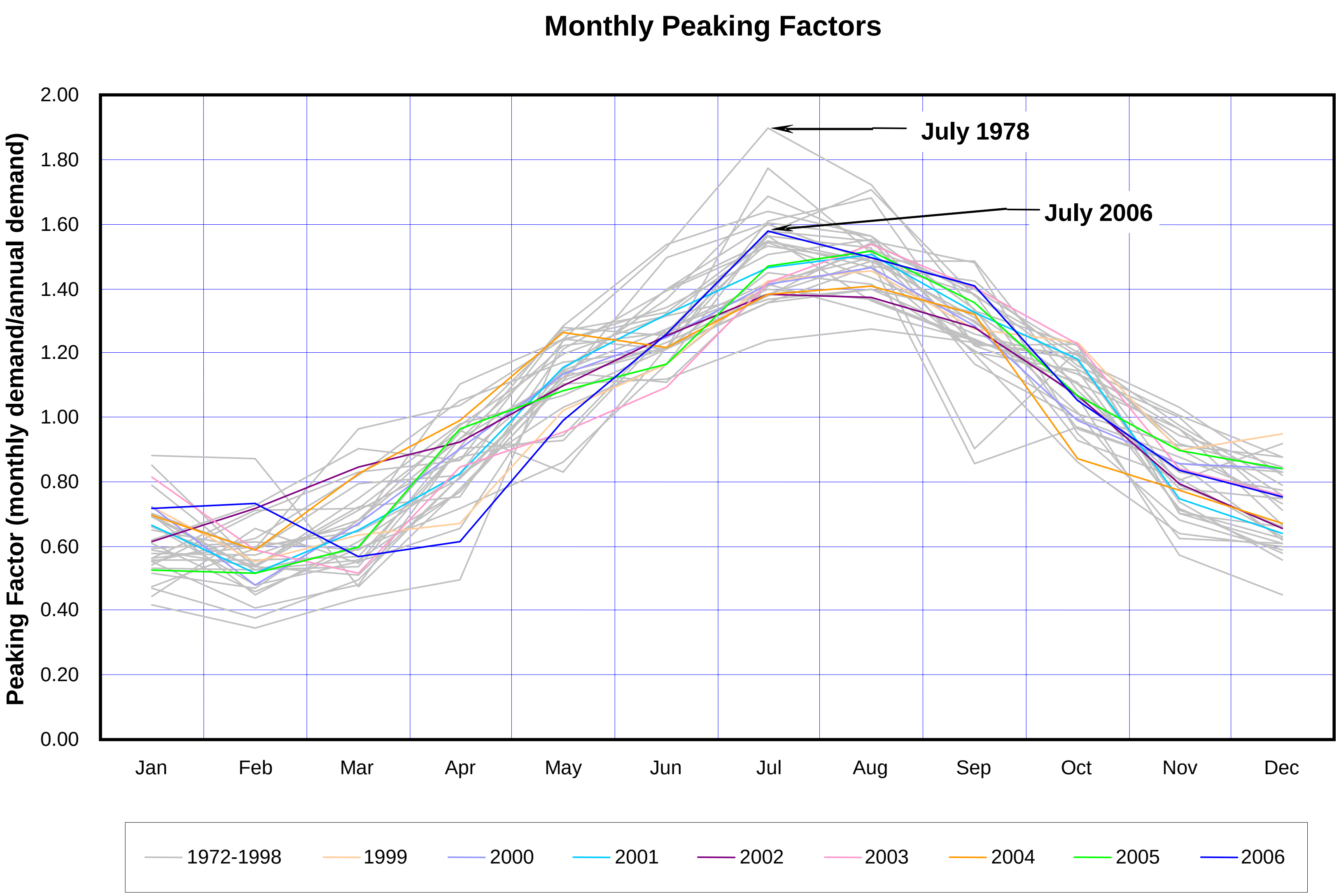
The demand factors indirectly account for the existing and future use of recycled water. Generally, recycled water has not been applied at single-family homes, so the residential demand factors are mostly not affected by recycled water use. Demands for the larger facilities like schools, golf courses, and parks are calculated and estimated on a case-by-case basis, and their demands are assigned to the potable or recycled water system, as appropriate. Virtually all of these types of customers are presently served with recycled water with a few notable exceptions like Malibu Golf Course and Alice C. Stelle School. For smaller recycled water customers, like common area landscaping of homeowner associations and landscaping at commercial properties, the demands in **Table 5-16** reflect the use of recycled water. To a large extent, the recycled water system within Las Virgenes is built-out along the 101 Freeway corridor, and where practical, the HOAs and commercial customers are served recycled water. The demands calculated in **Table 5-16** reflect this.

In other areas, primarily with the Main Zone (1235-foot zone), there will be additional recycled water use arising from in-fill development. The demand factors for this zone generally take into account the overall lower demand for potable water due to the use of recycled water at commercial and multi-family developments.

In Section 8 of this report, expected pumping and storage deficiencies in the Seminole Zone are discussed. A partial and interim solution to these deficiencies is a proposed extension of the recycled water system to Malibu Golf Course (also known as the Decker Canyon Project). If and when this project is built, it would significantly reduce the demands on the potable water system, particularly in the Seminole Zone. While the estimates of future demand shown in Section 5 include the golf course demands, the analysis in Section 8 assumes that these demands will be removed from the system.

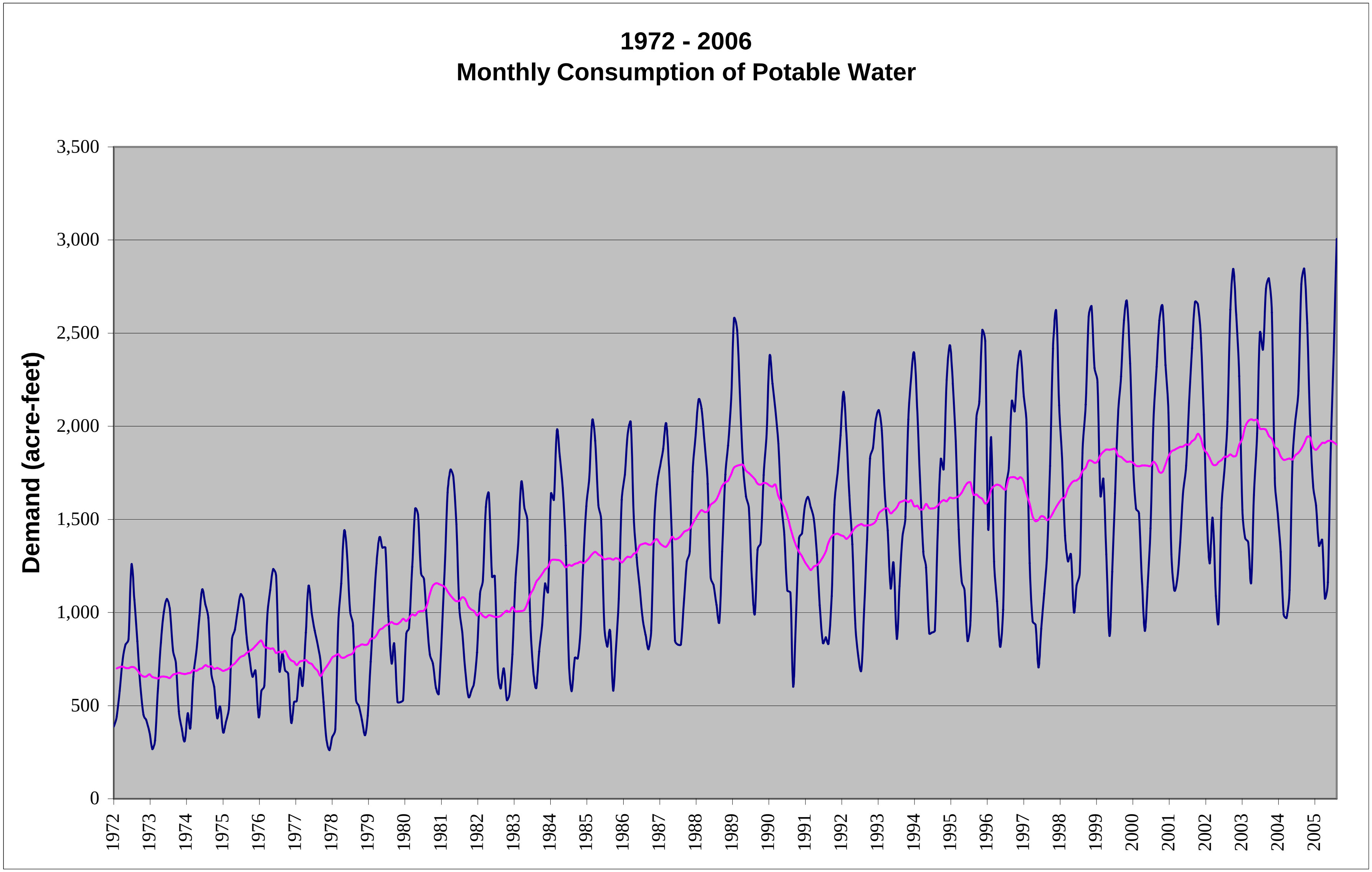
Another way demand for recycled water and potable water are related is in the fact that there is not enough recycled water available to meet the peak demand for recycled water. During times (usually during the summer) when demand exceeds recycled water supply, potable water is added to the recycled water system (supplemental water). This currently happens at three locations in the recycled water system: Cordillera Tank (1200 gpm), Reservoir 2 (about 2100 gpm) and Morrison Pump Station (about 1000 gpm). These quantities have been included in the hydraulic analysis of the potable water distribution system. A fourth supplemental facility exists at Parkway Tank, but this is not expected to be used regularly.

Figure 5 - 2



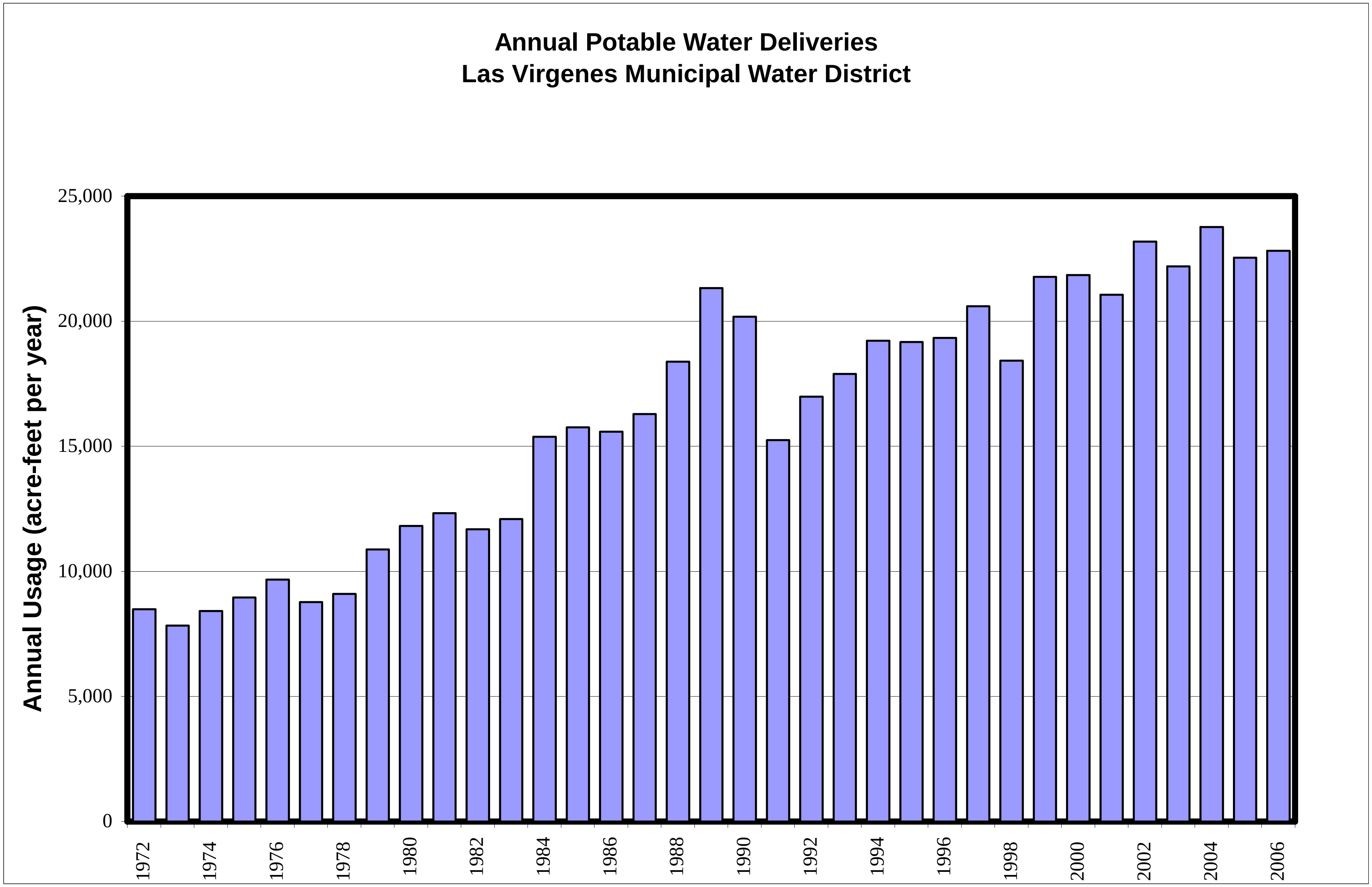
F:\LVMWD\23016-Potable & Recycled Water MP Update\0001\DRAFT\Potable\Section 5\Monthly Peaking Factors

