WATER STORAGE PLAN

VALLEY OF THE MOON WATER DISTRICT
SONOMA COUNTY, CALIFORNIA

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Prepared by:
Brelje & Race Consulting Engineers
5570 Skylane Blvd.
Santa Rosa, CA 95403
707/576-1322

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1. INTRODUCTION

1.1 Background

A Master Water Plan (Reference 1, Master Water Plan) was prepared for the District in February 1998 to update information contained in previous plans and reports. The 1998 Master Water Plan included water storage facility projections and recommendations based upon information available at that time. Water from Sonoma County Water Agency (SCWA or Agency) storage tanks was identified as an additional emergency water source during prolonged outages.

A Strategic Water Supply Plan (Reference 2, Strategic Water Supply Plan) was prepared for the District in January 1999. This plan includes a minimum growth forecast based on extension of existing growth management and a corresponding well rehabilitation and development program. This well program was the result of a well study initiated in early 1998 and completed in April 1999 (Reference 3, 1999 Well Study).

1.2 Purpose

The purpose of this plan is to evaluate the District's water storage requirements for each pressure zone using water supply information contained in the January 1999 Strategic Water Supply Plan, using the capacity of water stored in SCWA tanks and using well water to supplement storage.

Recommendations and cost estimates are provided for the District's Capital Improvement Program.

1.3 Scope

The scope of work performed for the Water Storage Plan included the following:

- Review and evaluate the District's current and historical water production and purchases from the Sonoma County Water Agency.
- Identify the pressure zones and the current and projected number of customers and water storage needs in each zone utilizing the revised growth projection and the local groundwater supply wells anticipated in the January 1999 Strategic Water Supply Plan.
- Obtain information from the SCWA regarding delivery capabilities and limitations and identify SCWA storage volumes that may be available to the District during emergencies.
- Identify and evaluate potential sites for proposed water storage tanks.
- Identify and evaluate potential improvements to the SCWA aqueduct system that may benefit the District and reduce District storage needs.

- Estimate costs for recommended storage improvements and the District's share of costs for improvements to SCWA facilities.

- Review District hydraulic model results to evaluate storage requirements and the overall effects on the water system with the recommended District and Agency improvements.

- Develop a model of the Agency's facilities to evaluate the proposed parallel pipeline or other aqueduct improvements beneficial to the District.

- Propose a schedule for the recommended storage improvements.

2. SUMMARY OF RECOMMENDATIONS AND ASSUMPTIONS

The following are near term (before year 2005) recommended water storage improvements. A discussion with District staff resulted in establishing the following schedule:

FY 1999-2000

Replace the existing redwood 0.15 MG Crest Tank with a 0.26 MG welded steel tank. The estimated cost is $285,000.

Construct a 0.5 MG welded steel tank in the area of Hill Road for the Glen Ellen pressure zone. Acquire a site large enough for a future second 0.5 MG tank. The estimated cost of the first tank is $513,000, including land acquisition costs for a site large enough to accommodate two equal size tanks and 1400 LF of 8" transmission main.

FY 2000-2001

After the new Crest Tank is in service, replace the existing 0.21 MG Boyes Springs Tank with a 0.26 MG welded steel tank. The estimated cost is $285,000.

Construct a 0.14 MG welded steel tank next to the existing 0.21 MG Sobre Vista Tank. Abandon the existing tank after the new tank is in service. The estimated cost is $178,000.

It is also recommended that the District encourage the Sonoma County Water Agency to construct a parallel aqueduct between the Eldridge Tanks and the Madrone Turnout, a distance of approximately 8500 linear feet, as soon as possible (currently proposed by the Agency for fiscal year 2004/2005).

The following are long term (after year 2005) recommended water storage improvements :

- Construct a second welded steel tank of up to 0.5 MG for the Glen Ellen area.
- If and when warranted by development, construct a 0.1 MG welded steel tank at the Sobre Vista tank site at the location where the 0.21 MG tank was removed.
- If and when warranted by development, construct the Cavedale and Moon Mountain Tanks. Construction of these tanks will not be necessary if additional water is available from either a parallel Sonoma Aqueduct or new District wells.

These recommendations are based upon the following assumptions:

- A growth projection of 68 ESD's per year in the District as developed in the 1999 Strategic Water Supply Plan.
- Development of District wells with a capacity of 2.25 by the year 2005 and 2.57 mgd by the year 2050. Two-thirds of these amounts are assumed available for reliable production purposes.
- An emergency reserve of one average day is sufficient from District tanks and wells.

- Pumped pressure zones require 25% of the zone's maximum day demand for operating reserve storage and fire storage volumes as recommended.
- The Agency's Eldridge Tank will be full and would be capable of providing additional emergency and fire reserves for the District.
- The Sonoma Aqueduct provides sufficient water for hourly demands and approximately one-half of fire flow demands to the Aqueduct and Madrone pressure zones.

