TABLE OF CONTENT

4.0 TECHNICAL MEMORANDUM NO. 4

5.0 TECHNICAL MEMORANDUM NO. 5

LIST OF FIGURES

EXECUTIVE SUMMARY

TECHNICAL MEMORANDUM NO. 1 SUPPLEMENTAL

TECHNICAL MEMORANDUM NO. 1

TECHNICAL MEMORANDUM NO. 2

LIST OF TABLES

EXECUTIVE SUMMARY

TECHNICAL MEMORANDUM NO. 1 SUPPLEMENTAL

TECHNICAL MEMORANDUM NO. 1

TECHNICAL MEMORANDUM NO. 2

TECHNICAL MEMORANDUM NO. 3

TECHNICAL MEMORANDUM NO. 4

TECHNICAL MEMORANDUM NO. 5

B&V Project 139074.0200
B&V File G.2
February 21, 2007
FINAL

PURPOSE

San Juan Water District (SJWD or District) is developing the Wholesale Master Plan Phase 2 (WMPP2) as a follow up to the Water Forum and Regional Water Master Plan. Overall goals for WMPP2 are to assess the District's storage and transmission as related to the Family of Agencies (Citrus Heights Water District, Fair Oaks, the Ashland area of the City of Folsom, Orange Vale Water Company, and SJWD Retail) and to develop a water supply plan for the Family of Agencies within the context of regional planning efforts. The major objectives of WMPP2 are to: (1) determine demands/level of service, (2) plan for normal operations, (3) plan for reduced surface water operations, and (4) determine cost for any additional required facilities. Project deliverables include a series of technical memoranda (TMs) and a Final Report.

Project concepts are described in five technical memoranda (TMs) developed in concert with the District and the Family of Agencies through meetings and workshops. This Executive Summary presents a Project Overview and highlights the five TMs constituting the main body of this report.

PROJECT OVERVIEW

The District provides wholesale treated water supplies to Fair Oaks and Citrus Heights Water Districts (Fair Oaks, Citrus Heights), Orange Vale Water Company (Orange Vale), the City of Folsom (Folsom) north of the American River (the Ashland area), and the SJWD Retail Service Area. The District also supplies water, when water treatment plant capacity is available, to Sacramento Suburban Water District (SSWD). At peak water demands, the wholesale service provides up to approximately 115 million gallons per day (mgd), 128,800 acre-feet per year (AFY), within the wholesale service area.

The District is signatory to the Water Forum Agreement (WFA) and is one of the American River Basin Cooperating Agencies (ARBCA). The concepts presented in this report are compatible with WFA and ARBCA goals and objectives.

The District contracted with Black & Veatch (B&V) to develop WMPP2. Project tasks and associated deliverables are summarized in Table ES-1.

Table ES-1
Project Tasks

Task	Deliverable(s)	Comments
Develop Demand Projections	TM1 – Historical and Projected Demand: Level of Service Workshop No. 1	Analysis of Family of Agencies data.
Analyze Water Storage and Transmission System	TM2 – Water Storage and Transmission System Analysis Workshop No. 2 TM3 – Water Storage and Transmission System Analysis Cost Update	Evaluation of the adequacy of the existing system to meet operational and emergency requirements.
Develop Strategies for Meeting Reduced Surface Water Delivery	TM4 – Plan for Meeting Reduced Surface Water Delivery Workshop No. 3	Development of strategies to address reduced inflows to Folsom Lake as well as emergencies.
Recommend System Improvements	TM5 – Opinion of Cost and Implementation Schedule for Recommended Improvements Workshop No. 4 Workshop No. 5	Conceptual design and schedule for facilities identified in TM 4.

As the project developed, reliability goals for the facilities were established by the General Managers of the Family of Agencies:

1. Water supply equal to 100 percent of annual average demand during Drier and Driest years defined in the WFA.

2. Water treatment capacity equal to at least 110 percent of maximum day demand.

3. Emergency supply equal to 100 percent maximum day demand for 12 hours with largest source out of service.

4. Emergency supply equal to 50 percent of average day demand for extended outage of largest source.

HISTORICAL AND PROJECTED DEMAND: LEVEL OF SERVICE (TM1)

At the outset of the project (April 2005), B&V developed an evaluation of historical and projected demand. Historical per capita demand, historical and projected population and total annual demands, and historical and various annual demand projections were reviewed for the Family of Agencies and SJWD Retail. The historical and projected demand are presented graphically on Figure ES-1 and summarized in Table ES-2. Other evaluation components included an approach to surface water and groundwater use in dry years, historical groundwater/surface water use and a projection for normal/average year use, factors used by each agency to estimate maximum day and peak hour demands, and a comparison of previous 2005 population projections and current estimated population for each agency. Discussions were also conducted with each agency to determine the desired level of service from the District.