Figure 5 - 3



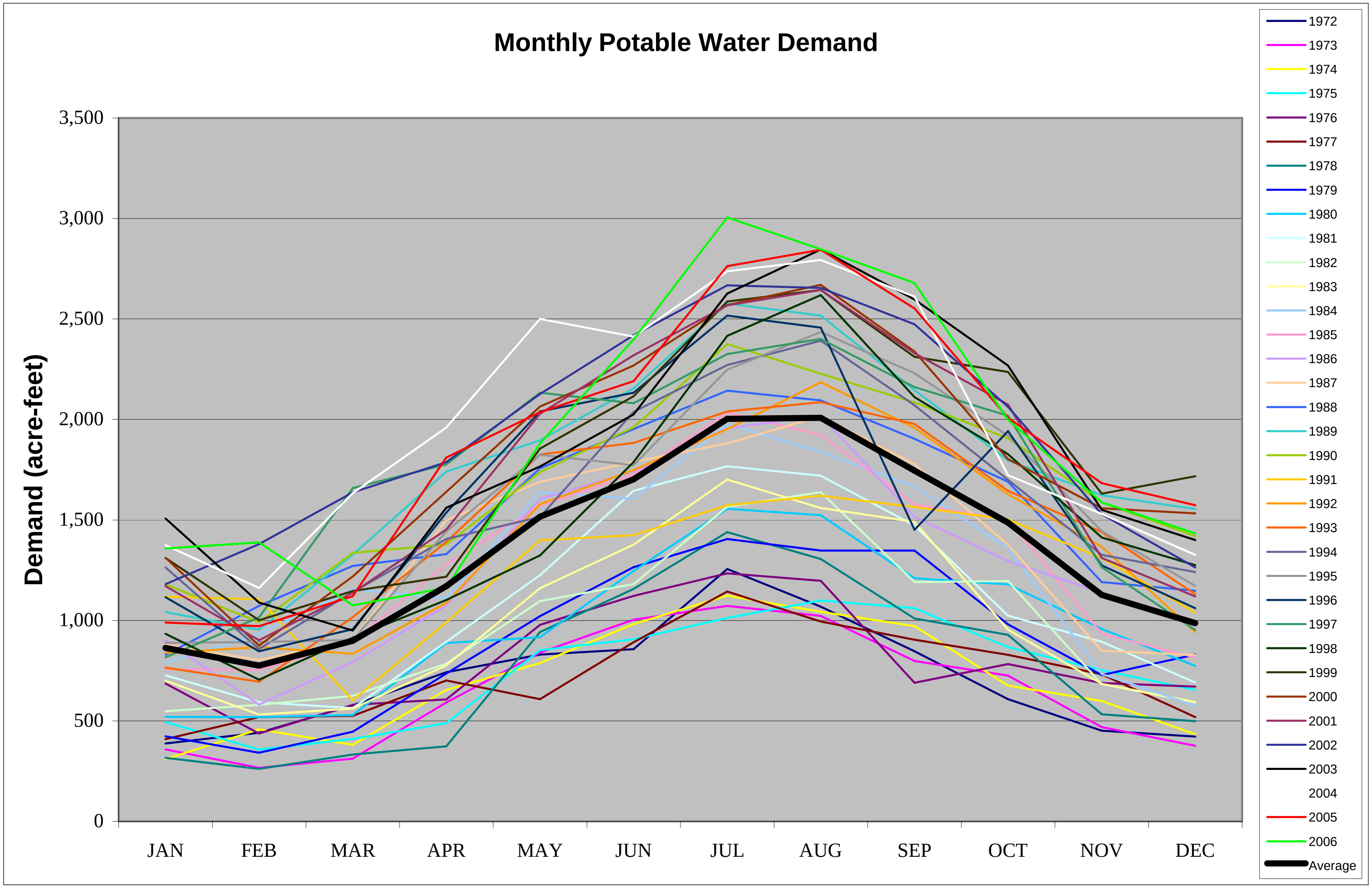
1972 - 2006
Monthly Consumption of Potable Water
Demand (acre-feet)
3,500
3,000
2,500
2,000
1,500
1,000
500
0
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005

Figure 5 - 4



F:\LVMWD\23016-Potable & Recycled Water MP Update\0001\DRAFT\Potable\Section 5\Monthly Peaking Factors

Figure 5 - 5



F:\LVMWD\23016-Potable & Recycled Water MP Update\0001\DRAFT\Potable\Section 5\Monthly Peaking Factors

Figure 5-6
Projected Potable Water Demands

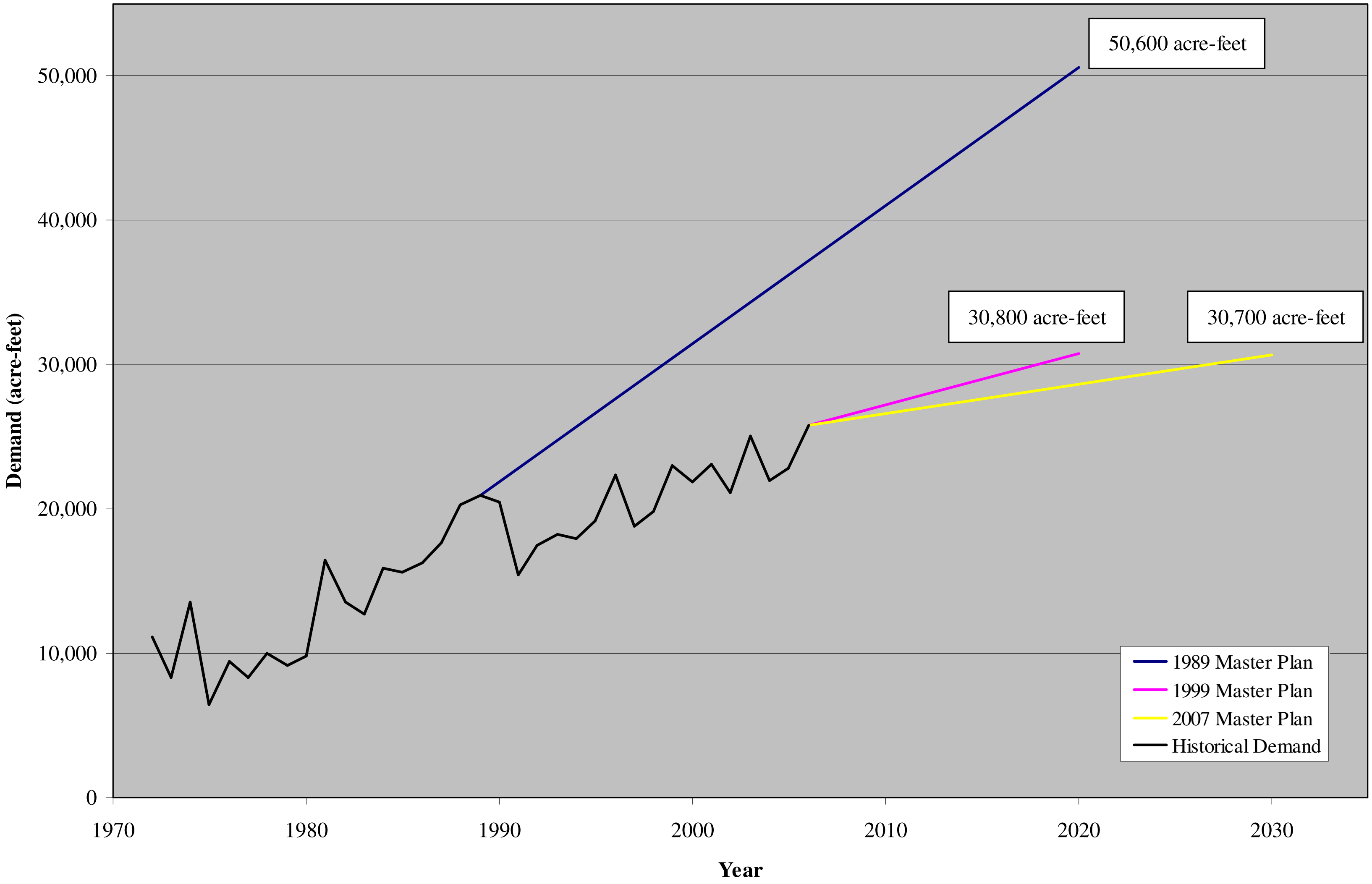
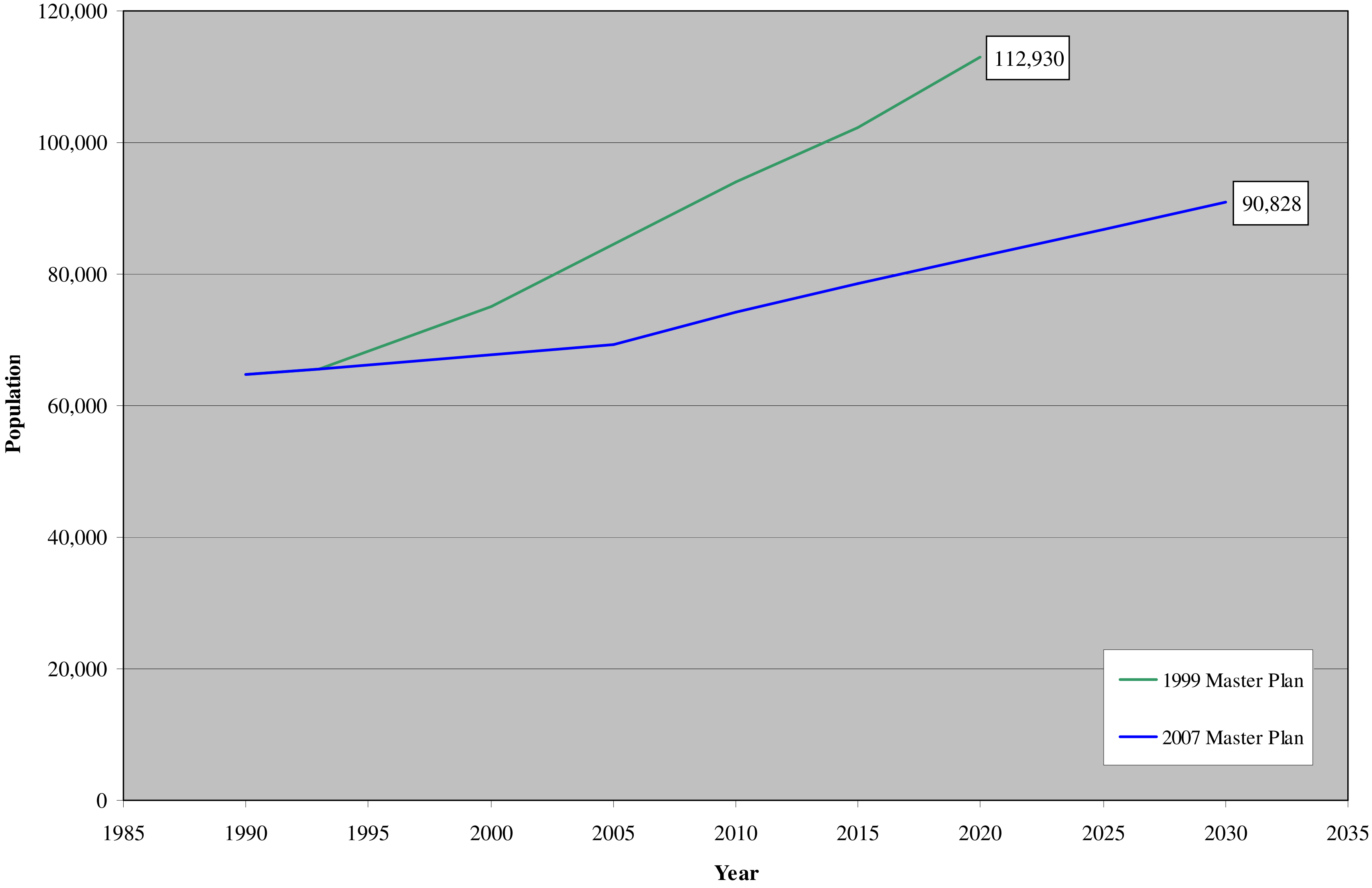


Figure 5-7
Population Forcasts for LVMWD



Section 6

Evaluation of Unaccounted for Water

6.1 Introduction

Water that is classified as unaccounted for is water that is consumed within the District and not recorded by a usage meter. The total amount of unaccounted for water is very important to the District for many reasons. First, unaccounted for water constitutes an expense with no corresponding revenue recovery. Also, leaks in the system pose a liability to the District for the potential for property losses.

There are several sets of data that the District uses to evaluate the total amount of unaccounted for water. The two main sets of data are the system usage reports and the individual water meters. The monthly system usage report measures and records the total amount of water delivered to both the potable and recycled water systems. The difference between the usage reports and the total amount of water delivery is used to estimate the unaccounted for water.

District operational staff also take steps to minimize the potential for unaccounted for water by the use of temporary meters during hydrant flushing to measure the volume used. The District also has taken action to reduce meter inaccuracies. LVMWD recognizes that individual meters have a +/- 5% accuracy, with a total of nearly 20,000 meters. Recent steps have been taken to reduce the inaccuracies by investing in newer meter technology, which records smaller flow on the larger meters. Regular replacement of ¾” meters has also been accelerated because many are older than the normal service life of 15 years.

It should be understood that comparisons of water billed with water delivered to system do not necessarily have identical time periods. The periods may differ because the billing of the water occurs bi-monthly, where consumer meters are read on a rotating weekly basis. The significance or these differences are reduced because: (1) The water use in December/January is at a minimum, and (2) Evaluations taken over multiple years will average out abnormalities that occur for a single year. This type of evaluation may be acutely precise, or give great evidence to the source of losses; they can provide valuable feedback to indicate where further investigation is warranted to correct problems.

There are many possible sources of unaccounted for water in the LVMWD system. Net changes to Las Virgenes Reservoir constitute potential for losses, by both evaporation and seepage. Aging water meters are less accurate, and have the tendency to err on the low side volumetrically. Flows consumed during fire fighting are not metered, but estimated; a potential source of unaccounted for water. Theft and unauthorized withdrawal is also a cause of unaccounted for water; these tend to increase in years with hotter weather. A normal, reasonable range of loss for a typical system is between 5-10%.

The last report to the Board in 2000 estimated unaccounted for water for both the potable and recycled water systems at 8.5%. Due to differences in the manner in which each system is operated and reported, it is more accurate to evaluate each system separately.

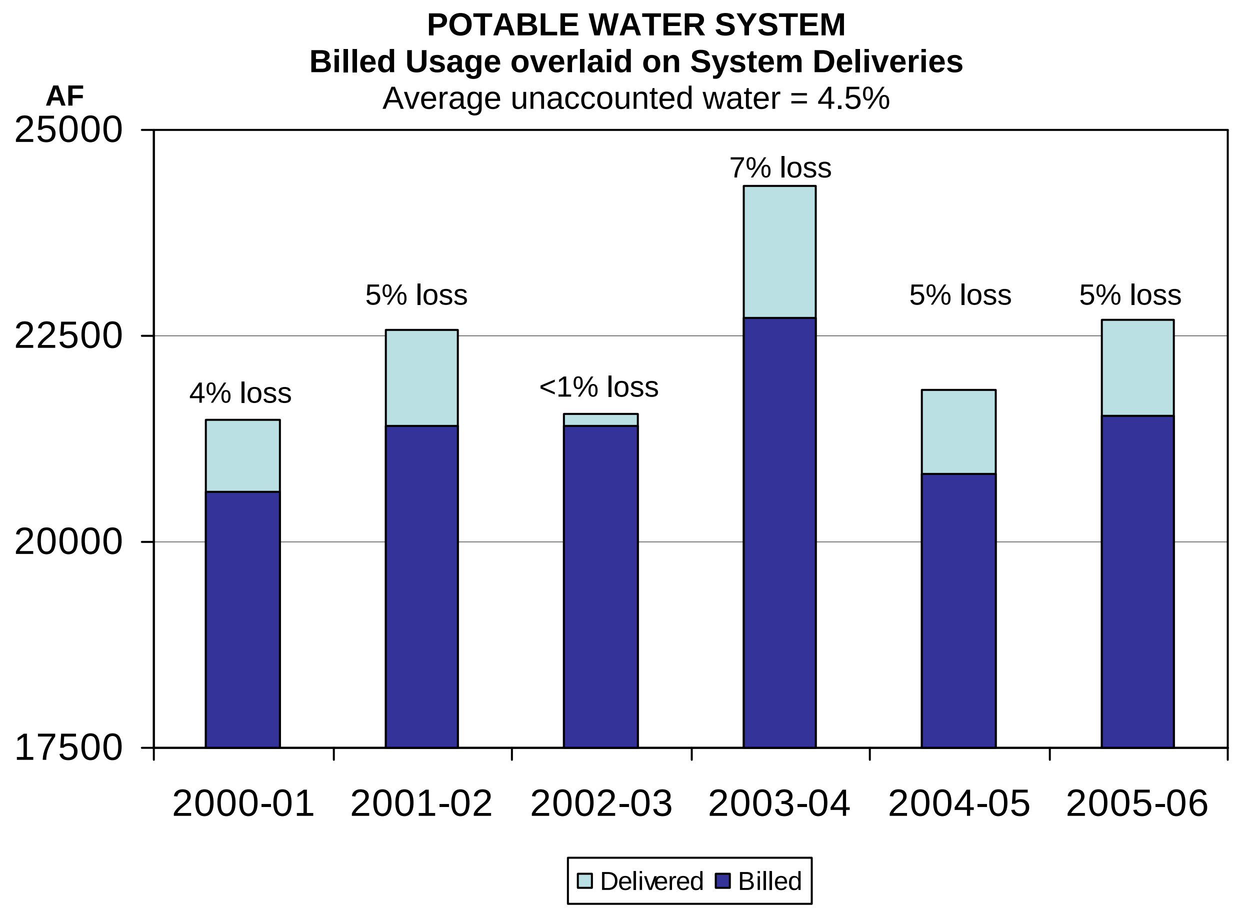
The previous Potable Water Master Plan based the examination of unaccounted for water on six calendar years. The analysis made in this Master Plan will do the same, as to furnish results that are directly applicative, this primary objectives being to identify losses or gains in both volumetric and economic terms.