3. SYSTEM EVALUATION

3.1 District System

3.1.1 Water Supply Wells

The District currently has three operating wells with a total capacity of 0.53 MGD. A fourth well should be available by this summer, with an expected capacity of 0.43 MGD, bringing total production capacity to 0.96 MGD. The District also plans to develop three additional wells over the next four years. The goal is to produce 1.3 MGD from these additional wells. If this goal is achieved, the District will have approximately 2.25 MGD of well production capacity.

3.1.2 Water Storage Tanks

Existing District water storage tanks are listed in Table 3.1. See Figure 1 for tank locations.

Table 3.1 District Storage Tanks

Tank[1] No.	Name	Capacity	Type	Year Built
T-1	Temelec 1	0.200 MG	Welded Steel	1968
T-2	Temelec 2	1.000 MG	Welded Steel	1985
T-3	Donald	0.200 MG	Welded Steel	1963
T-5	Boyes Springs	0.210 MG	Bolted Steel	1966
T-7	Crest	O.150 MG	Redwood	1909[2]
T-8	Chestnut	O.320 MG	Welded Steel	1992
T-9	Hanna	2.000 MG	Welded Steel	1977
T-10	Sobre Vista - Low	0.030 MG	Concrete	1909[2]
T-11	Sobre Vista - High	0.210 MG	Bolted Steel	1909[2]
T-12	Saddle	O.150 MG	Welded Steel	1987
T-13	Trinity [3]	O.030 MG [3]	Redwood [3]	1909[2]

Footnotes:
1 Sequence is based on Master Water Plan numbering system.
2 Tank pre-existed year listed. Actual year unknown.
3 Not in service.

3.1.3 Water Use

District water demands were evaluated for the 1998 Master Water Plan. The average metered water usage for each pressure zone is shown in Table 3.2, including a proposed new Madrone area pressure zone. See Figure 2 for pressure zone locations.

TABLE 3.2 - Average Metered Water Use by Zone, Calendar Year 1996

Pressure Zone	Number of Services[1]		Ave. Daily Use/Service (gpd)		Ave. Daily Use/Service[2] w/losses (gpd)	
	Residential	CII	Residential	CII	Residential	CII
Trinity Oaks	50	0	590	0	659	0
Glen Ellen	414	21	366	827	410	924
Madrone	466	8	406	594	453	664
Temelec	1,108	11	207	3,555	232	3,974
Sobre Vista 2 & 3	33	0	974	0	1,089	0
Chestnut 2 & 3	300	0	303	0	338	0
Donald/Michael	24	0	458	0	512	0
Aqueduct (Main Zone)	4,149	160	351	1,898	392	2,122

Footnotes:
1. 6453 services total.
2. Includes 11.8% allowance for losses.

The District's unaccounted water losses averaged 11.8% in 1996. Average water use for the District in 1996 was 443.2 gpd per service connection including losses. The overall average demand in 1996 was 2.9 MGD.

Growth in the District is expected to occur primarily in the Aqueduct Pressure Zone. The numbers of service connections in each pressure zone were tallied for 1996 from information gathered for the Master Water Plan, and were estimated on a prorated basis for 2005 and 2050 using the growth projections developed in the Strategic Water Supply Plan and information from the Master Water Plan. The numbers of service connections have been separated into residential and commercial/industrial/institutional (CII) categories, and are listed in Table 3.3.

TABLE 3.3 - Estimated Number of Service Connections Per Zone

Pressure Zone	1996		2005		2050	
	Residential	CII	Residential	CII	Residential	CII
Trinity Oaks	50	0	50	0	50	0
Glen Ellen	414	21	443	23	580	29
Madrone	466	8	499	9	652	11
Temelec[1]	1,108	11	1,108	11	1,434	14
Sobre Vista 2 & 3	33	0	35	0	132	0
Chestnut 2 & 3	300	0	321	0	420	0
Donald/Michael	24	0	26	0	30	0
Aqueduct (Main Zone)	4,149	160	4,430	170	5,800	220

Footnotes:

[1] Temelec numbers include mobile homes, for which there are actually only two service connections but several hundred mobile homes.

3.1.4 Storage Requirements

Storage requirements are usually determined from a formula which includes an operating reserve, an emergency reserve and a fire reserve. The District has several pressure zones. Several District pressure zones receive water from SCWA turnouts which can supply some of the District's storage needs.

Recommended storage requirements for the District, would usually be as follows:

Operating Reserve	=	25% of Maximum Day Demand
Emergency Reserve	=	100% of Average Day Demand
Fire Reserve	=	1000 gpm for 2-hr duration (Residential) or 2500 gpm for 2-hr duration (CII)

The actual requirements for storage in the District can vary for each zone. This variation is possible because reserve storage can be held in any zone as long as there is a way to deliver it to other zones when needed. Only zones with pumps should have an operating reserve to minimize pump sizing and to prevent the pumps from running excessively. In addition, the Agency's aqueduct system includes storage which benefits several of the District's pressure zones, thereby reducing overall District storage requirements. Summaries of the storage requirements by pressure zone and by year (1996, 2005, and 2050) are shown in Tables 3.4, 3.5 and 3.6. These tables were generated by applying the average residential and average commercial usage in each zone to the projected numbers of each type of connection in the zone, and using the recommended storage reserve criteria.