Figure ES-1: Total Demand Projections for SJWD Family Agencies

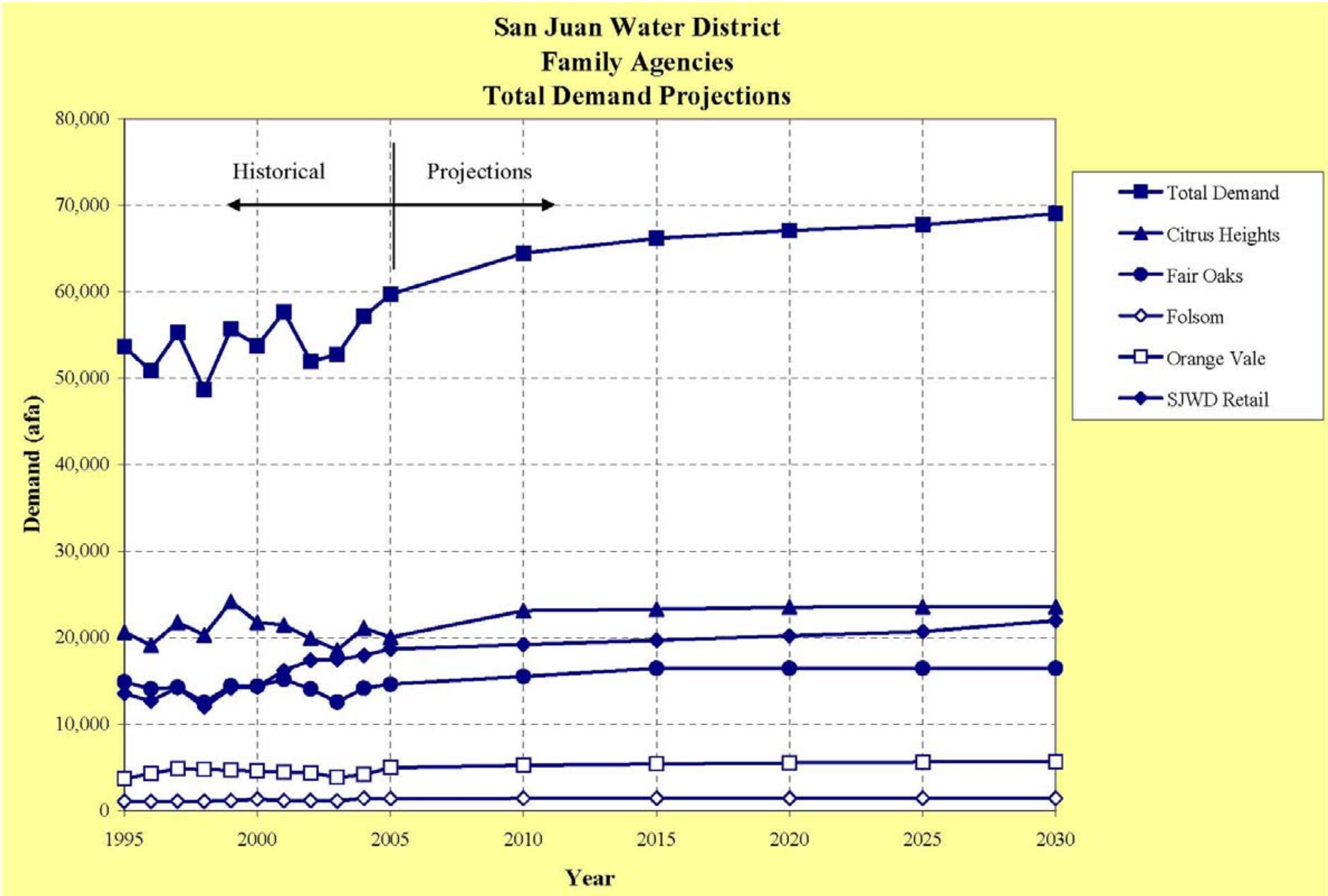


Table ES–2

Summary of Projected Average Demand (acre-ft / year)

Year	Citrus Heights	Fair Oaks	Folsom	Orange Vale	SJWD Retail	Total Demand
2005	20,036	14,611	1,382	4,982	18,691	59,702
2010	23,108	15,525	1,413	5,205	19,196	64,447
2015	23,258	16,438	1,413	5,381	19,700	66,190
2020	23,527	16,438	1,413	5,511	20,204	67,093
2025	23,577	16,438	1,413	5,592	20,708	67,728
2030	23,577	16,438	1,413	5,624	21,970	69,022

TM1 determined that the Family of Agencies would require approximately 121.3 mgd in 2030 as a maximum day flow. The associated peak hour flow was calculated to be 188.5 mgd. The projected average day, max day, and peak hour flows are summarized in Table ES-3.

Table ES–3

Summary of Projected Flows (mgd)

Family Agency	Max Day Factor	Peak Hour Factor	Average Demand	Max Day Flow	Peak Hour Flow
Citrus Heights	2.1	2.9	21.0	44.0	61.1
Fair Oaks	2.0	3.0	14.7	29.4	44.0
Folsom	2.0	3.6	1.3	2.5	4.5
Orange Vale	2.0	3.6	5.0	10.1	18.1
SJWD Retail	1.8	3.1	19.6	35.3	60.8
		Total Flow	**61.6**	**121.3**	**188.5**

To determine groundwater availability, the installed well capacity was derated to 80 percent to account for mechanical outages and under-performing wells. In addition, increased groundwater production would only occur for 9 months, since a “Dry Year” would not be declared until March, and production on an annual basis would be only 75 percent of the derated capacity. Table ES-4 summarized the analysis of a driest year in terms of supply and demand in 2030.

Table ES–4

2030 Driest Year Analysis

Family Agency	Demand (afa)	Surface Water (afa)	Supplemental Need (afa)	Groundwater Available (afa)
SJWD Retail	21,970	13,525	7,183	0
Citrus Heights	23,577	18,332	5,245	5,807
Fair Oaks	16,438	13,781	2,657	6,766
Folsom	1,413	1,063	350	0
Orange Vale	5,624	4,150	1,474	2,942
TOTAL	**69,022**	**50,851**	**16,909**	**15,515**

Existing and proposed groundwater wells within the family agencies' service areas are summarized in Table ES-5.

Table ES-5

Groundwater Wells

Family Agency	Well Name	Energy Source	Existing or Proposed	Year Built	Well Capacity (gpm)
Citrus Heights	Sunrise (10)	SMUD	Existing	1991	900
	Palm Ave (1A)	SMUD	Existing	1991	1,400
	Sylvan (8)	SMUD, diesel	Existing	1991	1,600
	Mitchell Farms (12)	SMUD	Proposed	2006	900
	Skycrest School	SMUD	Proposed	2007	1,200
				Subtotal	**6,000**
Fair Oaks	Chicago	SMUD	Existing	1947	581
	New York	SMUD	Existing	1972	830
	Casabella	SMUD	Existing	1953	850
	Park	SMUD	Existing	1990	1,090
	Northridge	SMUD	Existing	1992	940
	Town	SMUD	Proposed	2006	1,500
	Heather	SMUD	Proposed	2007	1,200
				Subtotal	**6,991**
Orange Vale	Well #1	Diesel	Existing	1977	1,200
	Well #2	Electric	Existing	1991	996
	Well #3		Proposed		1,040
				Subtotal	**3,040**
				TOTAL	**16,031**

The following preliminary conclusions were made:

- The area has reached a high level (90 percent +/-) of full development, and future increase in demand is estimated at approximately 10 percent.
- Water use on a per capita basis has declined over the long term from 450-500 gallons per capita per day (gpcd) in the 1960s to 300 +/- gpcd.
- Demand projections are mostly consistent with similar projections developed in the Regional Master Plan and through the Water Forum process.

- Recent historical use of groundwater has been minimal, consistent with regional policies to maximize surface water use during normal and wet years and reserve groundwater supplies for use during dry years.
- Citrus Heights, Folsom, Orange Vale, and SJWD Retail will continue to service their demand primarily through surface water, and Fair Oaks will meet approximately 70 percent of its demand with surface water, using groundwater to satisfy the remaining demand.

The information developed in TM1 was used in subsequent analyses developed for TMs 2, 3, and 4.

WATER STORAGE AND TRANSMISSION SYSTEM ANALYSIS (TM2)

The water storage and transmission system analysis was undertaken to determine the adequacy of existing facilities.