6.2 Total System

The percentage of unaccounted for water in the potable and recycled water systems is very low when compared to industry norms.

LVMWD Facilities and Operations department indicates that the yearly average unaccounted for water losses for the years 2000-2006 is about 4.5%. The largest percentage occurred during the 2003-2004 billing cycle at 7% and the smallest percentage occurred in 2002-2003 at a loss of less that 1%, as shown in **Figure 6-1**.

Figure 6-1



Over the past six years, unaccounted for water in the potable water system has dropped to an average annual amount near 4.5%. The drop, and continued stability in percentage represents the effect of the newer, larger meters and increase in change-out cycling in the smaller domestic meters.

Section 7

Evaluation of Existing System

7.1 Introduction

The criteria used for designing LVMWD facilities such as pump stations, reservoirs and pipelines were previously discussed in Section 3, and how the criteria are applied to the system was discussed in Section 5. Reservoirs and pump stations will be collectively evaluated, as they function together as a system to meet storage and demand requirements. In some cases, increased pumping capacity can reduce deficient reservoir storage. Conversely, in some cases, increased reservoir storage can mitigate pumping deficiencies. The first part of this section will discuss pumping and storage capacities, and the second portion will discuss the hydraulic capacity of the system.

7.2 Reservoir Storage

This Master Plan will use the term “reservoir” and “tank” interchangeably. Section 3 discussed the 3 components of reservoir storage: operational, emergency and fire flow storages. The exception is Las Virgenes Reservoir, which will always be referred to in full name, providing seasonal and emergency storage.

Fire Flow Storage: The required storage for fighting a fire is calculated by methods that are set forth by Los Angeles County Fire Prevention Regulation No. 8, as discussed in Section 3. The District has chosen to provide the storage and flow capacity in the 1235 foot zone for two independent fire events, one east and one west, because this zone can be operated as two separate subzones and the zone spans a large distance. The 1235 zone excluded, all other zones are designed and operated within the Fire Department regulations for one fire per zone. Further discussion of the fire flow analysis is presented in Section 7.9.

Emergency Storage: The District’s policy is to provide a minimum of 5 hours of MDD for emergency. This provides the District with the capability to maintain service in the event of a short power loss.

Operational Storage: This storage is the portion of overall reservoir storage that can vary greatly, depending on pumping mode. It is common to employ 24, 18 or 9-hour pumping strategies, and storage volumes will vary accordingly.

- ***24-Hour Pumping***: In all Master Plans prior to 1991, all systems were designed for 24 hour pumping except Dardenne, Oak Ridge, and Kimberly subsystems. The systems were later upgraded to include the required fire flow storage, with the ability to replenish this additional storage in 72 hours or less. This type of pumping provided little if any protection if demands exceeded previous estimates, pump capacities were less than design, or facilities were inoperable. The 1999 Master Plan proposed 18 and 9 hour pumping standards be used for all but the 1235 foot subsystems, providing the ability to pump additional hours if required.
- ***18-Hour Pumping***: Pumping in the 18 hour mode is more conservative than pumping for 24 hours. 18 hour pumping provides flexibility to the system. This can allow the operators to provide maintenance during MDD events and provides additional pumping hours to "catch up" if demands exceed design, or there were power interruptions. This is highly valuable for LVMWD, with the rugged service area and small systems that are not interconnected in some cases. This pumping mode also allows for pumps to be turned off during the highest portion of peak energy charges (known as "mid-peak" pumping), thus reducing energy costs.
- ***9-Hour Pumping***: This method is considered "off-peak". This alternative replaced the 10-hour pumping criteria set forth in the 1991 Master Plan, as required by Southern California Edison. This method provides the largest amount of reservoir storage and operational flexibility. Off-peak pumping generally occurS between the hours of 11:00 p.m. and 8:00 a.m.

7.2.1 Main Zone Storage

At the 1235-foot zone, a 24-hour pumping basis is deemed the most applicable for storage. There are several reasons:

- ***Economic Factors:*** The facilities in the 1235 zone are designed for 24-hour pumping and substantial upgrades and modifications would be needed to convert to 9 or 18 hour pumping. Given the large size of the zone, required capital investment would be unfeasible, and would not be repaid in terms of electrical cost savings. The size and hydraulic properties of the system would also make a large increase in storage ineffective.

- ***Backfeed:*** The overall system has the capability to flow water from higher-zone tanks back into the 1235 zone if needed. If the 1235 system has problems, and there is sufficient storage in other zones, it can provide a limited supply for the main zone.
- ***Ample, Multi-Faceted Supply:*** The main zone has large amounts of both daily and seasonal storage, providing extra capacity in times of need. The zone also has Las Virgenes Reservoir, LV-2, and Conduit Pump Station with the ability to meet peak demands. These facilities have standby and emergency operational features and the turnouts operate "on-demand".

7.3 Pumping Station – General Discussion

Pump stations should be designed and operated such that they are capable of pumping MDD flow in the designated number of hours. This should always be accomplished without the use of a standby pump (if so equipped).

Depending on pump sizing and the number of hours for pumping, more or less water goes into storage, versus going directly to customers. When pumping times are long, the volume pumped contains more flow for demand, for shorter pumping times, more water goes into storage for use at other times.

7.3.1 Pump Station Duty Factors

It is sometimes more convenient to refer to pump station capacity as a duty factor. The duty factor is determined by the overall percentage of time all duty pumps are running during the maximum day. Based on the hourly pumping criteria discussed earlier, applicable duty factors would be as follows:

24-hour criteria	=	100% duty factor
18-hour criteria	=	75% duty factor
9-hour criteria	=	38% duty factor

7.4 Reservoir – Conclusions

Table 7-1 displays the analysis of the existing storage of the reservoirs/tanks. Statistical and design information is contained in Columns 1-12. Column 17 displays which type of hourly operation is recommended the pump station: off-peak, mid-peak or peak. Recommendations are given in Column 14, and are based on storage requirements, storage capacities, and the following recommendations:

- If there is adequate storage in a particular subsystem to operate off-peak, then it must be classified as an off-peak system, disregarding the current operations.
- No subsystem, except the 1235 main zone, should be based on 24-hour pumping criteria. The 18-hour basis should be considered the maximum.
- The 1235 zone is recommended to run with 24-hour criteria, as discussed in Section 7.2.1.
- The Three Springs zone does not have a storage tank. This zone operates by PRV from the Seminole zone, which is lacking storage itself. Previous versions of the Master Plan have proposed a new 0.5 MG tank, and this is still recommended.

Reservoir surpluses and deficits are contained in Column 16. **Table 7-3** shows several deficits, they exist for many reasons. Many of the systems were designed for 24-hour pumping criteria, as discussed above, 18 hours should be the maximum for a pump station (except the 1235 zone as discussed). Some of the systems have had development occur and some have had increased demands from the population existing in the zone previously. Other explanations are described below the table.

Table 7-1
Tank/Reservoir Storage Capacity
Existing System

(1)	(2)	(3)		(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
	Tank High Water Elevation (Feet)	Fire		Required Fire Storage (Gal)	MDD (GPM)	5-Hour Emergency Storage (Gal)	Daily Regulatory Storage (Gallons) (4)			Total Storage Required (MG)			Possible Operations Off-Peak(2)	Recom-mended Storage (MG)	Existing Tank Capacity (MG)	Surplus (Deficit) Capacity (MG)	Basis of Recom-mendation	Need More Storage
Reservoir/Tank		Flow (GPM)	Duration (Hours)				24-Hour Basis	18-Hour Basis	9-Hour Basis	24-Hour Basis	18-Hour Basis	9-Hour Basis						
Dardenne Tank	1,618	1,250	2	150,000	263	79,000	110,000	163,000	336,000	0.34	0.39	0.57	no	0.39	0.50	0.11	18-hour	no
Jed Smith Tanks	1,420	1,250	2	150,000	1,943	583,000	816,000	1,201,000	2,483,000	1.55	1.93	3.22	no	1.93	1.20	(0.73)	18-hour	yes
Kimberly Tank	1,517	1,250	2	150,000	218	65,000	92,000	135,000	279,000	0.31	0.35	0.49	no	0.35	0.47	0.12	18-hour	no
Latigo Tank	1,775	1,250	2	150,000	248	74,000	104,000	153,000	317,000	0.33	0.38	0.54	yes	0.54	1.50	0.96	9-hour	no
Lower Oaks	1,616	2,500	2	300,000	466	140,000	196,000	288,000	596,000	--	0.73	1.04	no	0.73	1.00	0.27	18-hour	no
McCoy Tank (5)	1,476	2,500	2	300,000	1,880	564,000	790,000	1,162,000	2,403,000	1.65	2.03	3.27	no	2.03	2.00	(0.03)	18-hour	no
Mulwood Tank (6)	1,450	3,000	3	540,000	985	296,000	414,000	609,000	1,259,000	1.25	1.45	2.10	no	1.45	1.60	0.16	18-hour	no
Oak Ridge Tank	1,826	1,250	2	150,000	145	44,000	61,000	90,000	185,000	0.26	0.28	0.38	no	0.28	0.32	0.04	18-hour	no
Ranchview	1,302	1,250	2	150,000	153	46,000	64,000	95,000	196,000	--	0.29	0.39	yes	0.39	0.39	0.00	9-hour	no
Saddle Peak Tank	2,513	2,500	2	300,000	365	110,000	153,000	226,000	466,000	0.56	0.64	0.88	yes	0.88	2.30	1.42	9-hour	no
Saddle Tree Tank	1,420	1,500	2	180,000	129	39,000	54,000	80,000	165,000	0.27	0.30	0.38	no	0.30	0.28	(0.02)	18-hour	no
Seminole Tanks (1)	2,153	2,500	2	300,000	865	260,000	363,000	535,000	1,105,000	0.92	1.10	1.67	yes	1.67	2.00	0.33	9-hour	no
Twin Lakes Tank	1,585	3,500	3	630,000	1,100	330,000	462,000	680,000	1,406,000	1.42	1.64	2.37	yes	1.64	2.00	0.36	18-hour	no
Upper Oaks	1,753	1,250	2	150,000	159	48,000	67,000	98,000	203,000	--	0.30	0.40	yes	0.30	0.26	(0.04)	18-hour	no
Upper Twin Lakes	1,805	1,250	2	150,000	58	17,000	24,000	36,000	74,000	--	0.20	0.24	yes	0.24	0.39	0.15	9-hour	no
Upper Woolsey Tank	1,845	2,500	2	300,000	190	57,000	80,000	117,000	243,000	0.44	0.47	0.60	yes	0.47	0.50	0.03	18-hour	no
Warner Tanks	1,640	3,000	3	540,000	1,558	467,000	654,000	963,000	1,991,000	1.66	1.97	3.00	no	1.97	2.50	0.53	18-hour	no
1235 Zone West																		
Equestrian Tank	1,227														4.20			
Morrison Tank	1,212														3.00			
Subtotal West		5,000	5	1,500,000	13,272	3,982,000	5,574,000	8,202,000	n/a	11.06	13.68	n/a	24-hour	11.06	7.20	(3.86)	24-hr	
1235 Zone East																		
Calabasas Tank	1,235	5,000	5	1,500,000	8,776	2,632,800	3,686,000	5,424,000	n/a	7.82	9.56	n/a	24-hour	7.82	8.00	0.18	24-hr	note 11
Zone Total		10,000	5	3,000,000	22,048	6,614,800	9,260,000	13,626,000	n/a	18.87	23.24	n/a	24-hour	18.87	15.2	(3.67)		
TOTAL ALL STORAGE				**7,590,000**	**32,773**	**9,833,800**								**34.43**	**34.41**	**(0.02)**	(7)	

Notes:
(1) Three Springs pressure zone is currently served by the Seminole Tank and 1235 system through PR stations.
(2) Based on reservoir storage only, actual operation may differ.
(3) Lower Box Canyon pressure zone is gravity fed by the Metropolitan Water District of Southern California, Turnout LV-1.
(4) Factors for converting MDD to 24, 18, and 9-hour basis are 420, 600, and 1200 respectively.
(5) McCoy Zone is also fed by PRSs which receive water from the Warner System.
(6) Mulwood Zone is also fed by the Mulwood PRS which receives water from the Warner System.
(7) Apparent shortage in reservoir storage could be mitigated by Las Virgenes Reservoir providing up to 8800 gpm available during MDD events. For example, 20,760 gpm - 8,800 = 11,960 gpm.
Corresponding 24-hour storage = 3,000,000+3,588,000+5,023,000 = 11.61 MG, which is less than 15.20.

Table 7-2 provides recommendations for pump operation, based on current reservoirs and pump station capacities.

Table 7-2
Summary of Criteria - Reservoirs and Pumping Stations

Reservoirs/Tanks		1999 Master Plan	2005 Master Plan
Fire Flow		Per Los Angeles County Fire Dept.	Per Los Angeles County Fire Dept.
Emergency		5-hour of MDD	5-hour of MDD
OPERATIONAL	24-hour basis	Calabasas, Equestrian Trails, Morrison (all 1235 Zone)	Calabasas, Equestrian Trails, Morrison (all 1235 Zone)
	18-hour basis	Dardenne, Kimberly, McCoy, Mulwood, Jed Smith, Saddle Tree	Dardenne, Jed Smith, Kimberly, McCoy, Mulwood, Oak Ridge, Saddle Tree, Twin Lakes, Warner, Lower Oaks, Upper Oaks
	9-hour basis	Saddle Peak, Seminole, Upper Woolsey, Latigo, Warner, Twin Lakes	Latigo, Ranchview, Saddle Peak, Seminole, Upper Twin Lakes, Upper Woolsey
Pumping Facilities		**1999 Master Plan**	**2005 Master Plan**
24-hour basis		Calabasas, Equestrian Trails, Morrison (all 1235 Zone)	Calabasas, Equestrian Trails, Morrison (all 1235 Zone)
18-hour basis		Oak Ridge, Dardenne, Kimberly, McCoy, Mulwood, Jed Smith/Mt. Gate, Saddletree	Kimberly, McCoy, Jed Smith/Mt. Gate, Mulwood, Seminole, Stunt Road, Three-Springs, Twin Lakes, Warner/Cold Canyon
9-hour basis		Stunt Road, Twin Lakes, Seminole, Warner/Cold Canyon	Dardenne, Lower Oaks, Oak Ridge, Ranchview, Saddle Tree, Upper Oaks, Upper Twin Lakes

Table 7-3
Summary of Current Storage Facilities

Subsystem	Deficit	Comment
Jed Smith	0.73 MG	18-hour deficit, deficit would still exist at 24-hour pumping.
McCoy	0.03 MG	Negligible
Saddle Tree	0.02 MG	Negligible
1235-Zone West	3.86 MG	This deficit is reflected in low water levels in Equestrian Trail and Morrison Tank during peak summer usage.
Upper Oaks	0.04 MG	Negligible

Conclusions Based on **Table 7-1**:

- For the LVMWD system as a whole, there is a negligible surplus of 0.06 MG, however the 1235 zone west has a deficit of 3.86 MG. The deficit does not take into account the storage available in Las Virgenes Reservoir. This storage is designed for peak demands and is available, but there are plant, pumping and other factors that limit its use.
- The deficit exists for the existing system and population. The buildout population demands are larger in magnitude. The deficit will only grow larger at buildout if system modifications are not made.
- Deficits indicate that pumps are in operation in excess of the design hours. The deficit at Jed Smith is large enough to suggest that emergency storage is being used during Maximum Day Demands, and complete storage recovery may not occur on a daily basis.
- The storage differences do not occur uniformly across the District. There are a few isolated systems that should be concentrated on.
- Further analysis is needed on the buildout system.