TABLE 3.4 - Storage Requirements By Zone - 1996

Pressure Zone	Volume in Gallons			
	Operating	Emergency	Fire	Total
Trinity Oaks	0	33,000	0	33,000
Glen Ellen	142,000	189,000	300,000	631,000
Madrone	163,000	262,000	150,000	575,000
Temelec	226,000	301,000	300,000	827,000
Sobre Vista 2 & 3	27,000	36,000	120,000	183,000
Chestnut 2 & 3	76,000	102,000	120,000	298,000
Donald/Michael	9,000	12,000	120,000	141,000
Aqueduct (Main Zone)	0	1,970,000	150,000	2,120,000
Totals	**643,000**	**2,905,000**	**1,260,000**	**4,808,000**

TABLE 3.5 - Storage Requirements By Zone - 2005

Pressure Zone	Volume in Gallons			
	Operating	Emergency	Fire	Total
Trinity Oaks	0	33,000	0	33,000
Glen Ellen	152,000	203,000	300,000	655,000
Madrone	174,000	278,000	150,000	602,000
Temelec	226,000	301,000	300,000	827,000
Sobre Vista 2 & 3	29,000	38,000	120,000	187,000
Chestnut 2 & 3	82,000	109,000	120,000	311,000
Donald/Michael	10,000	13,000	120,000	143,000
Aqueduct (Main Zone)	0	2,101,000	150,000	2,251,000
Totals	**673,000**	**3,076,000**	**1,260,000**	**5,009,000**

TABLE 3.6 - Storage Requirements By Zone – 2050

Pressure Zone	Volume in Gallons			
	Operating	Emergency	Fire	Total
Trinity Oaks	0	33,000	0	33,000
Glen Ellen	198,000	265,000	300,000	763,000
Madrone	227,000	348,000	150,000	725,000
Temelec	292,000	389,000	300,000	981,000
Sobre Vista 2 & 3	108,000	144,000	120,000	372,000
Chestnut 2 & 3	107,000	142,000	120,000	369,000
Donald/Michael	12,000	15,000	120,000	147,000
Aqueduct (Main Zone)	0	2,746,000	150,000	2,896,000
Totals	**944,000**	**4,082,000**	**1,260,000**	**6,286,000**

Assumptions for Storage Requirement Tables 3.4, 3.5 and 3.6:

1. Emergency Reserve may be transferred between most zones in the District and is equal to one average day.
2. Fire Reserves are 1000 gpm for two hours in residential areas and 2500 gpm for two hours in commercial areas. One-half of fire flow is supplied by SCWA Aqueduct where available.
3. The reserve component for Trinity Oaks is shown, although it may not be required (see Section 3.1.5).
4. Growth in demands are approximately 7% by year 2005 and 40% by year 2050. The Sobre Vista area may receive additional growth based on 1998 Master Water Plan (the 2050 figures reflect this potential). The Trinity Oaks area is assumed to be already built out.

Values of zero in Tables 3.4, 3.5 and 3.6, indicate that a particular component was not necessary. For instance, Trinity Oaks has zeros for operating and fire reserves since those components are available from the Aqueduct. Fire components are either 120,000 gallons, or 300,000 gallons depending on whether a commercial area is present in the pressure zone. In the Madrone and Aqueduct pressure zones, the volume of water available from the aqueduct is considerable, therefore it was assumed that at least one-half of the flow during a fire event would be available from the aqueduct. The actual amount of water available from the aqueduct will depend upon hydraulic conditions, and the location of the fire relative to turnouts and storage tanks. Modeling runs for the Master Plan confirm that a large percentage of fire flow volume will come from the aqueduct along the Highway 12 and Arnold Drive commercial corridors.

The current storage available in each zone is shown in Table 3.7. The Aqueduct Zone has very little storage because the Donald and Crest Tanks are valved out-of-service and the Boyes Springs Tank is normally near empty during peak demand periods. Also, the Donald/Michael Zone has an effective storage capacity of 200,000 gallons because the Donald Tank is isolated and serves only as storage for the Donald pump station (which serves the Michael Drive Zone).

TABLE 3.7 – Current Storage Available by Zone

Pressure Zone	Effective	Actual
Trinity Oaks	0	0
Glen Ellen	150,000	150,000
Madrone	2,000,000	2,000,000
Temelec	1,200,000	1,200,000
Sobre Vista 2 & 3	30,000	240,000
Chestnut 2 & 3	320,000	320,000
Donald/Michael	200,000	0
Aqueduct (Main Zone)	0	560,000
Totals	**3,900,000**	**4,470,000**

3.1.5 Emergency Reserve Component

The amount of water that would be available from Agency storage tanks is uncertain. Therefore, it would be desirable for the District to maintain it's own emergency reserve capacity. Minimum storage requirements to provide domestic service are set forth in Title 22 of the California Administrative Code, Chapter 16, California Waterworks Standards. The Code requires that an emergency reserve equivalent to at least one average day of demand be available at all times. The American Water Works Association (AWWA) also makes the same recommendation in their storage standards. Therefore, to ensure that the requirements of Title 22 are met, it is recommended that the District have a minimum of one average day's demand for emergency reserves. Emergency reserves may be a combination of reliable well production capacity and storage volume.