Distribution System Analysis. The objective of the distribution system analysis was to assess the ability of the system to meet flow and pressure requirements. Using projected flows for 2030, the Cooperative Transmission Pipeline (CTP) and the Fair Oaks 40 (FO40) Pipeline were assessed using the projected maximum day and peak hour flows developed in TM1 (121.3 and 188.5 mgd, respectively). The system is shown on Figure ES-2. Projected pressures were found to be consistent with requirements of the CTP agreement as shown on Figure ES-3.

Figure ES-2
Distribution System Analysis

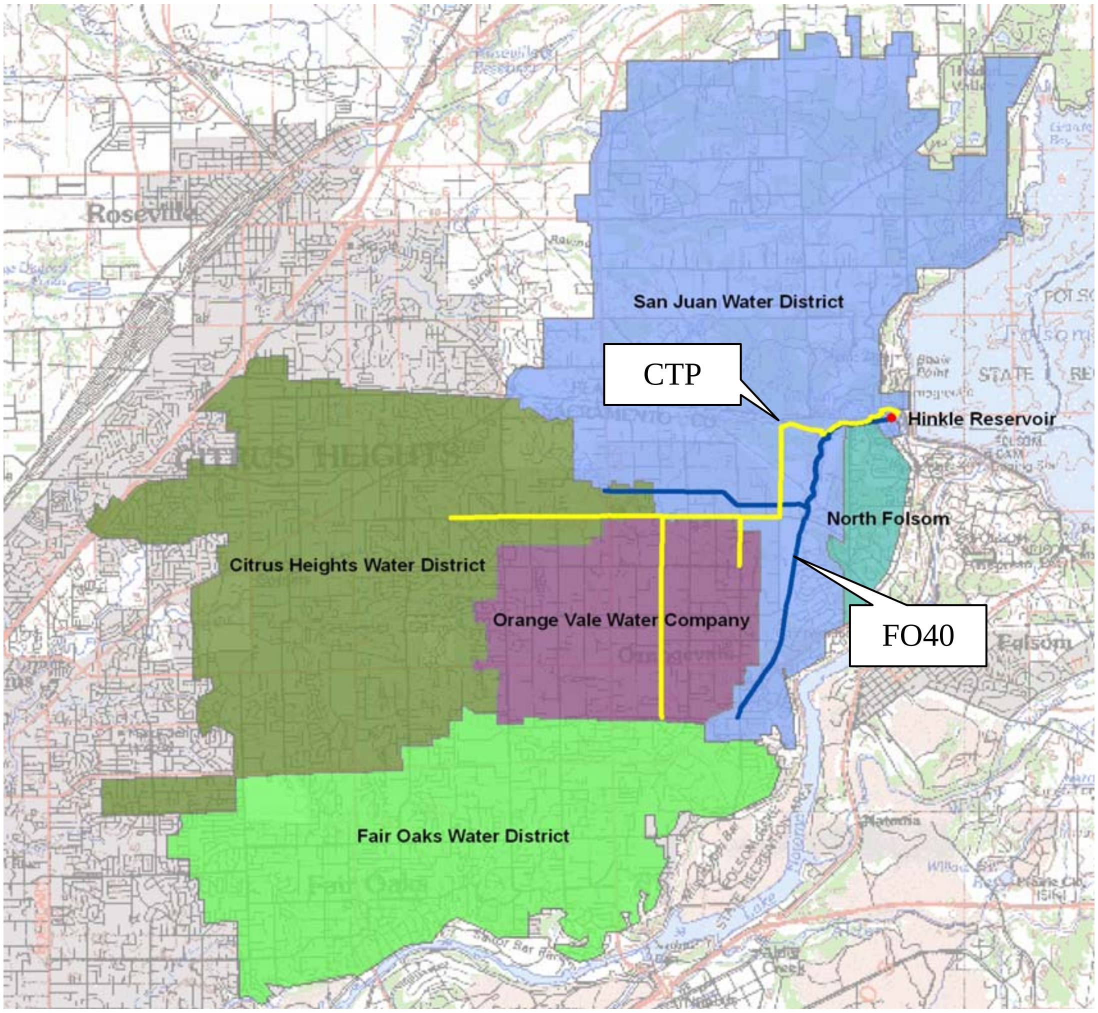
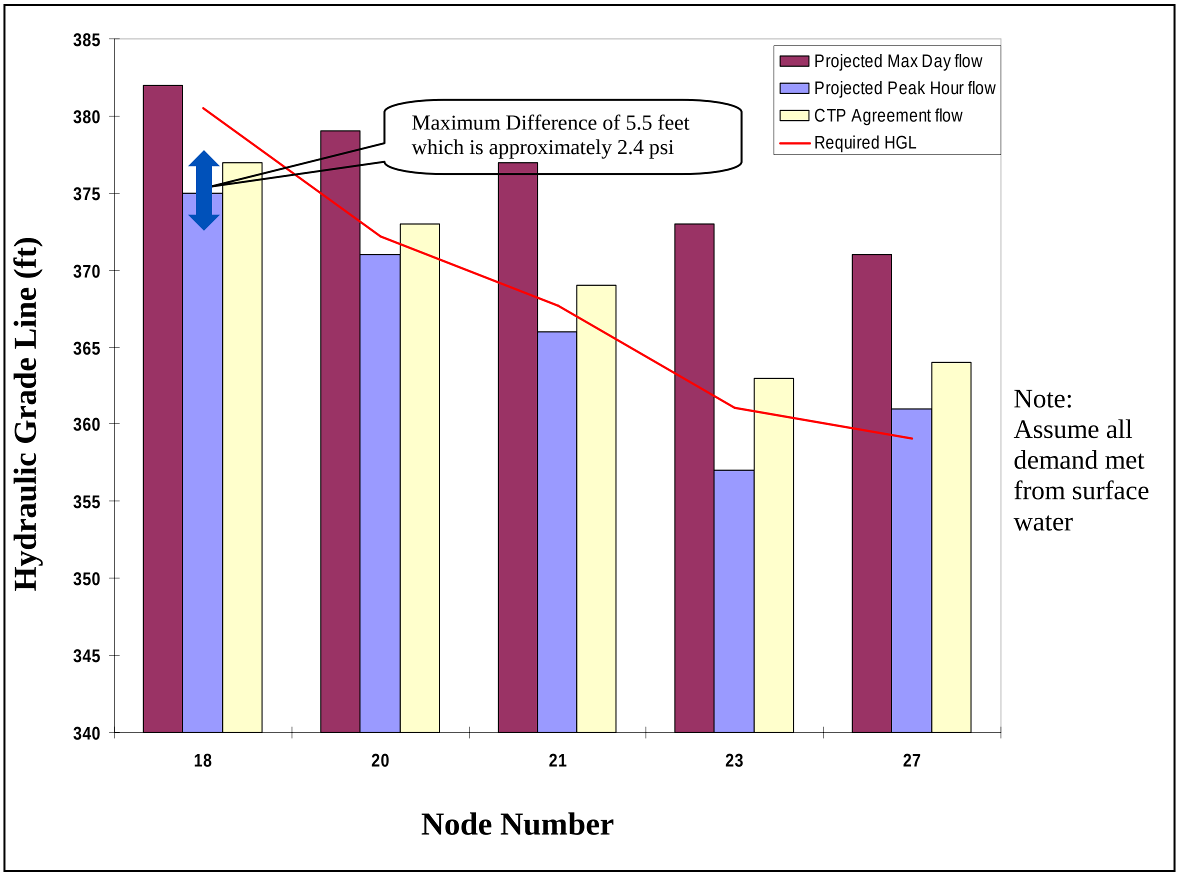