7.5 Reservoirs – Comments on System Reliability

In the event of a MWDCS shutdown following an earthquake or another event, the ability of the system to satisfactorily accommodate the outage is highly determinant on:

- ***Fire Flow Demands***: It would be likely to have a major fire flow event and a MWDSC outage occurring at the same time.
- ***Time***: The system would be more capable of accommodating the problem if the outage occurred in the evening or night when storage tanks are generally fullest. Also, if the outage occurred in the winter, demands are generally lowest.

Additional Storage is provided by the LVMWD system in various places:

- The system as a whole. Higher zones can provide water to the lower ones. Particularly Warner, Seminole, Latigo, and Saddle Peak have surplus storage. This water can be moved to lower zones with PRVs and then to higher zones with pumping. The only zones that cannot be supplied in this manner are the zones that are isolated from the rest of the system: Twin Lakes, Box Canyon, and Woolsey Canyon.
- Fire Storage throughout the system could be made available. There is a total of 7.5 MG of fire storage throughout the LVMWD system, equaling approximately 16 percent of a maximum day's worth of storage in fire flow storage alone.
- The Las Virgenes Reservoir filtration plant can deliver up to 10,000 gpm (15 mgd), but this is not generally sustainable. When the plant operates for extended periods, the average maximum flow that can be produced is about 9000 gpm (13 mgd). A critical consideration is how much water is extracted from the reservoir. During normal operations, the District must keep the reservoir above a certain minimum level in order to have adequate reserves for an earthquake or other emergency. There are also practical limitations on how low the water in the reservoir can drop, and still be useful. Another critical factor is how to refill the reservoir during the winter. If too much water is drawn out in the summer, hydraulic limitations in the transmission systems make it difficult to fully refill the reservoir in the winter.

Many factors are taken into consideration in deciding how much water to draw from Las Virgenes Reservoir, including the need for emergency reserve, water surface elevation, and difficulties in refilling.

- The District has numerous emergency connections. There is opportunity to receive emergency supplies from LADWP, Ventura County Waterworks District No. 17, the City of Simi Valley, California Water Service Company, and Oak Park Water Company.

7.6 Pumping Stations – Conclusions

Table 7-4 provides data and analysis on the current pump stations. Pump stations in the 1235 main zone are not included in the table, as they are addressed separately as part of the hydraulic analysis of that zone.

Table 7-4
Pump Station Capacity
Existing System

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
							Required flow at MDD (GPM)				Capacity for:			Deficit for:		
Pump Station(s)	Nominal Pump Station Capacity GPM	No. of Duty Pumps	Current Pump Capacity GPM[2]	Current Pump Station Capacity[1] GPM	No. of Standby Pumps	Provides Flow to	24-hr basis	18-hr basis	9-hr basis	Recom-mended Tank Basis	Off-Peak	18-Hour	24-Hour	Off-Peak GPM	18-Hour GPM	Comments
		2	240	480	0	MDD	103									Hydropneumatic facility (formerly used for Adamor)
		1	1750	1750	0	fire	1250									
Agoura + JBR	2300	3		2230	0	Agoura Zone	1353	n/a	n/a	n/a	n/a	n/a	yes	none	none	Includes fire flow
Dardenne	500	2	420	840	0	Dardenne Tank	263	350	702	Off-peak	yes	yes	yes	none	none	
	280	1	375	375	0	MDD	80									Hydropneumatic facility
	1250	1	1825	1825	0	fire	1250									
JBR	1530	2	1100	2200	0	JBR Zone	1330	n/a	n/a	n/a	n/a	n/a	yes	n/a	n/a	Includes fire flow
Kimberly	500	2	190	380	1	Kimberly Tank	218	290	582	18-hour	no	yes	yes	202	none	Production is low due to low suction gradient at MDD
Lower Oaks	1280	2	640	1280	1	Lower Oaks Tank	466	620	1244	Off-peak	yes	yes	yes	none	none	
						Lower Oaks PS	466									
						Upper Oaks PS	159									
						McCoy Tank	1880									
McCoy	3400	3	1133	3400	0	Total	2505	3332	6688	18-hour	no	yes	yes	3288	none	Deficit, if any, supplied by Park Granada PRS
Mountain Gate	1000	2	492	984	0											
Jed Smith	1700	2	850	1700	1											
Mountain Gate / Jed Smith	2700	4		2684	1	Jed Smith Tanks	1943	2584	5188	18-hour	no	yes	yes	2504	none	
						Mulwood Tank	985									
						Dardenne PS	263									
Mulwood	1000	2	490	1000	0	Total	1248	1660	3332	18-hour	no	no	note 3	large	note 3	
Oak Ridge	260	2	235	470	0	Oak Ridge Tank	145	193	387	Off-peak	yes	yes	yes	none	none	
Ranchview	400	2	400	800		Ranchview Tank	153	203	409	Off-peak	yes	yes	yes	none	none	
Saddle Tree	330	2	178	356	0	Saddle Tree Tank	129	172	344	Off-peak	yes	yes	yes	none	none	
						Seminole Tank	865	1150	2310							
						Latigo	248	330	662							
						Three-Springs PS	101	134	270							
Seminole	1600	2	750	1500	1	Total	1214	1615	3241	18-hour	no	yes	yes	1741	none	
Stunt Road	550	1	624	624	1	Saddle Peak Tank	365	485	975	18-hour	no	yes	yes	351	none	
Three-Springs	320	2	60	120	0	Three-Springs Zone	221	294	590	18-hour	no	no	no	470	174	Supplied by PRV
Pump No. 2		2	430	860	0	Upper Twin Lakes PS	58	77	155							
Pumps No. 3 and No. 4		1	585	585	1	Twin Lakes Tanks	1100	1463	2937							
Twin Lakes	2050	3		1445	1	Total	1158	1540	3092	18-hour	no	no	no	1647	95	Station Upgrade Needed
Upper Oaks	200	2	100	200	0	Upper Oaks Tank	159	211	425	Off-peak	no	yes	yes	none	none	
Upper Twin Lakes	400	2	200	400	0	Upper Twin Lakes Tan	58	77	155	Off-peak	yes	yes	yes	none	none	
						Warner Tank	1558									
						Cordillera Tank	1200									
						Oak Ridge PS	145									
Warner (1 & 2)	2840	2	822	1644	0	Stunt Road PS	365									
Warner (3)		1	1448	1448	0	Mulwood PRS	248									
Cold Canyon	1000	2	550	1100	1	Park Granada PRS	0									Cold Canyon production is low due to low suction
Warner/Cold Canyon	3840	5		4192	1	Total	3516	4676	9388	18-hour	no	no	yes	5196	484	gradient @ MDD

Notes:
1. Pump station capacity is calculated for MDD TDH and does not include standby units
2. Capacity per pump, if more than one operating.
3. Mulwood deficit supplied by Mulwood PRS. Mulwood flow is limited to 1000 gpm, to avoid low pressures on suction side.

The operations between pump station and reservoirs is highly integrated:

- Deficiencies in reservoir storage can be overcome by improving pump station capacity to directly feed customer supply during peak demands.
- Deficiencies in pump capacity can be overcome by increasing pumping hours, however, 24-hour pumping is not recommended (1235 main zone excluded).
- Off-peak pumping is a viable option only if both the tank/reservoir and pumping station are sized and operated appropriately.

It is noted that the determination of pump station capacities is less accurate than that of reservoir/tank storage capacities. Reservoirs are defined simply by geometry, where pump capacity is dependant on many factors:

Pump stations and tank capacities must be evaluated together. A storage deficit can be overcome if enough pumping is provided.

- Pump outputs are functions of pressure and flow rate. As pump pressures increase, flow rates decrease. Flow rates are also dependant on reservoir tank levels.
- The age of the pump highly affects pump output and efficiency, as does the age of the motor.
- Changes to the pump (impeller) may have altered the pump characteristics.
- Flow rate measurements are inherently less accurate than reservoir capacity requirements.

For the above reasons, pump, nominal pump, and pump station capacities are only considered to be best estimates. Columns 8-10 are based on MDD results for the existing conditions.

Summaries and key points are presented in **Table 7-4** in Columns 11-17. The recommended operation, based on pump adequacy, is shown in Column 11. The results of the pump and storage analyses are tabulated below in **Table 7-5**, with comments:

Table 7-5 Summary of Current Reservoir and Pump Station Capacities					
	Reservoir Adequate for:		Pump Station Adequate for:		
System	Off-Peak	18-Hour	Off-Peak	18-Hour	Comments
Agoura + JBR	n/a	n/a	n/a	n/a	Hydropneumatic, operates 24-hours
Dardenne	no	yes	yes	yes	More storage required for off-peak operation
Jed Smith/Mt. Gate	no	no	no	yes	Upgrade Needed
Kimberly	no	yes	no	yes	200 gpm short for off-peak
Latigo	yes	yes	n/a	n/a	Served by Seminole through PRV
Lower Oaks	yes	yes	yes	yes	No capacity problems
McCoy	no	no (minor)	no	yes	Can be fed by PRVs
Mulwood	no	yes	no	no	Can be fed by PRV
Oak Ridge	no	yes	yes	yes	Pumping capacity for off-peak, not enough storage
Ranchview	yes	yes	yes	yes	No capacity problems
Saddle Peak/Stunt Road	yes	yes	no	yes	Storage for off-peak, not pumping
Saddle Tree	no	no (minor)	yes	yes	No capacity problems
Seminole	yes	yes	no	yes	Needs more pumping
Three Springs	n/a	n/a	no	no	Supplied by PRV
Twin Lakes	no	yes	no	no	Needs more pumping
Upper Oaks	no	yes	no	yes	OK for 18-hour, if 2 pumps operate
Upper Twin Lakes	yes	yes	yes	yes	No capacity problems
Warner	no	yes	no	no	Pump output low due to poor suction
Woolsey	no	yes	n/a	n/a	Supplied by PRV

Many of the newer systems have adequate capacity, as they were designed for off-peak operation. There are some that cannot currently operate off-peak, upgrading should be considered after future scenarios are evaluated.

7.7 Turnouts

The amount of water that is delivered to the LVMWD System through the 1235 zone and either used in the zone or transmitted to a higher gradient zone is approximately 30,000 gpm (67 cfs). As shown, in **Table 7-6**, there are capacity limitations from the MWDSC turnouts. The maximum capacity is approximately 60 cfs, indicating a deficit. However, Las Virgenes Reservoir is available to provide seasonal storage for the District, and the turnouts can be upgraded if necessary. The seasonal storage at Las Virgenes Reservoir is determinant on the ability to re-fill during times of low demand.

Table 7-6
Existing Turnouts

	LV-1	LV-2	LV-3
MWDSC Feeder	West Valley Feeder No. 1	Calabasas	West Valley Feeder No. 2
Design Flowrate	24.5 cfs	75 cfs	4 cfs
Serves	1135 Zone	1235 Zone	Twin Lakes
Capacity w/o LVMWD Pumping	None into 1235 Zone	25 cfs	Pumping Required
Capacity with Pumping	11.5 cfs	50 cfs	4 cfs
Limiting Factor	Piping between Burbank and Kittridge	Piping	MWDSC Meter Size & Pumps
Pump Station	Conduit Pump Station	LV-2 Pump Station	Twin Lakes Pump Station

7.8 Evaluation of Hydraulic Capacity with Existing Demands

The previous sections discussed the methods by which the capacity of the District's pumping and storage facilities were evaluated to meet existing demand, and made recommendations for improvements, either to the capacity of the facility or to the operation of the facility. This section discusses the analysis of the hydraulic capacity of the existing transmission and distribution system (pipelines) to meet the existing demand, and provides recommendations for improving the pipeline capacity. Section 8 will discuss the capacity of the system to meet projected future demand.

The hydraulic analysis model was developed for the 1999 Potable Water Master Plan (LVMWD Report No. 2096.05) using GIS software and WaterCAD software (previously known as "Cybernet"). These were used to analyze flow and hydraulic gradients in the potable water distribution system under current demands and under buildout (year 2030) demands. Previous versions of the Master Plan discussed "intermediate" demands based on an intermediate year, with demand being greater than current, but less than buildout. These demands are difficult to predict, as land development projects determine the magnitude and location of demand increases. Transmission improvements will be recommended based on "trigger points" rather than time.

The results of the hydraulic analyses for the existing potable water system are presented in schematic diagrams throughout the remainder of this section. These diagrams generally show the relative locations of facilities in the District; however, they are not intended to be to scale. Flows through significant pipelines and pump stations are shown with arrows indicating the direction of flow at that time; flow direction may (and often does) change during the day. Hydraulic gradients are shown in ellipses at pump station suction and discharge points, tanks, and other significant points. (Gradients are shown rather than pressures since the pressure at any point is dependent upon the elevation at that point. Pressures can easily be calculated given the ground elevation.)

Most of the computer runs present results at peak hour, which is considered to be the worst case (highest flows through pipelines resulting in highest headloss, and therefore the lowest gradients through the system). The tanks are set at the bottom of the regulatory storage level; that is, the tanks are considered to have the full supply of fire flow storage and emergency storage, but no regulatory storage. These are worst case scenarios, and provide what may be considered to be conservative results. District staff may never have observed gradients as low as those presented on the schematics. Tanks are often kept well above the bottom of the regulatory storage range, and the peak hour of the Maximum Day Demand used for these analyses may not have actually occurred. However, based on the analysis presented in Section 5—Demand and Peaking Factors, the Maximum Day Demand, while conservative, is certainly not unrealistic. The District's system should be designed to deliver adequate flow and pressure under realistic circumstances.

Pipeline extensions have been shown to assist with the analysis, but the final location of these pipelines will depend on the nature of development that occurs.

Recommendations for pipeline improvements are generally for improving the hydraulic capacity of the distribution system to provide the necessary flows and gradients. Additional pipelines will be required to reach new users in the future; however, it is beyond the scope of this Master Plan to identify all future pipeline extensions that will be required. (Since many future pipelines will be within developments that have not yet been planned, it is impractical to attempt to guess where pipeline extensions may be required.) In certain instances, particularly in the Seminole, Latigo, and Saddlepeak subsystems, where it is likely that long reaches of pipeline will be required in existing roads, those lengths of pipeline have been included. They have been included not as recommended improvements, but simply to provide an idea of where future development might occur, and to provide an opinion of the pipeline size that may be required.