If the new District wells produce planned capacities, there would be at least one average day or more of reserve capacity available from now to the year 2050. The location of the District's emergency reserves are shown in Table 3.8. The volumes of emergency reserves were calculated by subtracting the operating and fire reserve storage component from available storage in each zone.

TABLE 3.8 - Emergency Reserves Within District

Pressure Zone	1999[1]	2005	2050
Trinity Oaks[3]	0	0	0
Glen Ellen[3]	0	0	0
Madrone	1,687,000	1,676,000	1,623,000
Temelec	674,000	674,000	608,000
Sobre Vista 2 & 3[4]	0	0	0
Chestnut 2 & 3	124,000	118,000	93,000
Donald/Michael[4]	0	0	0
Aqueduct (Main Zone)[4]	0	0	0
Well Production	958,000	1,800,000[2]	2,570,000
Total Reserve	**3,443,000**	**4,268,000**	**4,984,000**
Required Reserve	**2,905,000**	**3,076,000**	**4,082,000**
Excess Emergency Reserve	**538,000**	**1,192,000**	**812,000**

Footnotes:

1 Figures for 1999 are based on actual storage capacity. Well production includes the Mountain Avenue Well which should be on line later this spring.

2 Well Production in 2005 is assumed to be 1.8 MGD instead of the 2.25 MGD planned. (Two-thirds of planned well production.)

3 Glen Ellen and Trinity Oaks cannot borrow emergency reserves from other parts of the District.

4 Sobre Vista, Donald/Michael, and the Aqueduct zones lack a reserve component of their own, but can use excess emergency reserves located in other zones.

As shown in Table 3.8, there is an overall excess of emergency reserve storage volume in the District, although there are no emergency reserves in some pressure zones. For most pressure zones, the absence of reserves is compensated by large reserves in other pressure zones. Reserves can be available from storage or wells as long as a method of redistributing water is available in an emergency. With emergency reserves stored at their current locations, pumping facilities are available for delivering water to the zones without emergency reserves, with the exception of Trinity Oaks and Glen Ellen. During an emergency, it may be more practical to truck water to the Trinity Oaks area than to provide emergency reserve storage, since only 50 services would be involved. For the Glen Ellen Zone, emergency reserve storage capacity is necessary. This zone would be a good location for additional reserve storage for use by other pressure zones. Glen Ellen is higher than most other zones in the District and reserve water could flow by gravity to other locations through the existing 8-inch pipeline in Arnold Drive.

3.1.6 Operating and Fire Reserve Component

The operating and fire reserve requirements by pressure zone for 1996, 2005 and 2050 are also shown on Tables 3.4, 3.5 and 3.6. The upper zones, Glen Ellen and Temelec, rely on pumps and need to have full operating and fire reserves. The Madrone area and the main Aqueduct Zone can rely upon aqueduct storage and turnout capacity for fire flows, and operating reserve is

not essential. It has been assumed that at least one-half of the fire reserves would come from the aqueduct in these areas. Additionally, it is known from experience that the Hanna Tank (Madrone Zone) cannot always stay full from aqueduct pressures, and therefore essentially uses it's "operating" volume to balance with aqueduct pressures. The zone rearrangement proposed as Option 3 in a letter to Paul Gradolph of the District, dated July 16, 1997 will minimize the "operating" volume to approximately the upper eight feet of the Hanna Tank.

The operating and/or fire reserve shortfalls for each zone are shown in Table 3.9. A zero indicates that there is no shortfall. It should be noted that these values are operating and fire reserve figures. The Glen Ellen Zone also has an emergency reserve shortfall, which is not shown in Table 3.9.

TABLE 3.9 - Operating and Fire Reserve Shortfalls by Zone

Pressure Zone	1996	2005	2050
Trinity Oaks	0	0	0
Glen Ellen	-291,860	-302,164	-348,449
Madrone	0	0	0
Temelec	0	0	0
Sobre Vista 2 & 3	-116,973	-118,608	-197,893
Chestnut 2 & 3	0	0	0
Donald/Michael	0	0	0
Aqueduct (Main Zone)	-150,000	-150,000	-150,000

Note: Glen Ellen requires an emergency reserve capacity which is not included in the volumes in this table. Overall storage shortfall for Glen Ellen is determined by subtracting the current storage amount (150,000 gal.) from the required storage shown by year in Tables 3.4 – 3.6. (Example in 2005: 655,000 gal. - 150,000 gal. = 505,000 gal. shortfall)

3.2 Sonoma County Water Agency Sonoma Aqueduct

The District purchases the majority of its water from the SCWA (87.7% in 1998). Water is provided by the SCWA through the Sonoma Aqueduct. Current agreements require that the SCWA provide 1.5 times the daily water entitlement of the District in storage facilities. Since the District's current entitlement is 4.7 million gallons per day, the storage requirement is 7.05 million gallons. The Agency's Eldridge Tanks have a total capacity of 8 million gallons and appears to satisfy the Agency's storage obligation.