Figure ES-3
HGL Comparisons

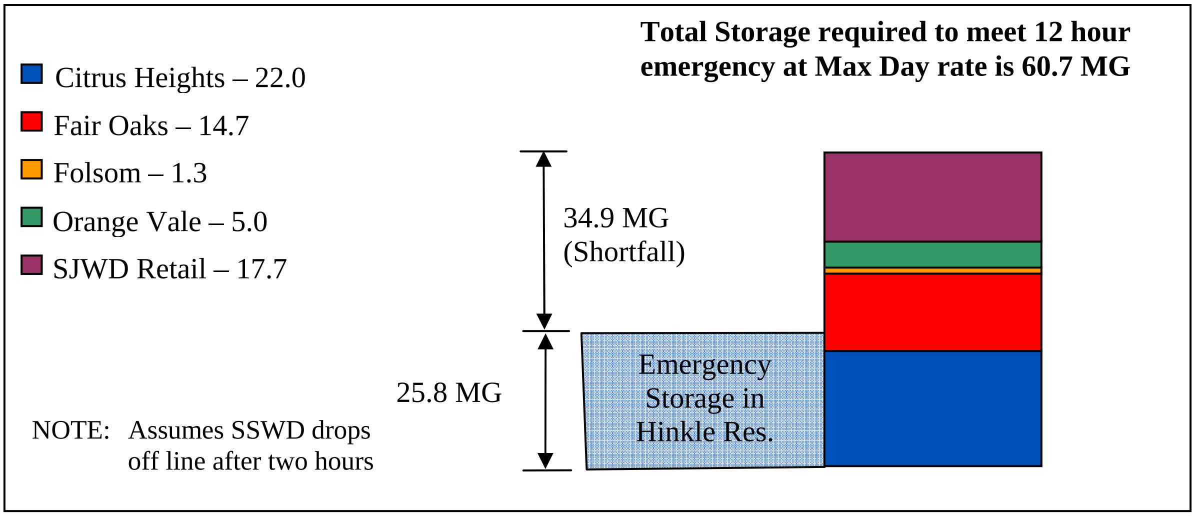


Storage Analysis. The objective of the storage analysis was to determine the adequacy of existing storage to meet operational and emergency requirements. Currently, storage for the majority of the wholesale system is only available at Hinkle Reservoir, although individual agencies are examining the potential for future storage in their respective service areas. Hinkle Reservoir has a nominal volume of 60 million gallons (MG), which occurs at a water depth of 20 feet. Depth is the reservoir must be maintained above 7 feet to avoid operational problems associated with the floating cover. The water volume at 7 feet is approximately 19.7 MG. Thus, approximately 42.3 MG is available as usable storage.

The usable storage must meet the needs of both normal operations and emergencies. Under normal operations a minimum of approximately 8% of the maximum day is required to balance demands and plant production. However, it is recommended that 15% of the available storage be used for this purpose, resulting in an operational need of 16.5 MG

Therefore, the Hinkle Reservoir can meet operational storage requirements through 2030. However, emergency storage within the reservoir will only supply maximum day demand for a limited duration. (See Figure ES-4.) Emergency storage available in Hinkle Reservoir is only 19.8 MG; however, 60.7 MG of storage (or 63.5 MG if SSWD is supplied water for only 2 hours after the start of the emergency) is required to meet the 12 hour emergency demand if no other strategy is employed.

Figure ES-4
Hinkle Reservoir Storage Issues



WATER STORAGE AND TRANSMISSION SYSTEM ANALYSIS COST UPDATE (TM3)

As part of the System Analysis, costs previously developed for the District for the rehabilitation of the Fair Oaks 40 Pipeline were updated. Table ES-6 presents the comparison of updated cost.

Table ES – 6

Comparison of Updated Costs to Rehabilitate FO40

		ENR Construction Cost Index		B&V Cost Database	
Section	**1998 Report**	**Updated Cost**	**Percent Increase**	**Updated Cost**	**Percent Increase**
Phase 1	$72,200	$87,900	122%	$87,900	122%
Phase 2-Section 1	$300,000	$365,300	122%	$718,500	240%
Phase 2-Section 2	$100,000	$121,800	122%	$239,500	240%
Total	**$472,200**	**$575,000**	**122%**	**$1,045,900**	**221%**

PLAN FOR MEETING REDUCED SURFACE WATER DELIVERY (TM4)

A plan was developed for meeting reduced surface water delivery. Information used included results of the water demand analysis (TM1) and the water storage and transmission analyses (TMs 2 and 3), review of past reports, and new information provided by the Family of Agencies in workshops and interviews. TM 4 outlines reliability goals and currently available surface water entitlements and groundwater supplies. Also described are potential shortage scenarios and available strategies to address them. Preliminary conclusions and recommendations are then presented.

Reliability Goals. Reliability goals were established by the General Managers of the Family of Agencies as follows:

1. Water supply equal to 100 percent of annual average demand during Drier and Driest years defined in the WFA. (See Table ES-7, below.). Available water supply should consider well capacity de-rated to 80 percent of actual to account for mechanical outages, declining production, and other factors. This capacity should be de-rated further to 75 percent to account for only part of the year being available for pumping during Drier and Driest year scenarios.