7.8.1 Existing System with Existing Demands

The following subsections present a discussion of existing subsystems that have either been identified by the District as having problems or that appear to have inadequate capacity based on the hydraulic analyses. Subsystems that do not appear to have capacity deficiencies with existing MDD or peak hour demands have not been discussed. Pumping and storage issues were discussed earlier in this section.

Plate 1 shows the locations of major facilities in the existing potable water distribution system (smaller distribution pipelines are not illustrated). **Plate 3** shows the existing and identified future pressure zones.

7.8.1.1 1235 – Foot Main Zone and East-West Transmission Pipeline

The "Main Zone," which distributes potable water to customers within the 1235-foot gradient (below an elevation of about 1100 feet), is the "backbone" of the District's potable water system. Most subsytems, with the exceptions of the Twin Lakes area (which is served from the separate LV-3 connection), the western Box Canyon area (which is currently served from a connection to Ventura County Waterworks District No. 8), and the Woolsey Canyon area (served by a connection to Ventura County Waterworks District No. 17), receive their supply from the 1235-foot pressure zone. Potable water purchased from MWD at the LV-2 and LV-1 turnouts is moved west throughout the District through the Main Zone.

Plate 1 shows the entire LVMWD service area with major existing potable water system facilities. The 1235-foot system stretches along the 101 Freeway corridor, from eastern Calabasas (where the LV-2 turnout is located) to the western edge of Westlake Village. It also serves portions of the District north of Hidden Hills and south of Conduit Pump Station (which raises the gradient of water purchased at LV-1 from about 1135 feet to 1235 feet); 1235-foot water can also serve users as far north as Box Canyon/Chatlake if no water is being purchased at LV-1 (in this instance, Conduit Pump Station is turned off and the 1235-foot water is regulated down to the 1180-foot range by a pressure regulating station on a bypass at Conduit).

Water purchased at the LV-2 turnout in Calabasas can either flow by gravity into the system, or, at larger flows, it can be pumped into the backbone system. With the current system and existing demands, flows up to about 25 cubic feet per second (cfs) can flow by gravity. At flows above that rate, headloss in the pipelines causes the gradient in the middle of the system, in the vicinity of Cornell Pumping Station, to fall unacceptably low. At flows over about 25 cfs, the LV-2 Pump Station is used to raise the gradient in the backbone system. (The current system is limited to about 50 cfs (22,500 gpm) due to backbone pipeline capacity. The pump station and MWD meter, however, will allow flow rates of up to 75 cfs with appropriate additional hydraulic capacity.)

Water purchased at LV-2 and LV-1 can be pumped west by Cornell Pumping Station, which is located in Agoura Road just east of Cornell

Road and Kanan Road. Depending on the flows and the gradients in the system (which are generally governed by the water levels in Calabasas, Equestrian Trails, and Morrison Tanks), it is possible for the District to maintain acceptable gradients throughout the system without using the Cornell Pumping Station. When Cornell is pumping to the west, it lowers the pressures on the east side of the pump station. Cornell is used to "balance" the gradient east and west of the pumping station. If the water level in Equestrian Trails Reservoir gets below a given set point, Cornell Pump Station turns on to try to fill it. Conversely, if the level in Calabasas Tank gets too high, Cornell will pump extra water to the west. (There is an override to prevent the pump station from emptying Calabasas Tank too low.)

In the event of a shutdown by MWD, Cornell Pumping Station can be reconfigured to pump water east (from Las Virgenes Reservoir) by changing valve positions at the pump station. This happens very infrequently. However, when Cornell Pumping Station is pumping east, it draws the suction pressure (on the west side of the pump station) down considerably, causing problems with low suction pressure at pump stations in the west.

Transmission improvements constructed in 2002 have greatly increased the ability to move water from east to west. Higher suction and discharge pressures at Cornell are an indication of this improvement.

Previous studies assumed the following minimum and maximum gradients at Cornell Pumping Station when pumping from east to west:

Minimum Suction Gradient:	1165 feet (135 psi)	To maintain adequate pressures east of Cornell
Minimum Discharge Gradient:	1210 feet (154 psi)	To maintain adequate pressures west of Cornell
Maximum Discharge Gradient:	1250 feet (171 psi)	To avoid impacting existing pipelines due to pressure class

Prior to the transmission pipeline improvements constructed in 2002, the suction and discharge gradients at Cornell were as low as 1075 and 1175 feet, respectively, well below the parameters shown above. District staff also reported that pressure complaints in certain parts of Agoura Hills were common, and getting adequate water transmitted to the western half of the District was problematic.

With the transmission pipeline improvements, particularly the addition of a 42-inch pipeline in Calabasas Road (extending from Warner Pump Station westward to the end of the road), these problems were greatly alleviated. Suction and discharge gradients at Cornell PS at peak hour rose to about 1130 and 1205 feet, respectively. While these gradients were still considerably lower than the parameters used in earlier analyses, District staff reported that the earlier problems with pressures and flows were no longer experienced.

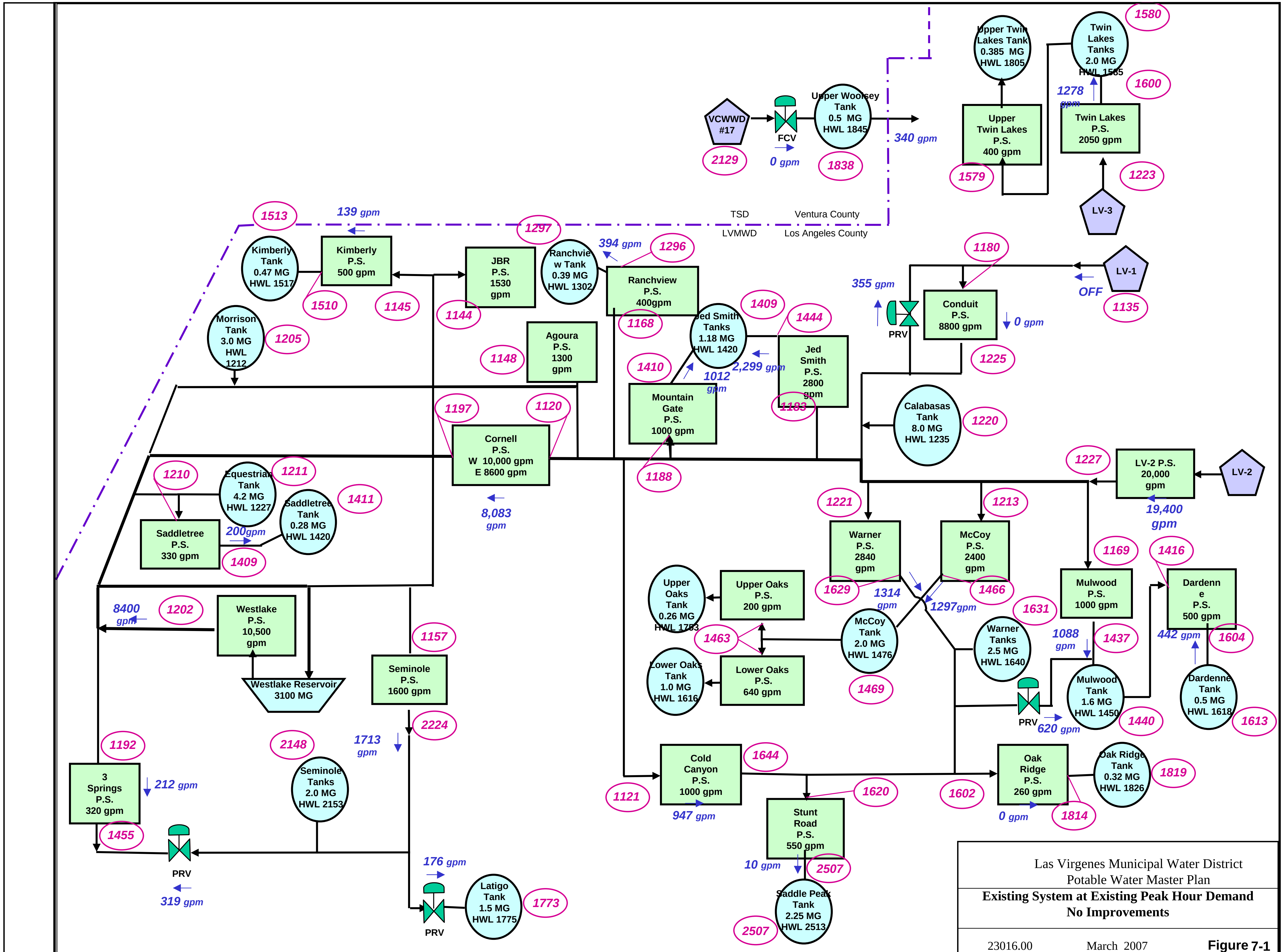
Additional transmission system improvements will be needed to prevent the return of problems. Development throughout the District is creating significant growth in demand.

Figure 7-1 shows the potable water system with existing peak hour flows through the existing potable water system; no improvements are incorporated into this analysis. The results are based on 19,400 gpm (43 cfs) supplied at LV-2, 8,400 gpm (19 cfs) supplied by Las Virgenes Reservoir, and no supply was modeled from LV-1 turnout.

At peak hour flows, the suction and discharge gradients at Cornell Pumping Station have declined some, and are well below the previous parameters of 1165 feet on the suction side and 1210 feet on the discharge side, but significantly higher than they were in 1999. The model calculates a suction gradient of 1120 feet and a discharge gradient of 1197 feet. While the pipeline between LV-2 and Calabasas Tank, and between Calabasas Tank and Cornel Pump Station, is sizable (24- to 42-inch, with most of the length being 30-inch), it is a long reach—over 35,000 feet, or six miles. Even a small amount of headloss every thousand feet of pipe results in a very significant change in gradient between Calabasas Tank and Cornell Pump Station. At peak flows, there is now approximately 100 feet of headloss, lowering the gradient from 1220 feet at Calabasas Tank to 1120 feet at Cornell Pump Station.

As the population of the District grows and demands increase, the earlier problems with pressures and flows are expected in return. Since the improvements were constructed, demands have increased about 15 percent, with another 15 to 20 percent expected. Much of this increase will occur in the Seminole / Latigo Zone and other areas in the western part of the District.

The previous version of the Master Plan modeled a scenario in which Cornell Pump Station was not pumping, but east-west flow was accomplished by gravity only. This scenario is unlikely to occur, as gradients in the west fall unacceptably low during peak hour demand and tanks quickly empty and cannot be refilled. This scenario was not modeled in this Master Plan update.



Las Virgenes Municipal Water District
Potable Water Master Plan

Existing System at Existing Peak Hour Demand
No Improvements

23016.00 March 2007 **Figure 7-1**

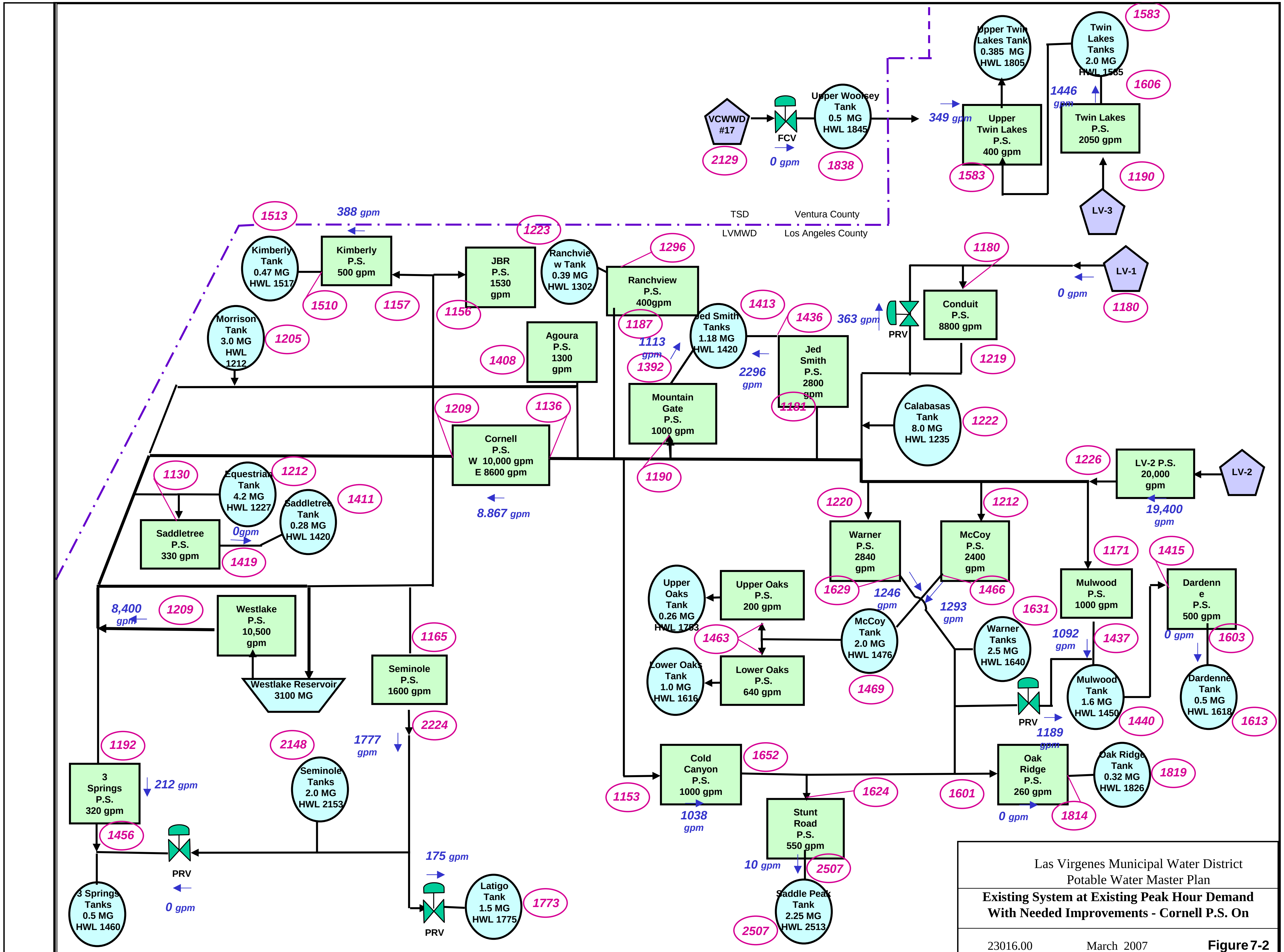
Other issues noted when analyzing the current system with existing peak hour flows were:

- High velocities and head loss in the transmission system east of Las Virgenes Road.
- Low pressures near Equestrian Tank and Morrison Tank.
- Low pressures in higher portions of Kittridge area.
- High velocities in 20-inch pipeline in Valley Circle.

Figure 7-2 shows the results of our analysis with a portion of the improvements that are recommended for future build out. If constructed sooner rather than later, these pipelines will further improve east-to-west transmission of water, and raise the gradients at Cornell. Also, a facility to provide potable water supplement to the recycled water system has been constructed at Morrison Tank. This facility is designed to provide up to 2000 gpm of supplement, but the current transmission pipelines are not adequate to fully use this facility. The full use of this facility will be needed if major extensions to the western recycled water system are constructed, particularly if both the Decker Canyon Project and the Thousand Oaks Boulevard Extension Project are constructed.