Water used by the District and the City of Sonoma approaches their maximum month entitlements and exceeds the maximum month entitlements on peak summer days. The result has been a lowered hydraulic grade line in the Sonoma Aqueduct which causes lower than desirable pressures for both the District and the City. A parallel aqueduct is proposed by the Agency to supply the entitlement increases that have been requested by the District and the City. The parallel aqueduct is scheduled by the Agency to be completed in segments.

3.2.1 The availability of water from SCWA storage facilities to the District during emergencies would depend upon procedures followed by Agency staff. In general, the 8 million gallons stored in the Agency's Eldridge Tanks should be available. However, water in the Eldridge Tanks could flow by gravity to the Sonoma Tanks and refilling the Eldridge Tanks would depend upon operation of the Agency's Sonoma Booster Pumps located at Spring Lake in Santa Rosa. It would be in the District's interest to review emergency procedures with Agency staff to insure that the maximum amount of water would be available to the District from Agency tanks during an emergency.

3.2.2 Aqueduct Model Results

A portion of the Sonoma Aqueduct and planned segments of the parallel aqueduct were modeled using a computer hydraulic modeling program. The model begins near Oakmont with the two Annadel Tanks and terminates at the Sonoma Tanks. Several scenarios were run with altered conditions including: varying water levels in the Sonoma Tanks; the Eldridge Tanks in service and bypassed; and demands set at current and requested entitlements. The demand settings were intended to simulate peak month demand conditions, both now and in the future, with full entitlements as currently requested being withdrawn. Should the District's demands actually be less than it's entitlement request, model results would be conservative.

The purpose of modeling the Sonoma Aqueduct No. 2 was to quantify the benefit of each segment to the District and to determine the priority of each segment.

A summary of the modeling runs is included in Appendix A. Complete model inputs, outputs, and model schematic diagram are included in Appendix C, which is bound separately.

The SCWA has proposed a schedule for constructing segments of the parallel aqueduct. The SCWA schedule does not provide the most cost/benefits to the District. For full entitlements as currently requested by the City of Sonoma and the District (8.5 mgd and 6.3 mgd, respectfully), the proposed schedule for constructing the parallel aqueduct segments is shown in Table 3.10. The SCWA schedule is also shown on Table 3.10.

Construction of the first proposed segment of aqueduct would provide the most benefits to the District for the cost of the project. Based upon requested entitlements, the District's share is estimated to be approximately $1,000,000. District peak demands would be satisfied, and the flows into the Sonoma tanks would be increased by approximately 1.3 MGD over current conditions. Pressure at the Madrone turnout would always remain above the Hanna tank level. Consequently, the 2 million gallons at Hanna would become more usable, and the hydraulic grade line at the District's other tanks, including those proposed in this report, would also be improved.

TABLE 3.10 – Proposed Parallel Aqueduct Construction Schedule

Proposed Schedule		SCWA Schedule[3]		Length of Segment	Segment Description
Priority	Year	Priority	Year		
1	2001-2	1	2001-2	8,500 LF	Eldridge Tanks to Madrone Road
2[1]	2005-6[4]	4	2012-13	17,000 LF	Madrone Road to Railroad Avenue
3[1]	2010-11[4]	2	2001-2	26,000 LF	Annadel No. 2 to Trinity Oaks
4[2]	N/A	3	2004-5	7,000 LF	Trinity Oaks to Eldridge Tanks
5[2]	N/A	5	2012-13	7,000 LF	Railroad Avenue to Sonoma Tanks

Footnotes:

1 The 17,000 LF and 26,000 LF segments are equal in priority.

2 These segments may not be needed since the first three segments proposed will satisfy the full entitlement flows for both Sonoma and VOMWD.

3 From SCWA Water Supply & Transmission Project EIR -- Table 1B, "Long Range Capital Program Cost Allocation -- High Water Use Projection." (See Appendix B and Reference 4)

4 The proposed dates for installation represent the earliest period the District should consider constructing them. The actual need may be delayed if the demand forecasts of the Strategic Water Supply Plan are realized.

The priority of the second and third segments is interchangeable, based on their benefits to the District. The proposed priority has the lower cost segment being constructed first. If both of these segments were constructed, the District's and the City of Sonoma's full entitlement increase request would be satisfied and tank level problems in the District would disappear. The proposed years listed in Table 3.10 represent the earliest fiscal years the District would want the segments constructed and is not a recommendation for when they should be built. It may not be necessary to build Segments 2 and 3 for some time after the dates suggested, and perhaps not at all, if the lower demand forecasts of the Strategic Water Supply Plan are accurate and water production from planned District wells meets expectations.