2. Water treatment capacity equal to at least 110 percent of maximum day demand.

3. Emergency supply equal to 100 percent maximum day demand for 12 hours with largest source out of service.

4. Emergency supply equal to 50 percent of average day demand for extended outage of largest source.

Currently-available Surface Water Entitlements and Groundwater Supplies. Folsom Lake is the source of the District's surface water supplies, and the District is able to divert variable amounts depending on the projected annual inflow to the lake. Reductions in availability of surface water to the Family of Agencies would result from reduced inflows into Folsom Lake or from emergency outages. The analysis conducted for this Project assumed "Normal," "Drier," and "Driest Year" conditions as defined in the WFA Agreement. These definitions are summarized in Table ES-7.

Table ES-7
Normal, Drier, and Driest Year Definitions

Category of Year	Projected March - November Unimpaired Inflow to Folsom Reservoir	District's Allocation of Surface Water
Normal	Greater than 950,000 AF	Divert and use 82,000 AF
Drier	Less than 950,000 AF and equal to or greater than 400,000 AF	Divert and use from 82,000 to 54,200 AF in proportion to the decrease in unimpaired inflow
Driest	Less than 400,000 AF	Diversion reduced to 52,400 AF (baseline amount)

As part of the evaluation, groundwater availability was estimated for existing and proposed wells in Citrus Heights, Fair Oaks, and Orange Vale. In keeping with Reliability Goal No. 1, the total well capacity provided by the Agencies was de-rated by both 80 and 75 percent. The evaluation of available groundwater assumed that each Agency will maintain the wells in a manner that ensures the indicated capacity will be available when needed. The evaluation further assumed that the proposed wells are installed as planned. Groundwater availability is shown in Table ES-8.

Table ES-8

Groundwater Availability

Family Agency	Well Capacity (mgd)			Derated Capacity[1] (80 %) (mgd)	75% of Derated Capacity[2] (mgd)
	Existing	Planned	Total		
Citrus Heights	5.6	3.0[3]	8.6	6.8	5.3
Fair Oaks	10.5	0.0	10.5	8.2	6.4
Folsom	0.0	0.0	0.0	0.0	0.0
Orange Vale	2.8	1.5[4]	4.3	3.5	2.7
District's Retail	0.0	0.0	0.0	0.0	0.0
Total Flow	**18.9**	**4.5**	**23.4**	**18.5**	**14.4**

Note: 1) Derated to 80% to account for mechanical outages, declining production, etc.
2) Derated further to 75% to account for only part of the year being available for pumping.
3) Proposed for 2006 and 2007.
4) Proposed, but no date specified.

Using the 75 percent derated capacity shown in Table ES-8, water availability for the Family of Agencies was evaluated for surface water and groundwater (normal, drier, and driest years). Results are shown in Table ES-9.

Table ES-9
Year 2030 Average Demands and Currently Available Supplies

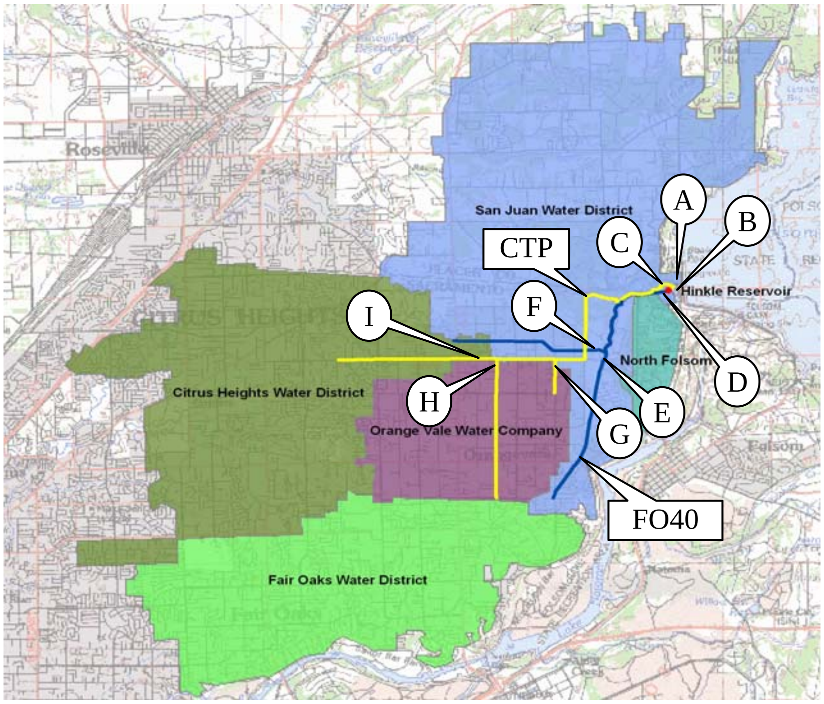
Family Agency	Year 2030 Average Demand (mgd) (1)	Surface Water			Groundwater	
		Normal Year (mgd)	Drier Year (mgd)	Driest Year (mgd) (2)	Normal, Drier & Driest Year (mgd)	Emergency Outage (mgd)
Citrus Heights	21.0	21.0	21.0 – 16.4	16.4	5.3	6.8
Fair Oaks	14.7	14.7	14.7 – 12.3	12.3	6.4	8.2
Folsom	1.3	1.3	1.3 – 0.9	0.9	0.0	0.0
Orange Vale	5.0	5.0	5.0 – 3.7	3.7	2.7	3.5
District's Retail	19.6	19.6	19.6 – 12.1	12.1	0.0	0.0
Water for Conjunctive Use	12.9	12.9	12.9 – 1.5	1.5	0.0	0.0
Total Flow	**74.5**	**74.5**	**74.5 – 46.9**	**46.9**	**14.4**	**18.5**

1. Year 2030 Average demand from Table 4 – 2.
2. Surface Water allocated to each member to meet Driest Year Demand in excess of available groundwater.

Emergency Conditions The evaluation also considered emergency conditions, defined as any unanticipated, partial or complete, interruption in service from the system. Examples include mechanical, structural, electrical, or control failures at USBR or District facilities, whether caused by natural disasters, terrorist actions, or other factors. Other anticipated conditions include a break in one of the transmission pipelines. The District currently maintains 163 miles of pipeline, which transports water to wholesale and retail customers. Nine specific emergency outage scenarios were considered. These are shown on Figure ES-5.

Figure ES-5
Emergency Outrage Scenarios

A. Water Treatment Plant or Intake
B. Hinkle Reservoir
C. CTP pipe leaving Hinkle Reservoir
D. FO40 pipe leaving Hinkle Reservoir
E. FO40 pipe to Fair Oaks Water District (FOWD)
F. FO40 pipe to SJWD, OVWC, and CHWD
G. CTP pipe to OVWC
H. CTP pipe to OVWC and FOWD
I. CTP pipe to CHWD and SSWD



As shown in Table ES-10, water available varies by outage scenario.