The improvements modeled in **Figure 7-2** include a 24-inch pipeline from Mureau Road to Las Virgenes Road and a pipeline from Cornell Pump Station, running westward and northward, toward Morrison Tank, terminating at Thousand Oaks Boulevard. The size of this latter pipeline varies from 12-inches to 18-inches.

When the current demands are modeled with these suggested improvements, the suction gradient at Cornell Pump Station increases from 1120 feet to 1136 feet. The discharge pressure increases from 1197 feet to 1209 feet. These more closely match the parameters used earlier for design and analysis of the system.



Las Virgenes Municipal Water District
Potable Water Master Plan

Existing System at Existing Peak Hour Demand With Needed Improvements - Cornell P.S. On

23016.00 March 2007 **Figure 7-2**

The improvements to the 1235-foot system, with approximate lengths, that were modeled include:

- 24” pipeline from west end of Calabasas Road to Las Virgenes Road (6711 feet).
- 18” pipeline from Cornell PS to Kanan Road (1150 feet).
- 12” pipeline from Kanan Road to Reyes Adobe Road (5,900 feet).
- 12” pipeline in Reyes Adobe from Backbone north to Thousand Oaks Blvd (4000 feet).

7.8.1.2 Jed Smith / Mountain Gate Subsystem (1420-foot Zone)

The Jed Smith/Mountain Gate system includes many pipelines that were installed many years ago, before Las Virgenes Municipal Water District was formed. There are many four- to six-inch pipelines that are incapable of supporting the current fire flow requirements, but were within code at the time, so there is no responsibility for the District to upgrade based on fire flow. In addition, prior to the last Master Mlan, District staff began having a difficult time filling the two Jed Smith tanks (1.38 MG total storage capacity), and noticed that the water level in the tanks drops well below the regulatory storage level into the emergency and fire flow storage volumes, even with four pumps operating 24 hours per day.

Pipeline improvements were constructed in 2000, on the suction side of Jed Smith PS, which enabled the running of 5 pumps (3 at Jed Smith PS and 2 at Mountain Gate PS). This improved pumping capacity by about 20 percent, providing some temporary relief, but also eliminating the only standby pump in the system.

The problem with the Jed Smith / Mountain Gate system was an unusual one. It was not a matter of new developments requiring more water as much as existing developments using more water, as new residents moved in. The area of Hidden Hills, in particular, was undergoing a conversion from traditional “horse properties”, where there was sparse landscaping, to an area of well-irrigated estate homes.

The District commissioned a study (LVMWD Report 2202.00), which examined the demand increase and concluded that ultimately a 30 percent increase in demands might occur, if demands in the Hidden Hills area eventually were to match the same levels experienced at other estate homes areas in the District (2000 gallons/acre/day). This was considered a conservative estimate; it was recognized that how many properties are ultimately converted from "horse properties" to well-irrigated estates would be difficult to predict.

In June 2004, another study (LVMWD Report 2202.20) examined what additional improvements would be recommended to meet the growing demands. A phased improvement program was recommended, because: (1) demands may not grow to the full extent estimated by the demand study, (2) facilities could be constructed as the demands increase, and (3) there was no easy way to construct a single project that could handle the demands once and for all.

The principal deficiency was storage. The two existing tanks were inadequately sized for the demands that were being experienced, and there was no feasible site to construct another tank. In the 1999 Master Plan, a new tank had been indicated, but its proposed location was in Ventura County, on the Ahmanson Ranch property. This property is now owned by the State of California as parkland and obtaining permission to construct a tank there is now considered to be very difficult.

A multi-phase program of improvements is recommended for the Jed Smith Zone. Because the Zone is nearly built out, growth in demand is hard to predict, but demands have consistently out-paced earlier predictions.

As discussed earlier, one way of mitigating a storage deficiency is by adding additional pumping capacity. This allows more water to be delivered directly to customers at peak hour, and less water is drawn from storage. This is the general approach of the first few phases of the improvement program.

The first phase of the improvement plan was to expand the capacity of Jed Smith PS, by installing larger pumps in the existing pump cans. This phase was completed in 2006, and increased capacity by 300 gpm overall, while allowing one of the pumps to be rededicated as a standby unit. The next phase of the improvement program, an expansion of Mountain Gate Pump Station, is recommended soon, to provide additional margin for meeting peak demands, and also provide a standby pump at that facility. Currently, if a pump at Mountain Gate fails, substantial capacity is lost. (The standby pump at Jed Smith cannot be run concurrently with the other two pumps.)

To implement this pumping upgrade, discharge piping improvements are recommended. Parallel discharge pipeline (approximately 900 feet) are needed to improve system hydraulics to allow a pumping capacity increase of 500 gpm.

Recommended improvements:

- Upgrade Mountain Gate pump station to a capacity of 3300 gpm and provide a stand-by pump.
- Install approximately 900 feet of parallel discharge improvements for Mountain Gate pump station. Hydraulic analysis of the existing system at peak hour shows high velocities in this pipeline. The velocities and headlosses will exceed District standards with the addition of more pumps.

Future improvements which may be needed, are the following:

- Construct a hydro-pneumatic pump station to connect to THE existing system. This pump station would relieve demands from the Jed Smith / Mountain Gate system by recreating the Adamor Zone. A former pump station that served this area was removed many years ago, and the homes in this area have since been served via a PR Station, via the Jed Smith / Mountain Gate system.
- Replace Jed Smith Tank No. 2 with a larger tank.
- Expand Jed Smith Pump Station, adding a 4th pump. This last improvement would also necessitate the following pipeline improvements:
    - Provide additional suction pipeline in Round Meadow Road.
    - Upgrade discharge pipe in Jed Smith Road.

Whether these future phases of the improvement program are needed, remains to be seen. An review of SCADA data (tank levels and pumping rates) should be conducted each autumn, to see how low the tank levels are dipping during peak demands. When tank levels dip consistently into the emergency and fire storage reserves, the next phase of improvements should be started.

7.8.1.3 Twin Lakes System (1585-foot Zone) and LV-3 Turnout

A pump station upgrade for Twin Lakes is currently in design.

The Twin Lakes System is currently not connected to the rest of the LVMWD system. The supply for Twin Lakes comes from the MWD supply through the LV-3 turnout. The emergency supply for this zone is provided by a connection to a LADWP fire hydrant in Germain Avenue. A 14-inch pipeline connection to the "30-inch Conduit" (recommended in the 1999 Master Plan), is currently in the design phase.

The Twin Lakes system also provides supply to Upper Twin Lakes and the proposed Deerlake Ranch zones. Currently, the Twin Lakes pump station is nearing capacity, and when the Deerlake Ranch development occurs, will be undersized. A pump station upgrade will be needed, along with other improvements. In order to increase the pumping capacity at Twin Lakes, both the pump station suction line and MWD turnout will need to be upgraded in order to provide adequate suction pressure to the pump station. Theses improvements are also in the design phase.

7.8.1.4 Woolsey Canyon

Woolsey Canyon is similar to the Twin Lakes area in that it only has a single source of potable water, through a connection with Ventura County Waterworks District 17. District 17, in turn, receives that water from the City of Simi Valley (Waterworks District 8). This supply that was intended to be temporary and can be terminated by District 17, with a one-year notice.

District 17, which serves the Bell Canyon area of Ventura County, has experienced problems with the reliability of their supply from Simi Valley. The water is pumped through a series of three pump stations and a long pipeline that crosses over very rugged terrain. The capacity of the system is very marginal, given the current demands in Bell Canyon, which are growing. District 19 has been looking at alternative supplies for Bell Canyon, and the preferred alternative in a study that they recently completed, involved a joint venture project with Las Virgenes. The project would serve residents in Bell Canyon, Woolsey Canyon, and a few Las Virgenes customers in nearby Box Canyon who presently receive water from Simi Valley.

Ventura County is investigating measures to improve service to Bell Canyon. One alternative involves a joint project that would also serve Woolsey Canyon.

In some ways, the situation in Woolsey Canyon is of more concern than Twin Lakes. For Woolsey, there is currently no existing emergency connection alternative, and the area is so isolated that an improvised solution would be difficult to devise in the time of crisis.

The future improvements outlined later in this report, are based on the concepts from the District 17 study, which was done with Las Virgenes input. Improvements include a high-lift pump station as well as an 18-inch diameter discharge pipeline which would run the length of the canyon, connecting to the District 17 transmission pipeline at the top. The pump station would need to lift the water to 1924 feet, which is the high-water level of Bell Canyon Reservoirs I and II, about 80 feet higher than Woolsey Tank.

7.8.1.5 Box Canyon

There are two separate subsystems in the Box Canyon/Chatlake area: (1) the western portion, which receives water at a gradient of about 1326 feet (reduced from 1550 feet by a pressure regulating station) from the City of Simi Valley (Ventura County Waterworks District 8), and (2) the eastern portion, which is served from the District's "30-inch Conduit" at a hydraulic gradient of about 1135 feet. The two systems are contiguous, and are separated by a zone valve in Box Canyon Road near Chaparral Road. There are some connections with relatively high elevations in the northwest area served by the LVMWD 1135 zone that receive low pressures.

Section 9.6 discusses the potential of changing the connection for the 1135-foot system from MWD's West Valley Feeder No. 1, which supplies water at a gradient of about 1135 feet, to MWD's West Valley Feeder No. 2, which supplies a gradient of up to 1265 feet. This reconnection would allow the entire Box Canyon area to be supplied most of the time directly by the District, with only a PRV backup connection to VCCWD No. 8. The backup connection is believed to be needed, because the gradient during peak demand periods on West Valley Feeder No. 2, has reportedly been measured as low as 1200 feet, and may be expected to dip as low as 1185 feet.[11]

[11] The MWDSC is continuing to study options for providing additional flows to Calleguas MWD and Las Virgenes, and has performed several hydraulic analyses with varying results.

Alternatively, the western Box Canyon area could be served from the discharge piping of the pumping system previously described for service to Woolsey Canyon. That would be less energy efficient than service from West Valley Feeder No. 2, if reduced-pressure service were taken from the high lift pumps, but installing a small, low lift pump as part of the pump station is something that should be considered. In either case, delivering the water from a Woolsey pump station will still be more efficient than the Simi Valley delivery system, which lifts water to over 2100 feet.

7.8.1.6 Cold Canyon / Warner System

The Cold Canyon/Warner subsystem, which provides water at a 1640-foot gradient, is a complex system. It takes its supply from the 1235-foot Main Zone through the Cold Canyon and Warner Pump Stations, and, in addition to providing potable water to many of the District's customers in Calabasas and along Mulholland Highway, it provides water to the Oak Ridge and Stunt Road/Saddle Peak systems, and can also supply the Mulwood system through a pressure regulating station (sometimes referred to as the "third pump" of the Mulwood Pump Station).

The existing demands on the existing system did not show any needed hydraulic improvements to this system, as PRV's are available if needed. There may be reliability concerns with some pipelines in the system, as discussed in Section 11.

7.8.1.7 Oak Ridge System

There were no specific near-term pipeline improvements noted in the Oak Ridge subsystem.

7.8.1.8 Stunt Road / Saddlepeak System

There were no specific near-term pipeline improvements noted in the Stunt Road / Saddlepeak subsystem.

7.8.1.9 McCoy System

There were no specific near-term pipeline improvements noted in the McCoy subsystem.

7.8.1.10 Mulwood System

There were no specific near-term pipeline improvements noted in the Mulwood subsystem.

7.8.1.11 Dardenne System

During hydraulic modeling of the current system with existing MDD demands, low pressures were observed near Dardenne Tank at peak hour. These low pressures likely occur due to the relatively high elevations and the higher diurnal peaking patterns that have been occurring in recent years. These higher peaks result in higher pipeline velocities, higher headlosses, and lower tank levels early in the morning.

No improvements are recommended at this time.

7.8.1.12 Kimberly System

During hydraulic modeling of the current system with existing MDD demands, low pressures were observed near Kimberly Tank at peak hour. As with Dardenne, these low pressures likely occur due to the relatively high elevations and the higher diurnal peaking patterns that have been occurring in recent years. No improvements are recommended at this time.

7.8.1.13 Seminole System

A multi-phase program is also recommended for the Seminole System. Improvements are needed soon, as demands already exceed pumping capacity during summer peaks.

As noted earlier in this Master Plan, there is the potential for considerable additional demand for potable water in the Seminole subsystem, and the pump station has had difficulties refilling the tanks at times. A short-term solution, implemented a couple of years ago, was to improve pump station performance by rebuilding the pumps, but the station is still running short of capacity. Fortunately, the storage is relatively large, and storage has not been depleted to such an extent that a crisis has occurred. Generally, recovery has occurred on the week end, perhaps because irrigation of vineyards in the area is reduced on weekends.

Section 8 presents a multi-phase program for improving both pumping and storage in the Seminole zone. In the long-term, major investments in facilities may be needed, due to the large potential for development in the area. The first phase of this program is to increase pumping at the existing pump station, by running the third pump that is there, and installing a fourth pump as a standby unit. This is an improvement that is needed in the short-term.

There are concerns that running a third pump will overstress the discharge piping of the pump station and cause pressure problems for customers on the suction side of the pump station. The hydraulic model shows that these are legitimate concerns, but tends to indicate that the effect will be modest. **Table 7-7** shows the differences in pressure that are predicted by the model.

Table 7-7
Analysis of Pipeline Pressures at Seminole Pump Station

Number of Operating Pumps	Pump Station Flow	Max. Discharge Pressure at Pump Station	Min. Suction Pressure at Pump Station
2 Pumps	1950 gpm	560 psi	65 psi
3 Pumps	2680 gpm	595 psi	55 psi

According to our records, the discharge piping is rated at 600 psi.

During modeling, high velocities and headloss pressures were noted near the Malibu Golf Course. A water system design report (LVMWD Report No. 2281.00) had earlier identified the potential for negative pressures in this area if large fire flows are demanded. Before new developments with higher fire flows can occur in this area, an upgrade to the existing 10-inch pipeline will be needed.

7.8.1.14 Latigo System

Pressure problems are a consistent problem along the Ramira Ridge pipeline that feeds the Latigo System. This is due primarily to the high-elevation of the pipeline for which there is no feasible solution. As noted in Section 7.9, hydrants along this pipeline are not capable of delivering standard fire flows, and when the Latigo Tank is filling rapidly, pressure problems become particularly acute.

7.8.1.15 Saddletree System

There were no specific near-term pipeline improvements noted in the Saddletree subsystem.

7.8.1.16 Upper Oaks and Lower Oaks Systems

There were no specific near-term pipeline improvements noted in the Upper Oaks and Lower Oaks subsystems.

7.8.1.17 Ranchview System

There were no specific near-term pipeline improvements noted in the Ranchview subsystem.

7.8.1.18 Upper Twin Lakes System

There were no specific near-term pipeline improvements noted in the Upper Twin Lakes subsystem.

7.9 Fire Flow Analysis

The hydraulic model was used to determine which general areas receive fire flows significantly below what may be the current minimum standards.