For full entitlement demands, and especially for the demand projections of the Strategic Water Supply Plan, the final two segments would not be necessary. The main benefit of constructing these segments would be increased reliability.

3.2.3 Other Agency Improvements

The benefits of installing one or more booster pump stations along the Agency aqueduct was also evaluated as an alternate means of increasing capacity. This alternative appears to be attractive because the costs for constructing pump stations are funded by all water contractors.

The benefit of a booster pump station would be less than the benefits of other alternatives (additional District wells and tanks, and parallel segments of the aqueduct). A booster pump station would provide two benefits: higher flows into the Sonoma tank and higher pressures immediately downstream of the pump stations. The drawbacks of a booster pump station would include reduced upstream pressures, high operating and maintenance costs, and less reliability in emergency situations than additional storage or a parallel aqueduct.

4. DISCUSSION AND RECOMMENDATIONS

4.1 District Storage Improvements

Storage requirements for the District were outlined in the previous section. Storage recommendations for each area are discussed in the following subsections. See Figure 1 for locations.

4.1.1 Glen Ellen Area Pressure Zone

The current storage capacity in the Glen Ellen pressure zone is provided by the 150,000 gallon Saddle tank. Storage requirements for the zone, including operating, emergency and fire reserve volumes, total 631,000 gallons, and are projected to increase to 655,000 gallons by 2005, and to 763,000 gallons by 2050.

The current storage shortfall is 481,000 gallons. The shortfall will increase to over 600,000 gallons by 2050. The Glen Ellen area is an ideal location for additional District reserves because it is at the high end of the District's water distribution system.

It is recommended that one 500,000 gallon storage tank be constructed in the Hill Road area after the completion of the planned Glen Ellen Booster Pump Station. The tank site should be large enough to accommodate a second tank with a capacity of 500,000 gallons to be constructed in the future. The overflow elevation should match the existing Saddle Tank.

The capacity of the future second tank could be between 100,000 gallons and 500,000 gallons, depending upon the amount of reserve the District elects to locate in the Glen Ellen area. Establishing the capacity of the second tank should be deferred until the actual capacity of planned wells is known and more information regarding growth, water conservation efforts and water re-use is available.

4.1.2 Sobre Vista Area Pressure Zones

Currently the Sobre Vista Area has a second and a third level pressure zone. Sobre Vista Zone 2 has only 3 services, and there are 30 services in Zone 3. Some growth is likely to occur in these zones. There is also a potential for the Sobre Vista Mutual Water Company to be incorporated into the District.

There are two tanks currently serving the two zones, a 30,000 gallon tank for Zone 2 and a 210,000 gallon tank for Zone 3. The Zone 3 tank is one of the tanks the DHS has ordered replaced or rehabilitated.

Storage requirements for the Sobre Vista area include operating and fire reserves. Emergency reserves are not required to be stored in either of these two zones. With elimination of the existing 210,000 gallon tank, the storage shortfall would

be approximately 120,000 gallons. This shortfall would not change significantly until a major subdivision occurs, or until the Sobre Vista Mutual Water Company is incorporated into the District.

It is recommended that a new 140,000 gallon welded steel tank be constructed adjacent to the existing 210,000 gallon tank. After completion of the new tank, the existing tank should be dismantled. The site of the existing tank should be retained for future construction of a 100,000 gallon tank. The future tank will only be necessary if additional development occurs or if the Sobre Vista Mutual Water Company is added to the zone.

4.1.3 Aqueduct Pressure Zone

The required storage for the aqueduct zone is 150,000 gallons, which is one half of a commercial area fire demand. With emergency reserves available from other tanks and District wells, an emergency reserve storage capacity in the Aqueduct Zone is not necessary. An operating reserve capacity is also not needed since operating pressures are supplied by the aqueduct system.

It is recommended that the 150,000 gallon redwood Crest tank and the 210,000 gallon Boyes Springs tank be replaced. Each new tank should be 40 feet in diameter and 30 feet tall with a capacity of 260,000 gallons, for a total capacity of 520,000 gallons.

The recommended capacity is 370,000 gallons greater than is required. The additional capacity is desirable to allow for fluctuations in tank water levels, which are expected to continue until all planned District wells and pipeline improvements are in service, and the recommended first segment of the parallel aqueduct has been completed. The height of the tanks will allow for winter water level fluctuations (to prevent stagnant water quality problems from occurring), while maintaining adequate fire reserves during high demand periods.

The expected minimum fire storage volume available in the two tanks recommended for the Aqueduct pressure zone for various demand situations are shown in Table 4.1 with the recommended tank additions only and with the Priority 1 parallel aqueduct addition in place.

TABLE 4.1 – Proposed Aqueduct Zone Minimum Fire Storage Volumes

Demand Situation	w/Proposed District Tanks (Aqueduct PZ)	w/Priority 1 Aqueduct Addition
Peak Hour Demands	94,000 gal.*	225,000 gal.
Maximum Day Demands	225,000 gal.	375,000 gal.
Average Day Demands	500,000 gal.	500,000 gal.