Table ES-10
Available Water during Various Emergency Outage Scenarios

Family Agency	12-hr Emergency Demand (mgd)	Extended Emergency Demand (mgd)	A (mgd)	B (mgd)	C (mgd)	D (mgd)	E (mgd)	F (mgd)	G (mgd)	H (mgd)	I (mgd)
Citrus Heights	44.0	10.5	6.8	20.3	27.6	30.0	50.8	30.0	50.8	50.8	27.6
Fair Oaks	29.4	7.4	8.2	17.2	21.2	24.5	24.5	37.6	37.6	21.2	37.6
Folsom	2.6	0.7	0.0	0.8	2.5	0.0	2.1	2.4	2.5	2.5	2.5
Orange Vale	10.0	2.5	3.5	6.6	3.5	13.5	13.5	13.5	8.0	9.0	13.5
SJWD Retail	35.3	9.8	0.0	10.8	34.6	0.7	29.4	33.3	3.53	35.3	35.3
Total Flow	**121**	**31**	**18.5**	**55.7**	**89.4**	**68.7**	**120.3**	**116.8**	**134.2**	**118.8**	**116.5**

Includes both available surface water and groundwater
Note:
- Yellow means meet extended emergency.
- Red means meet neither criterion.

Based on the outrage scenarios, strategies were developed to address shortages, and preliminary recommendations were identified.

Strategies To Address Shortages. Available strategies considered to address shortages included demand reduction, storage, groundwater, alternative surface water, and improved reliability/redundancy.

- *Demand Reduction.* Per capita demand has decreased significantly over the last 30 years, indicating the success of the Family of Agencies' conservation efforts, including best management practices (BMPs) and pricing policies. The demand reduction anticipated to be realized is addressed in the formulation of the reliability goals.

- *Storage*. Since demands during the drier and driest years occur over a long period of time, storage at Hinkle Reservoir would be relatively ineffective in helping to meet these demands, but can play a critical role in meeting demands during a short-term emergency. To meet Reliability Goal No. 3, emergency supply would need to be able to meet the maximum day demand for 12 hours (60.7 MG).

- *Improved Supply Reliability/Redundancy.* Supply-side and transmission-side improvements are currently being evaluated by others and should be investigated further to determine appropriate locations and the volume of water that could be made available.

Preliminary Recommendations. Based on the reliability goals established by the General Managers of the Family of Agencies, the following conclusions and recommendations were developed in TM4:

- *Drier and Driest Years.* No additional groundwater or storage is required to meet demands during Drier and Driest years.
- *12-HourEmergency.* To meet the goal of providing water sufficient to supply the max day demand for 12 hours, 38 MG of storage or 103 mgd of groundwater is required. However, the storage is only usable if the location is downstream of the outage point. The additional groundwater is only usable with pump back provisions if the outages are upstream of the connection.
- *Extended Emergency.* Additional storage would be ineffective in meeting an extended emergency outage. To meet extended emergency demands, 12 mgd of additional groundwater would be required. However, as in the case with the 12-hour emergency storage, the groundwater is only usable with some pump back provisions and if the outages are upstream of the connection.
- *Additional Activities.* Several other actions would help enhance the system: (1) maintain current groundwater supplies by periodically testing the wells to confirm capacity, routine maintenance, and well redevelopment, if necessary, (2) install wells currently proposed by Family Members, and (3) investigate the potential for additional inter-ties with surrounding utilities and between the Family of Agencies.
- *Recommendations.* It is recommended that a minimum of 12 mgd of additional groundwater and 32 MG of storage be added to the system (3 tanks at 11 MG each) and 3 pumping stations (one pump station for each tank).

OPINIONS OF COST AND IMPLEMENTATION SCHEDULE FOR RECOMMENDED IMPROVEMENTS (TM5)

TM 5 developed conceptual-level storage, pumping, and well facilities required to fulfill the demand reduction strategies in TM4 and provided a preliminary opinion of probable cost and improvements schedule. Tables ES-11, ES-12 and ES-13 present, respectively, a summary of proposed facilities, preliminary costs, and preliminary schedule.

Table ES-11
Summary of Conceptual Level Facilities

Facilities	Description	Comments
Storage (Total 33 MG)	3 tanks @ 11 MG	Three tanks provide increased reliability/redundancy, compatibility with developed areas, and greater choice of tank type.
Pumping (Total 66 mgd)	3 @ 22 mgd	Pumping stations will meet emergency requirements for customers at higher elevations and will allow for turnover of tank volume to optimize water quality.
Groundwater Wells (Total 12 mgd)	12 @ 1 mgd	The wells would be tied to existing mains to allow water to be available throughout the regional system.

Table ES-12
Summary of Opinion of Probable Project Cost

Facilities	Unit Cost	Rounded Cost
Tanks (3 @ 11 MG)	$ 9,600,000	$ 28,800,000
Pumping (3 @ 22 mgd)	$ 6,000,000	$ 18,000,000
Groundwater Wells (12 @ 1 mgd)	$ 2,000,000	$ 24,000,000
Property Acquisitions (12 Acres)	$ 300,000	$ 3,600,000
Subtotal Net Construction		$ 74,400,000
Engineering Contingency	30%	$ 22,300,000
Engineering, Legal, and Administration	25%	$ 24,200,000
Total Project Cost		**$ 120,900,000**

Table ES-13
Schedule of Recommended Improvements

Facilities	Current Need	2013	2021	Total
Storage	3 @ 11 MG	-----	-----	33 MG
Pumping	3 @ 22 mgd	-----	-----	66 mgd
Groundwater Wells	10 @ 1 mgd	1 @ 1 mgd	1 @ 1 mgd	12 mgd

SJWD–Wholesale Master Plan Phase II
Historical and Projected Demand
Level of Service

B&V Project 139074.0200
B&V File G.2
December 15, 2006
FINAL

Technical Memorandum (TM) No. 1 was finalized on April 29, 2005. During the preparation of TM No. 4, the Family of Agencies provided additional data. The following tables and figures from TM No. 1 were updated based on this additional data provided by the Family of Agencies as of September 21, 2006. Changes are highlighted in the tables.