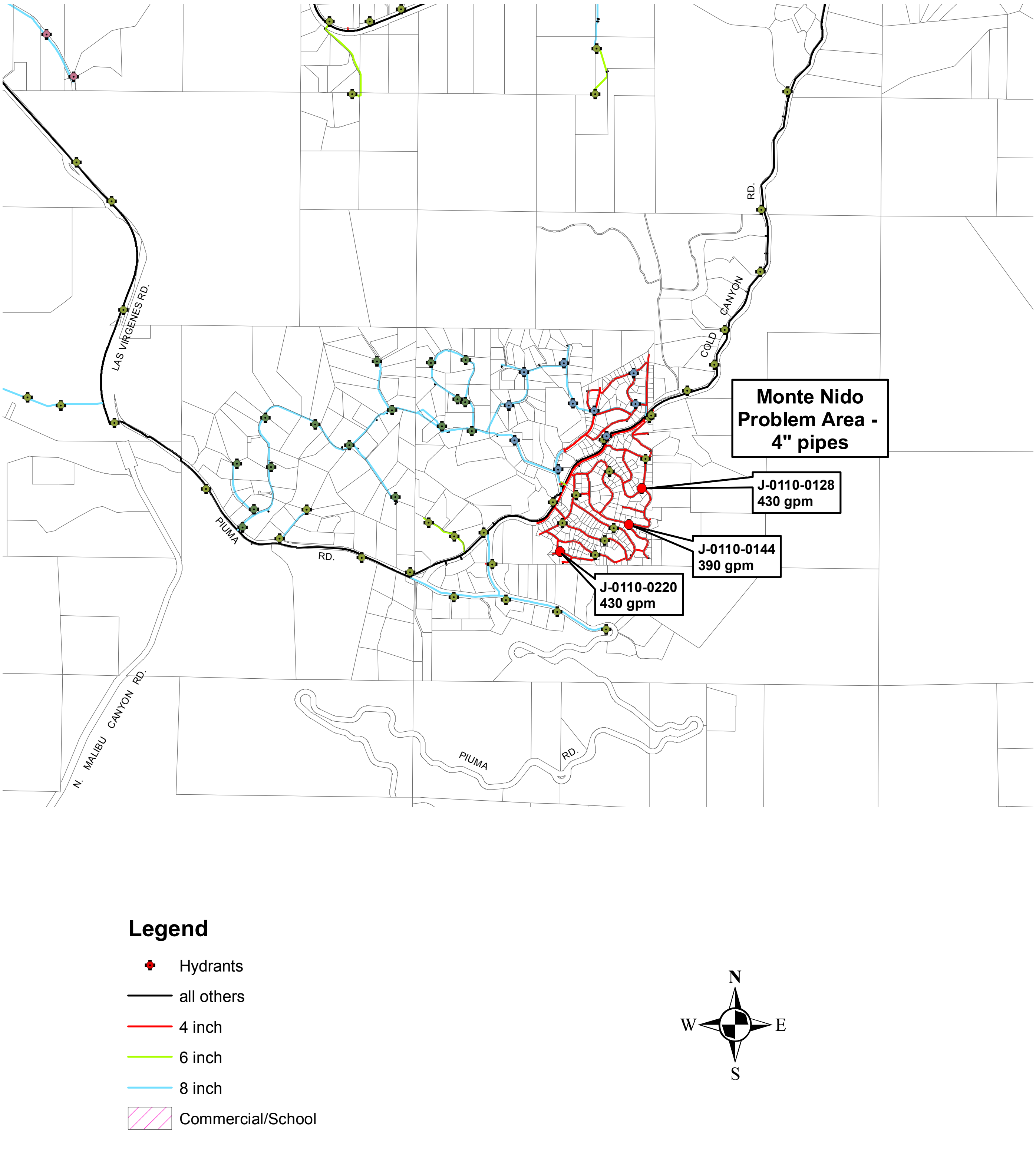
The fire flow analysis was performed to provide general information. The District is not obligated to make improvements to meet standards that have changed since the system was built.

This analysis was performed to provide general information for District Board, staff, and customers. It was not performed to identify capital improvements. As indicated earlier, water districts and other water utilities are not obligated to upgrade portions of their systems that do not meet current fire flow requirements. Typically, such systems complied with the standards that existed at the time they were constructed, and updating the system to increasingly higher standards would be economically unfeasible. It is purely a policy choice of the District, if any upgrades will be performed. Alternatively, customers who reside in areas where available fire flows are low, could form a special improvement district to fund improvements. However, more typically, where fire flows are low, sprinklers, on-site storage, or special types of fire-resistive construction can be used—such measures are often mandated by building permits, if new construction occurs.

The goal of the analysis was originally to identify all hydrants in the District that deliver less than 1250 gpm at 20 psi residual pressure. This is the minimum for single family homes in a high-fire risk area (per LACFD Regulation No. 8). For major commercial areas in the District (Agoura Road, Calabasas City Center, Lindero Canyon Road, Thousand Oaks Boulevard and Canwood Street), the analysis was to be for 2000 to 5000 gpm. This goal was set based on the understanding that a new hydraulic model of the District (by others) would be available for the analysis. Instead, the older model was used, which did not include fire hydrants—so an intensive effort was required to identify areas of concern, and modify the model so that hydrants in these areas could be analyzed. Also, in addition to the commercial areas, schools were examined, which are often located in residential areas, but typically require much higher fire flows.

In residential areas, the hydrants that were deemed critical are at relatively high elevations within a zone and/or at the end of long, small pipelines. All hydrants in commercial and school areas were evaluated.

The results of the modeling for the fire flow analysis are displayed on **Figures 7-3 through 7-9**.



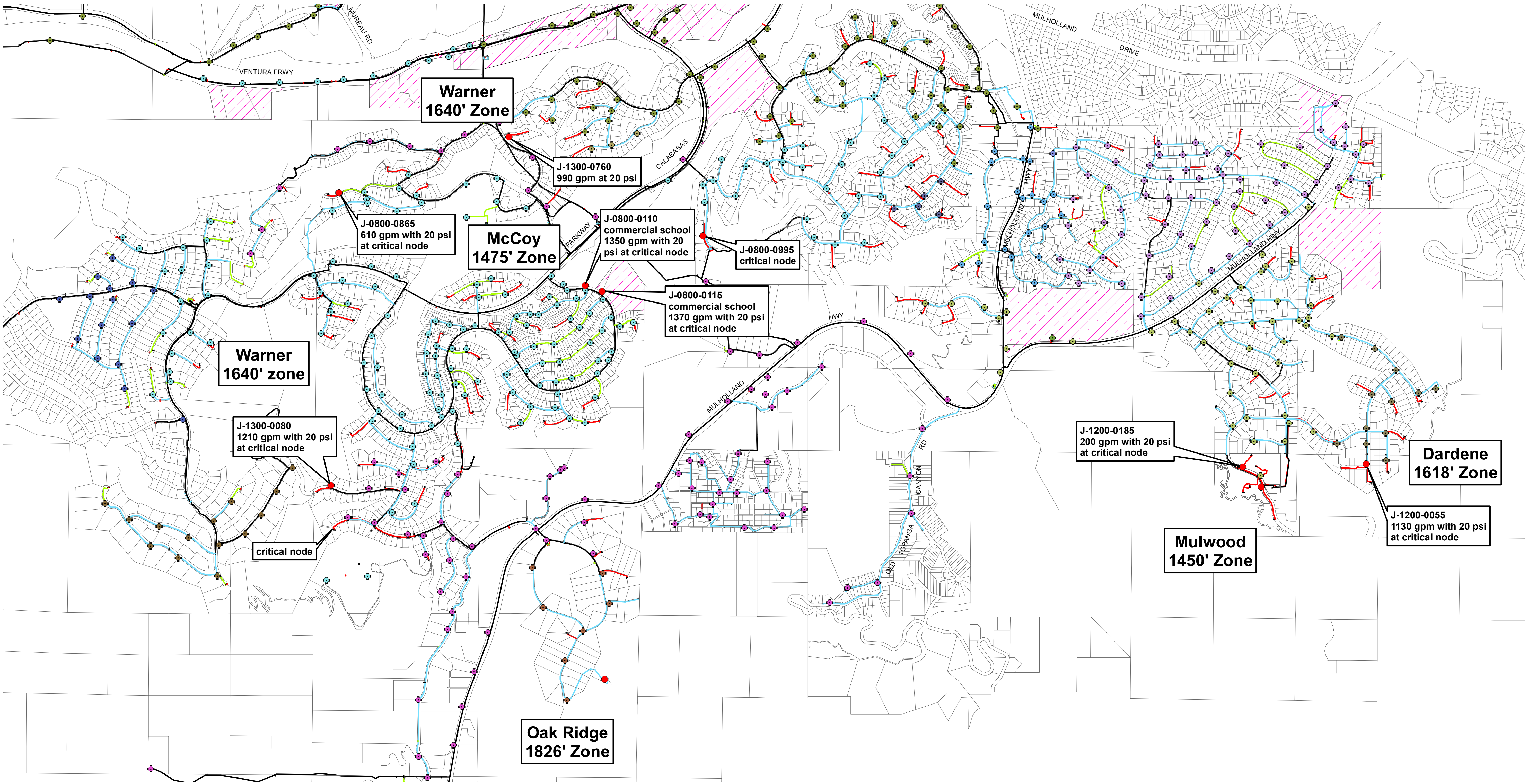
BOYLE ENGINEERING CORPORATION

Scale: 1" = 1600'

LAS VIRGENES MUNICIPAL WATER DISTRICT
FIRE FLOW ANALYSIS

FIGURE 7-3

F:\LVMWD\MISC LVMWD\MasterPlan\MASTER PLAN\zone 1235 hydrants figure 7-3.mxd



Legend

- Hydrants
- all others
- 4 inch
- 6 inch
- 8 inch
- Commercial/School

BOYLE ENGINEERING CORPORATION

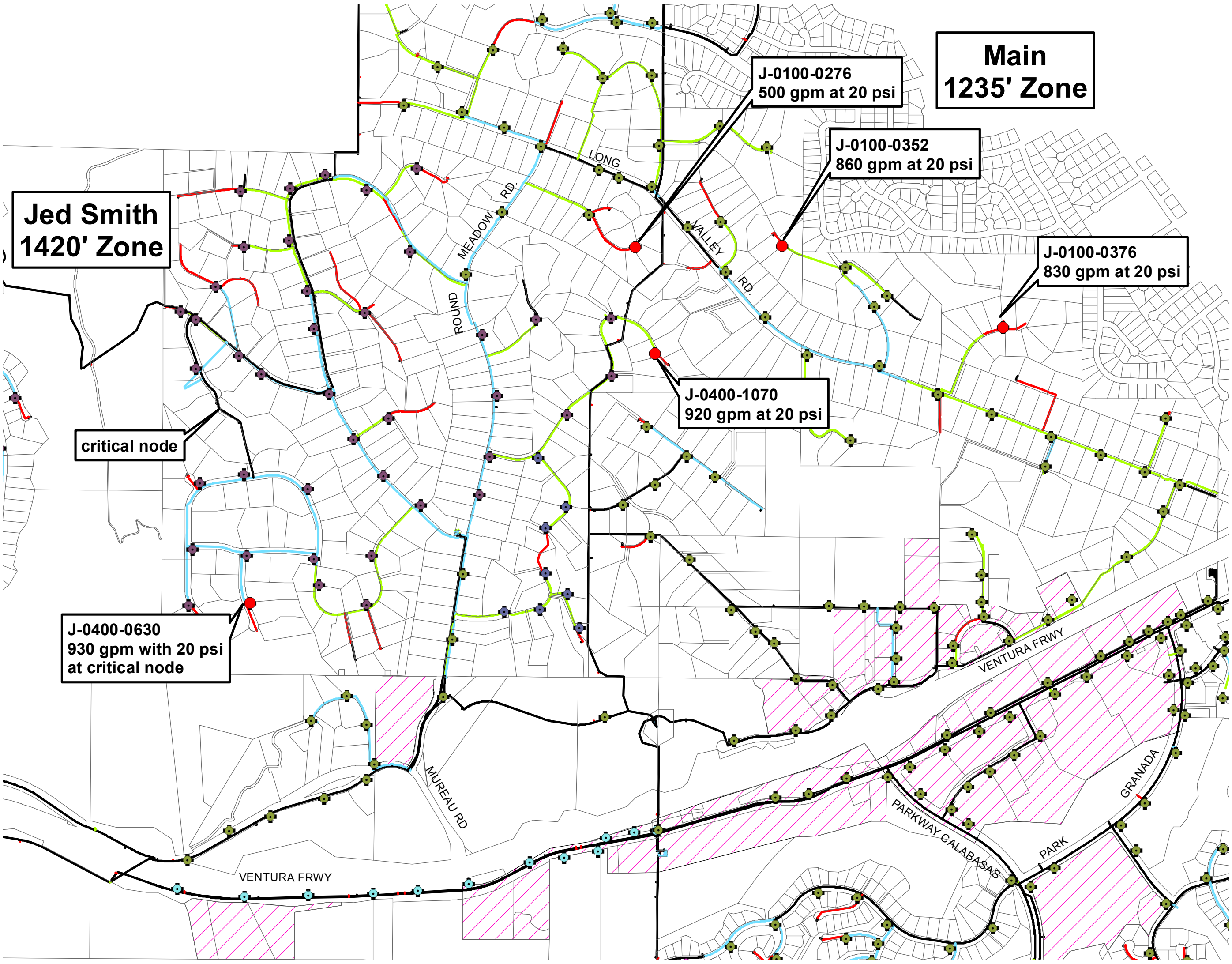
Scale: 1" = 1600'

N W E S

LAS VIRGENES MUNICIPAL WATER DISTRICT
FIRE FLOW ANALYSIS

FIGURE 7-4

F:\LVMWD\MISC LVMWD\MasterPlan\MASTER PLAN\zone 1235 hydrants figure 7-4.mxd

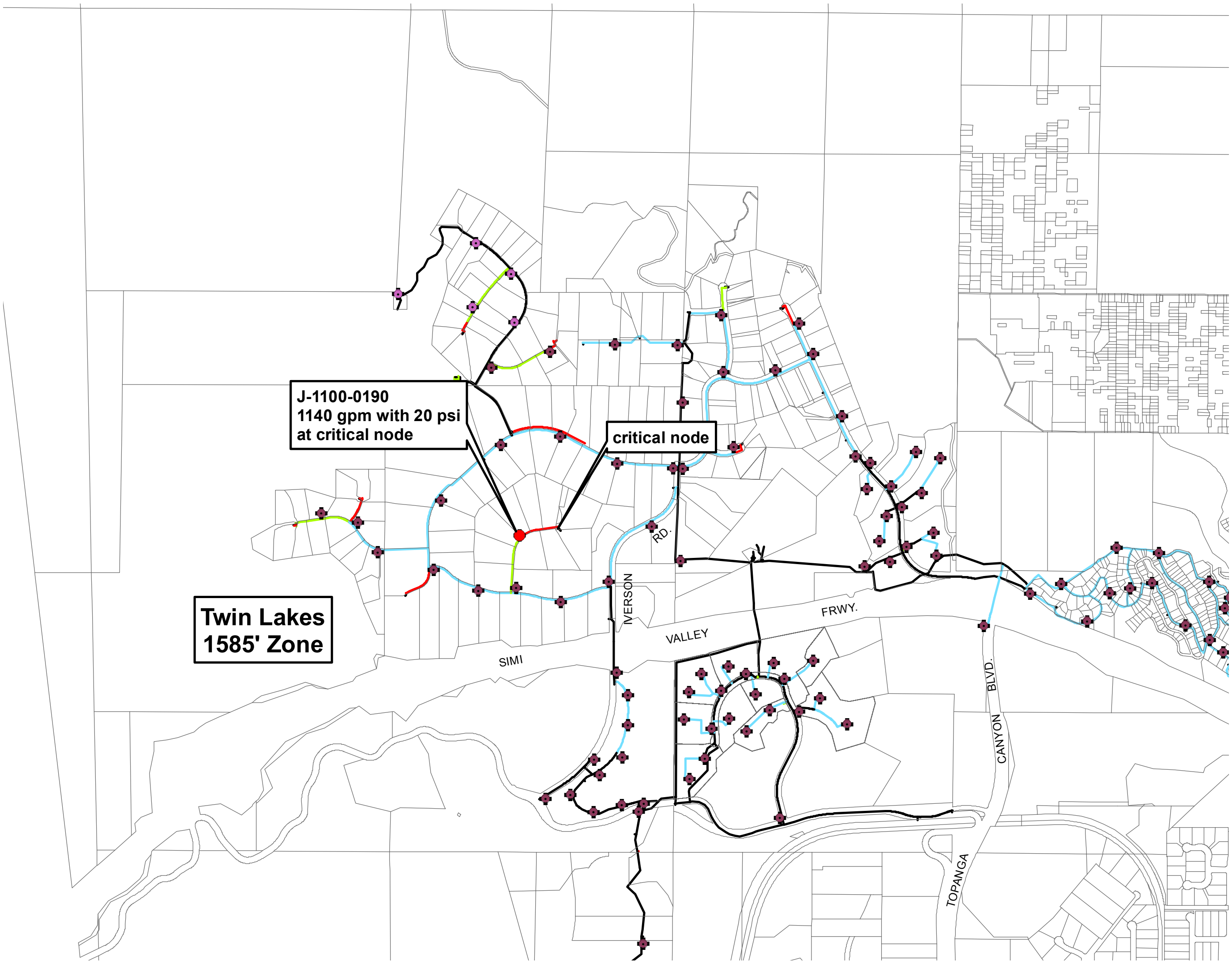


Scale: 1" = 1600'