* Less than the 150,000 gallons recommended, however, this situation is extremely brief and occurs one day of the year only.

It is recommended that the existing Crest tank be replaced and placed into service prior to replacing the Boyes Springs tank to ensure that there will be some fire storage capacity available in the Aqueduct Zone.

4.1.4 Additional Storage Facilities

The 1998 Master Water Plan anticipated growth to occur in the Cavedale and Moon Mountain areas. Without additional sources of supply from new wells or a parallel aqueduct, it is likely that new storage facilities will be required to supply the demands in these areas.

4.1.5 Proposed Schedule for District Improvements

A discussion with District staff resulted in establishing a two year schedule for constructing the first four storage tanks. The remaining tanks, Glen Ellen No. 2, Sobre Vista No. 2 and any tanks to satisfy future pressure zone needs, will require scheduling when demands have increased to warrant their construction (after 2005).

It is recommended that the replacement 0.26 MG Crest tank be constructed in the first year. Concurrently, or in the same year, the 0.5 MG Glen Ellen No. 1 tank should be constructed in the Hill Road area. The following year, after the Crest tank has been completed, work should begin on the replacement 0.26 MG Boyes Springs tank. Also in the second year, the 0.14 MG Sobre Vista No. 1 tank should be constructed. After this tank is completed and in service, the existing Sobre Vista tank should be removed from service and abandoned.

4.2 Agency Improvements

The parallel aqueduct project is included in the Water Supply and Transmission System Project proposed by the SCWA. The final EIR for this project, approved in December 1998, is currently being challenged by a lawsuit claiming the EIR is inadequate. The Project will be delayed until the challenge is resolved.

The need for the Agency's parallel aqueduct will depend on growth and the success of the District's well development program. Based on the low growth forecast and well production goals contained in the Strategic Water Supply Plan, the Agency's planned parallel aqueduct additions would not be necessary for delivering the additional capacity to the District. If growth close to the maximum growth scenario in the Strategic Water Supply Plan occurs, then segments 1, 2 and 3 of the aqueduct, (as reprioritized in this report), will be needed. It is unlikely that Segments 4 or 5 will be needed for capacity reasons, even if the maximum growth scenario were to occur.

Regardless of the rate of growth or actual well production, it would be beneficial to construct Segment 1 of the Agency's planned aqueduct additions (8500 LF from Eldridge tanks to Madrone turnout). The Agency planned this segment for construction sometime between 2001 and 2005. The addition of this segment will yield significant

operational benefits to the District, at a moderate cost. The benefits from this segment include higher hydraulic grade lines at all District turnouts, (significantly higher to the Boyes/Altamira turnouts), which will result in higher District tank levels during critical demand periods (approximately 8 feet higher on the maximum day) and up to 1 MGD higher flow rate into the Sonoma tanks without having to bypass the Eldridge tanks (not bypassing improves water quality in the tanks). The District may wish to encourage the SCWA to undertake and complete this segment as early as possible.

Segments 2 and 3 also provide increased operational benefits. However, these segments would mainly improve aqueduct flows, a benefit the District doesn't require, making them less attractive because of higher costs. When the second and third segments will be needed will depend upon the growth rate and water demands within the Valley of the Moon Water District and the City of Sonoma, and the success and sustainability of District wells.

The fourth and fifth segments may not be required for supply or capacity reasons. However, having parallel aqueducts would increase aqueduct supply reliability.

4.3 Estimate of Costs

The estimated costs for the recommended system tanks are shown in Table 4.2. The costs are in today's dollars plus 10 percent, and need to be adjusted when the tanks are actually constructed.

TABLE 4.2 - Tank Costs

A. Glen Ellen Tank 0.5 MG Welded Steel	
Item	**Cost**
61' diam. x 24' ht. tank & appurtenances & coating	$ 136,500
3' knuckle	11,000
12" x 18" foundation ring	6,500
Subgrade material	14,000
Cathodic protection	9,000
Dehumidifier	20,000
Property (sized for two tanks) (1/2 acre±)	75,000
Earthwork	15,000
8" Transmission Main (1400LF)	63,000
Access road	15,000
Electric/telemetry	15,000
Subtotal	**$380,000**
Contingency Incl. Eng/Insp/Cont. @ 35%	**133,000**
Total	**$513,000**

B. Crest/Boyes Springs Tanks - 0.26 MG Welded Steel	
Item	**Cost**
40' diam. x 27' ht. tank & appurtenances & coating	$ 105,000
3' knuckle	7,400
3' x 5' wide foundation ring	38,000
Subgrade material	6,000
Cathodic protection	5,600
Dehumidifier	20,000
Demo – existing tank	10,000
Earthwork	4,000
Electric/telemetry	15,000
Subtotal	**$211,000**
Contingency Incl. Eng/Insp/Cont. @ 35%	**74,000**
Total	**$285,000**

C. Sobre Vista Tank - 0.14 MG Welded Steel	
Item	**Cost**
38' diam. x 18' tank & appurtenances & coating	$ 75,500
3' knuckle	7,300
12" x 18" foundation ring	4,000
Subgrade material	6,300
Cathodic protection	5,500
Dehumidifier	15,000
Earthwork	4,000
Electric/telemetry	15,000
Subtotal	**$132,000**
Contingency Incl. Eng/Insp/Cont. @ 35%	**46,000**
Total	**$178,000**

The costs for Agency facility improvements, if needed, are shown in Table 4.3. These costs were provided by Agency staff.