Table 1 - 1: Summary of Projected Average Demand (acre-ft / year)

Year	Citrus Heights	Fair Oaks	Folsom	Orange Vale	SJWD Retail	Total Demand
2005	20,036	14,611	1,382	4,982	18,691	59,702
2010	23,108	15,525	1,413	5,205	19,196	64,447
2015	23,258	16,438	1,413	5,381	19,700	66,190
2020	23,527	16,438	1,413	5,511	20,204	67,093
2025	23,577	16,438	1,413	5,592	20,708	67,728
2030	23,577	16,438	1,413	5,624	21,970	69,022

Table 1 - 2: 2030 Driest Year Analysis

Family Agency	Demand (afa)	Surface Water (afa)	Supplemental Need (afa)	Groundwater Available (afa)
SJWD Retail	21,970	13,525	7,183	0
Citrus Heights	23,577	18,332	5,245	5,807
Fair Oaks	16,438	13,781	2,657	6,766
Folsom	1,413	1,063	350	0
Orange Vale	5,624	4,150	1,474	2,942
TOTAL	**69,022**	**50,851**	**16,909**	**15,515**

Figure 1 - 1: Total Demand Projections for SJWD Family Agencies

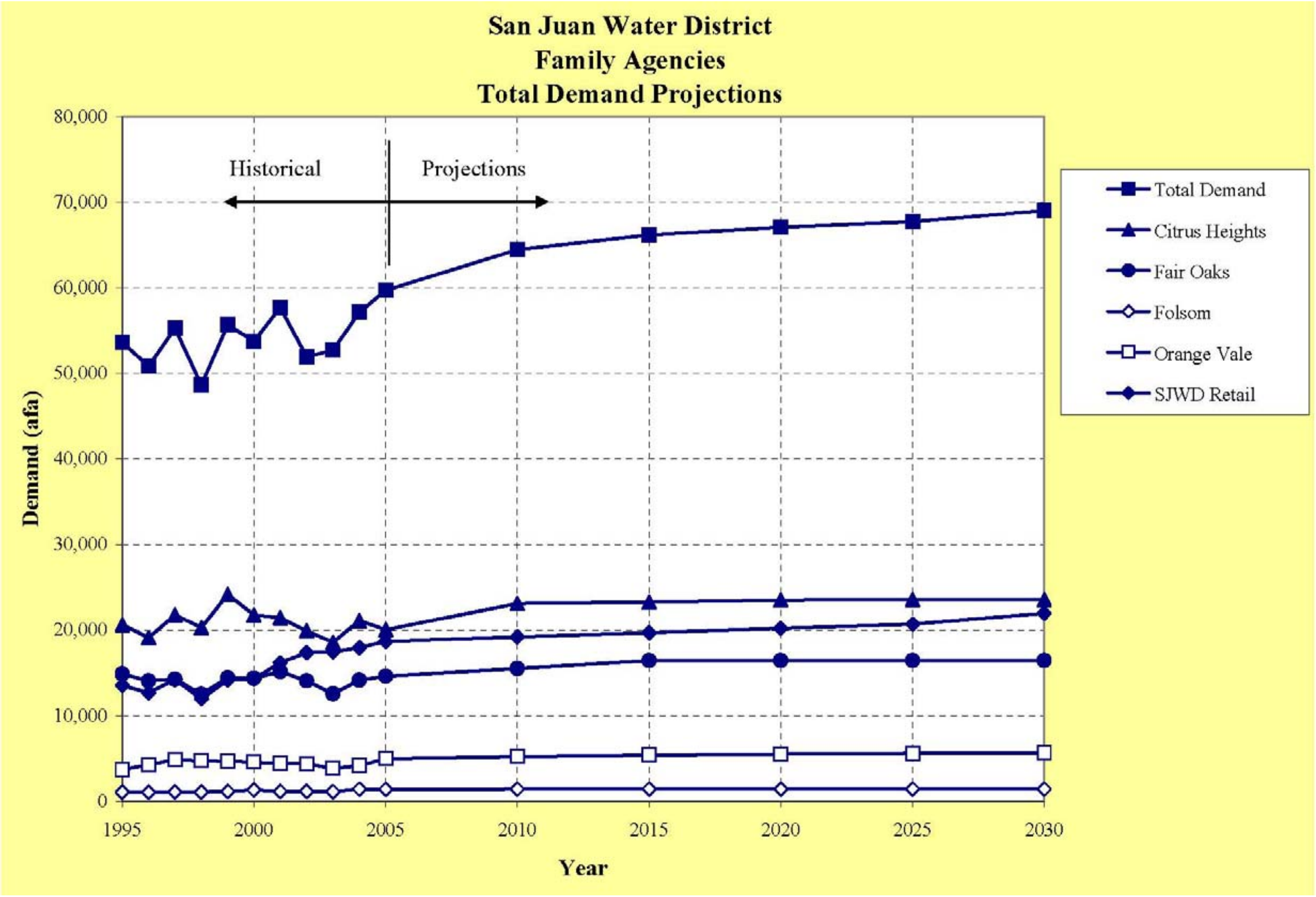


Table 1 - 3: Groundwater Wells

Family Agency	Well Name	Energy Source	Existing or Proposed	Year Built	Well Capacity (gpm)
Citrus Heights	Sunrise (10)	SMUD	Existing	1991	900
	Palm Ave (1A)	SMUD	Existing	1991	1,400
	Sylvan (8)	SMUD, diesel	Existing	1991	1,600
	Mitchell Farms (12)	SMUD	Proposed	2006	900
	Skycrest School	SMUD	Proposed	2007	1,200
				Subtotal	**6,000**
Fair Oaks	Chicago	SMUD	Existing	1947	581
	New York	SMUD	Existing	1972	830
	Casabella	SMUD	Existing	1953	850
	Park	SMUD	Existing	1990	1,090
	Northridge	SMUD	Existing	1992	940
	Town	SMUD	Proposed	2006	1,500
	Heather	SMUD	Proposed	2007	1,200
				Subtotal	**6,991**
Orange Vale	Well #1	Diesel	Existing	1977	1,200
	Well #2	Electric	Existing	1991	996
	Well #3		Proposed		1,040
				Subtotal	**3,040**
				TOTAL	**16,031**

BLACK & VEATCH
TECHNICAL MEMORANDUM NO. 1

SJWD–Wholesale Master Plan Phase II
Historical and Projected Demand
Level of Service