LAS VIRGENES MUNICIPAL WATER DISTRICT
FIRE FLOW ANALYSIS

FIGURE 7-5

F:\LVMWD\MISC LVMWD\MasterPlan\MASTER PLAN\zone 1235 hydrants figure 7-5.mxd



Legend

- Hydrants
- all others
- 4 inch
- 6 inch
- 8 inch
- Commercial/School

N
W E
S

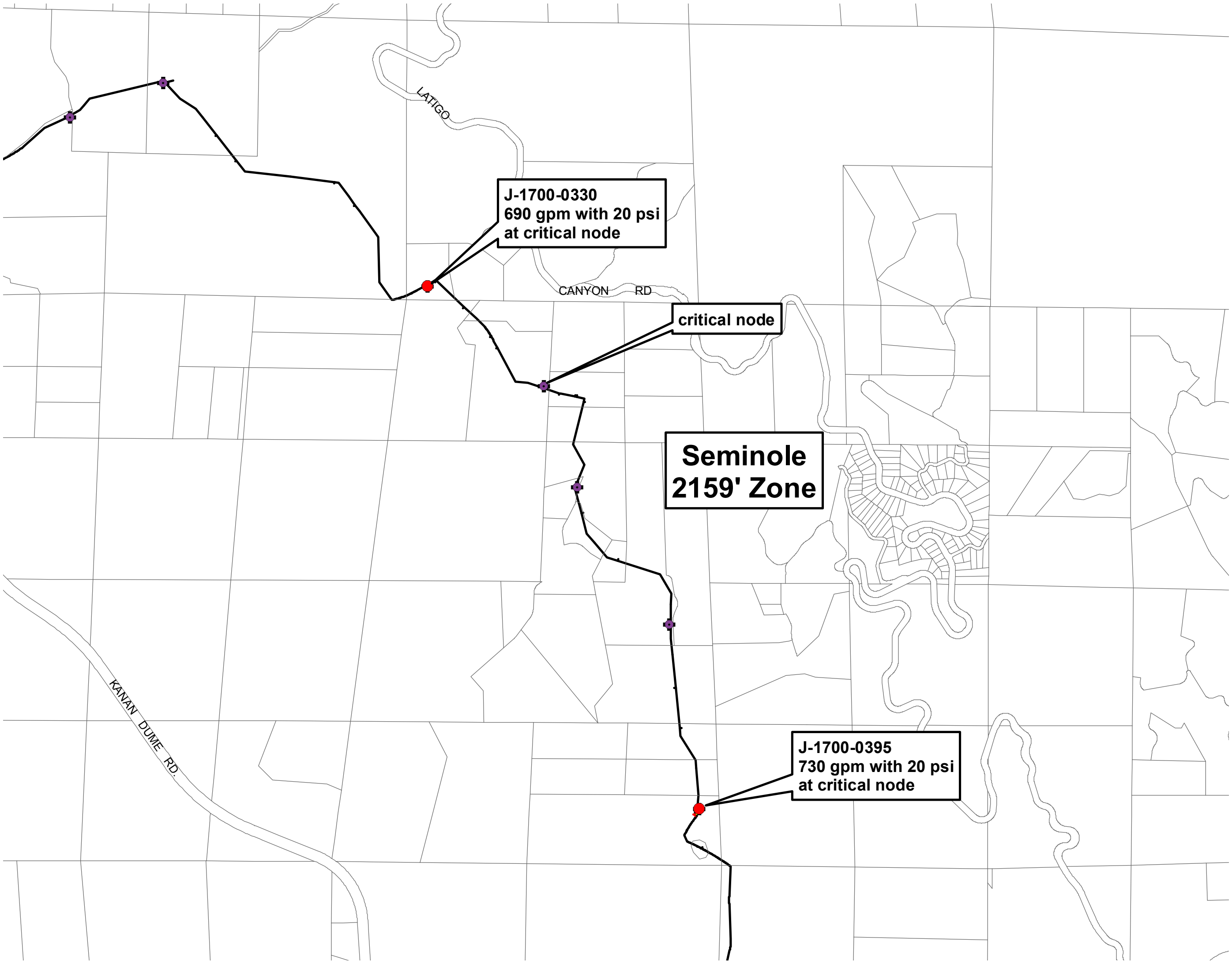
BOYLE ENGINEERING CORPORATION

Scale: 1" = 1600'

LAS VIRGENES MUNICIPAL WATER DISTRICT
FIRE FLOW ANALYSIS

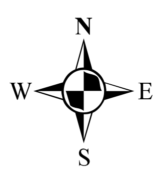
FIGURE 7-6

F:\LVMWD\MISC LVMWD\MasterPlan\MASTER PLAN\zone 1235 hydrants figure 7-6.mxd



Legend

- Hydrants
- all others
- 4 inch
- 6 inch
- 8 inch
- Commercial/School



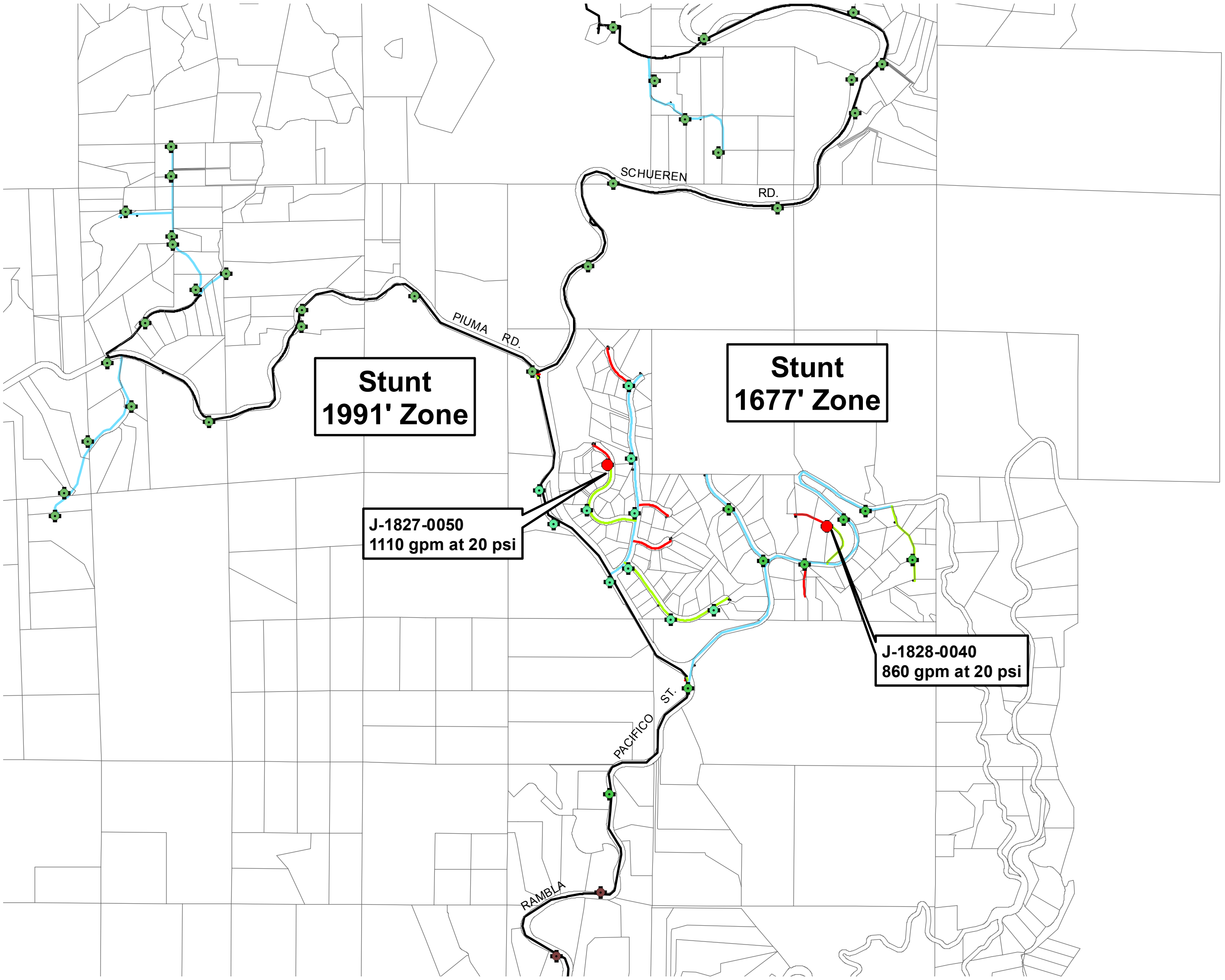
BOYLE
ENGINEERING CORPORATION

Scale: 1" = 1600'

LAS VIRGENES MUNICIPAL WATER DISTRICT
FIRE FLOW ANALYSIS

FIGURE 7-7

F:\LVMWD\MISC LVMWD\MasterPlan\MASTER PLAN\zone 1235 hydrants figure 7-7.mxd



Legend

- Hydrants
- all others
- 4 inch
- 6 inch
- 8 inch
- Commercial/School

N W E S

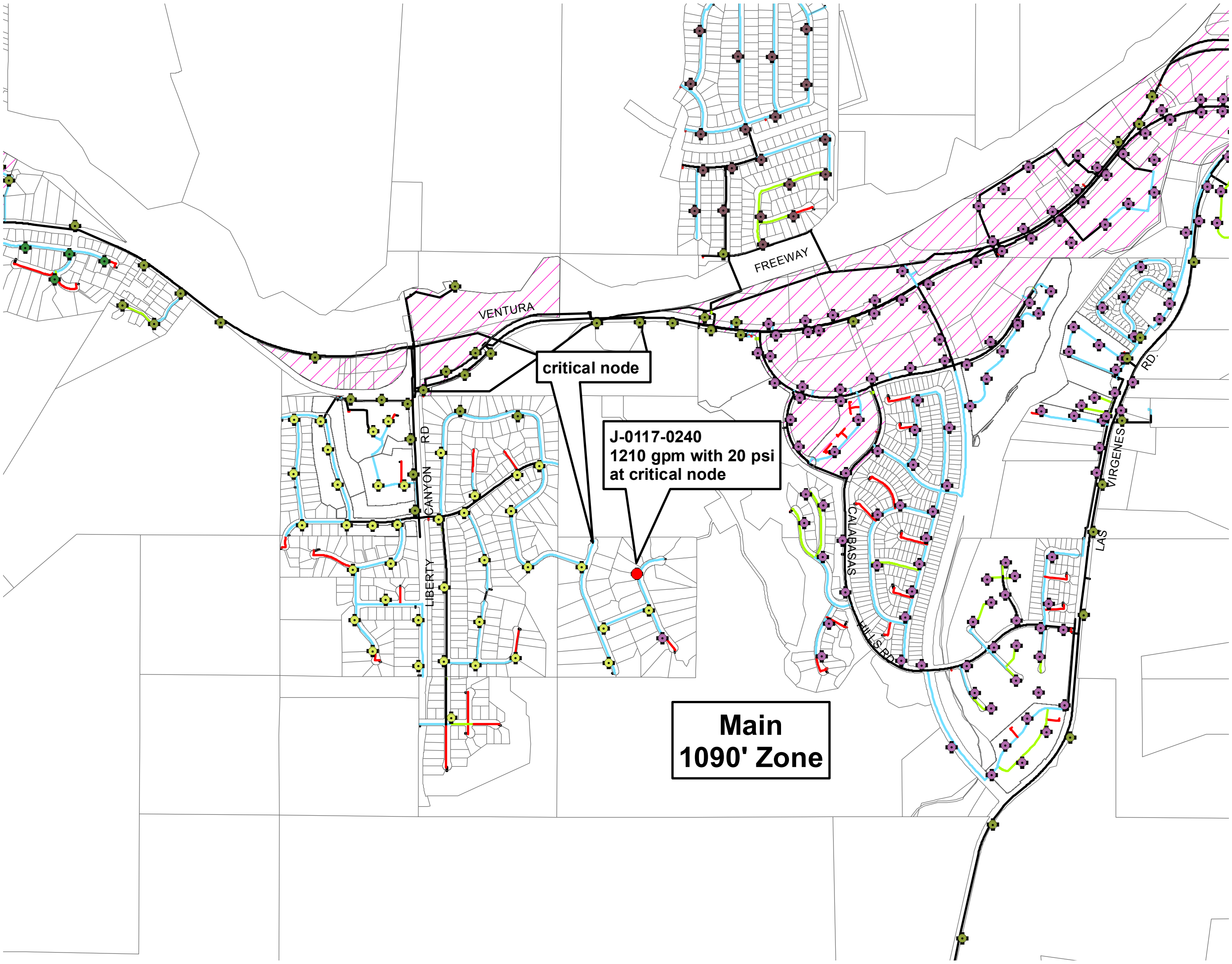
BOYLE ENGINEERING CORPORATION

Scale: 1" = 1600'

LAS VIRGENES MUNICIPAL WATER DISTRICT
FIRE FLOW ANALYSIS

FIGURE 7-8

F:\LVMWD\MISC LVMWD\MasterPlan\MASTER PLAN\zone 1235 hydrants figure 7-8.mxd



Legend

- Hydrants
- all others
- 4 inch
- 6 inch
- 8 inch
- Commercial/School

N W E S

BOYLE ENGINEERING CORPORATION

Scale: 1" = 1600'

LAS VIRGENES MUNICIPAL WATER DISTRICT
FIRE FLOW ANALYSIS

FIGURE 7-9

F:\LVMWD\MISC LVMWD\MasterPlan\MASTER PLAN\zone 1235 hydrants figure 7-9.mxd