TABLE 4.3 - Agency Pipeline Segment Costs

Segment	Length	Diameter	Cost*
1	8,500 LF	20	$1.7 M
2	26,000 LF	24	6.8 M
3	7,000 LF	24	1.68 M
4	17,000 LF	20	3.3 M
5	7,200 LF	20	1.3 M
Total Project Cost (Inc. Eng/Insp/Const)			**$14.78 M**
Total Project Cost (District Share)			**$8.5 M**

* These costs are taken directly from the SCWA cost estimate as it appears in Table 1B of the Water Supply and Transmission System Project EIR, Appendix H.

The District's share of the recommended first 8500 LF aqueduct segment addition is approximately $1.0 million based on entitlement shares requested. Combined with tank improvement costs, the total cost for all recommended improvements is estimated to be approximately $2.26 million. These improvements are recommended to be constructed over the next three to five years.

REFERENCES

1. Brelje & Race, Valley of the Moon Water District Master Water Plan, February 1998.

2. John Olaf Nelson, Valley of the Moon Water District Strategic Water Supply Plan, January 1999.

3. Luhdorff and Scalmanini Consulting Engineers, Valley of the Moon Water District Master Plan for Ground Water Development & Management, April 1999.

4. Sonoma County Water Agency, Final EIR Water Supply and Transmission System Report, Appendix H, Economic and Financial Report, adopted December 1998.

5. Personal Communication, George Hicks, Bill Waters, Hody Wilson and Pamela Jeane, March 1999.

APPENDIX A
Modeling Summary of Results

APPENDIX A

TABLE A.1 - Modeling Summary of Results

Run No.	Condition	Resulting Excess Flows & HGL	Comments
1 Benchmark Run	Current entitlements, current Eldridge Tanks flow through conditions and existing aqueduct.	• 2.6 MGD • Low HGL	Existing conditions which are known to be inadequate.
2	Eldridge Tanks bypassed & existing aqueduct.	• 2.9 MGD • Better HGL	Existing bypass conditions -- slight improvement over flow-through.
3	Eldridge tanks in flow-through mode and 8500 LF segment of parallel aqueduct.	• 3.9 MGD • Excellent HGL to Hanna turnout • All HGL's improved	Eldridge tank levels begin to fluctuate, significant flow & HGL improvements.
4	Eldridge Tank in flow-through mode -- 1st and 2nd planned aqueduct segment additions.	• 3.9 MGD • (5.2 MGD in bypass) • Excellent HGL's to Hanna turnout • All HGL's improved	Eldridge tank stabilized with same significant flow & HGL improvements of Run #3.
5	Eldridge Tank in bypass mode -- 1st, 2nd & 3rd planned aqueduct segment additions.	• 5.6 MGD (bypass) • 3.9 MGD (flow-through) • Excellent HGL to Hanna turnout, all HGL's improved	No significant flow or pressure improvements with addition of 3rd planned segment.
6	Demands increased to full entitlements planned -- 1st to 4th aqueduct segments added. Flow-through mode.	• 6.5 MGD • HGL @ all turnouts > regulator settings	Full entitlement flows easily satisfied with no decreased HGL.
7	Full entitlement flows, complete parallel aqueduct, flow-through mode.	• 9.3 MGD • HGL @ all turnouts > regulator settings	Even Eldridge fills at 2.6 MGD rate under these conditions. More than satisfactory.
8	Current entitlements, flow-through condition -- 1st & 4th planned aqueduct additions, only.	• 7.9 MGD • HGL @ all turnouts > regulator settings	Sonoma tanks stay full, but Eldridge tanks empty at 4.5 MGD rate. Would need to run Glen Ellen pumps more often.
9	Current & proposed entitlements, flow-through condition -- 1st, 2nd & 4th segments.	• 7.9 MGD (current entitlements) • 6.5 MGD (proposed entitlements • HGL > regulator settings	Eldridge and Sonoma stay full. Most cost effective solution.

Demands = Average day of peak month applied at turnout locations.

* Notes:

1. All of these runs were performed with Sonoma Tanks at Elev. 255. Additional runs were performed for some conditions with lower tank levels. Those results showed slightly higher flow rates with slightly lower aqueduct pressures.
2. Eldridge Tank flow-through conditions may be slightly inaccurate. This case is not available in the model, and had to be modeled with approximate methods.