B&V Project 139074.0200
B&V File G.2
April 29, 2005
Final

To: Keith Durkin

Prepared By: Jay Hesby
Willard Pack
Christina Hartinger
Melissa Blanton

Reviewed By: Jim English

PURPOSE

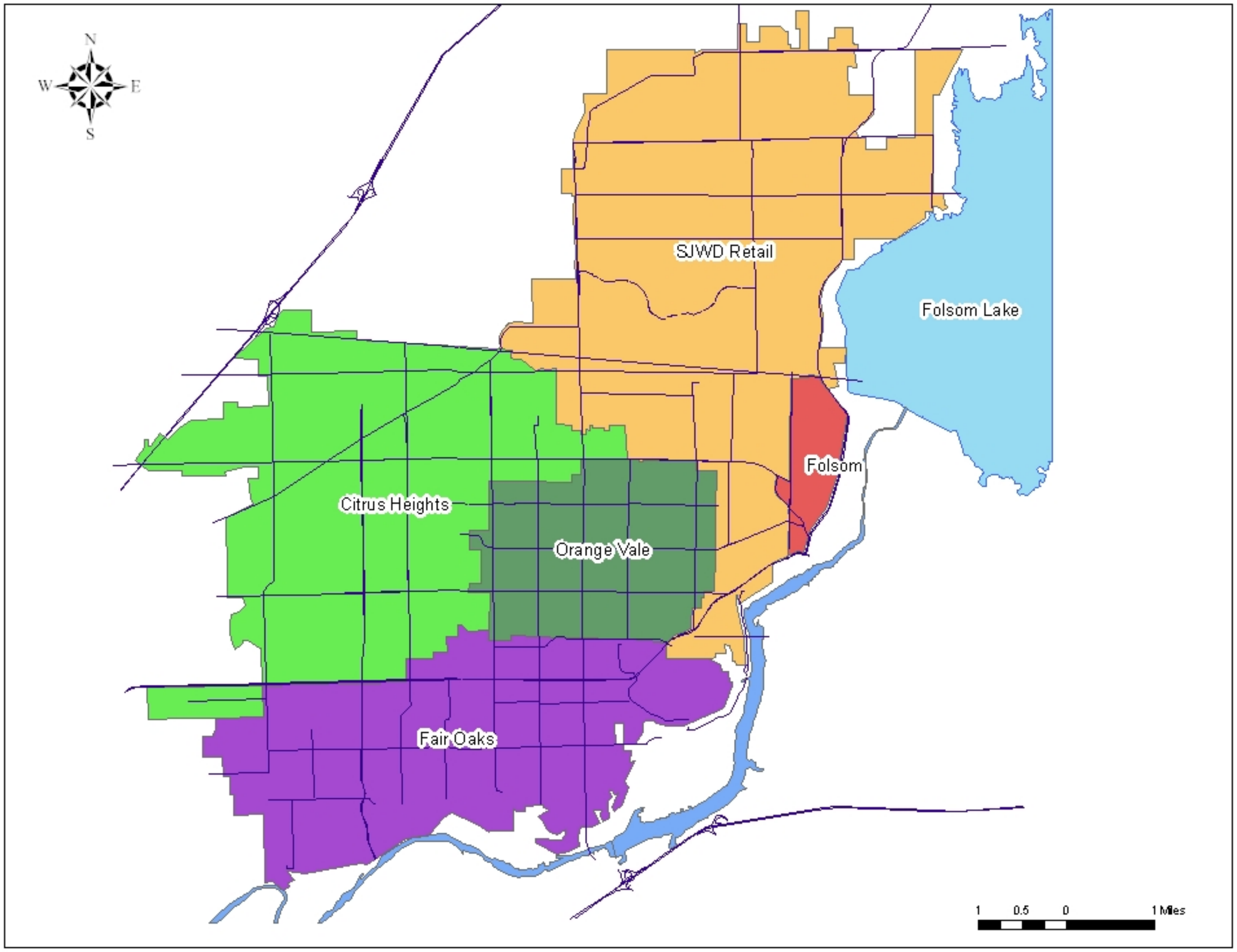
San Juan Water District (SJWD or District) is developing the Wholesale Master Plan Phase 2 (WMPP2) as a follow-on to the Water Forum and Regional Water Master Plan, to assess the District's storage and transmission as related to the Family of Agencies (Citrus Heights Water District, Fair Oaks, the Ashland area of the City of Folsom, Orange Vale Water Company, and San Juan Water District Retail)and to develop a water supply plan for the Family of Agencies within the context of the regional planning efforts. Figure 1-1 presents the District's service area.

The four project objectives of WMPP2 are as follows:

- Determine demands/level of service
- Plan for normal operations
- Plan for reduced water operations
- Allocate costs

This technical memorandum (TM) presents historical and projected demands and levels of service for the four Family Agencies. The information will be used in determining system treatment, storage, and delivery requirements.

Figure 1 - 1: San Juan Water District Service Area



HISTORICAL AND PROJECTED DEMAND EVALUATION

The historical and projected demand evaluations for the Family Agencies are presented in the tables and figures attached as an appendix to this TM. The information is summarized in Table 1 - 1 below and discussed in more detail in the paragraphs that follow.

Table 1 - 1: Summary of Historical and Projected Demand Evaluation

Appellation Title(s)	Description
For Each Agency ▪ Per Capita ▪ Projections ▪ Graph	*(One set of information for SJWD Retail and one for each of the four Family Agencies.)* ▪ Analysis of historical per capita demand ▪ Historical and projected population and total annual demands ▪ Historical and various annual demand projections
Population-Demand	Population and demand data for all agencies, including SJWD Retail demand (developed by others)
Wholesale Demand Chart	Historical and projected demands for each agency, including SJWD Retail demand, and the total of all demands
Dry Years	An approach to surface water and groundwater use for driest years
Demand Type	Historical groundwater/surface water use and a projection for normal/average year use
Peak Values	Factors used by each agency to estimate maximum day and peak hour demands
2005 Comparison	Comparison of previous 2005 population projections and current estimated population in each agency

Demand Projections

Demand projections, through the Plan Year of 2030, were based on population projections and estimated per capita use (gallons per capita per day). In general, population projections were obtained from each agency and verified against Sacramento Area Council of Governments (SACOG) projections where possible. Population projections are presented in Table 1 - 2.

Per capita demand has decreased significantly over the last thirty years due to conservation efforts including routine use of low water-use fixtures and increased consumer awareness. As shown in the Per Capita analysis, historical total demand (surface water plus groundwater) and population figures were used to determine historical per capita use. Future per capita demand was determined by projecting the historical trend line to 2005 and adding one standard deviation. This approach provides a reasonable projection of water demand, i.e. a projection that captures many of the higher demand years without being overly conservative. In addition, historical per capita use, the trend line, and the recommended per capita use are developed and included in the appendix. A summary of the per capita demand for each of the member agencies is presented in Table 1 - 3.

Table 1 - 2: Population Projections

Year	Citrus Heights	Fair Oaks	Folsom	Orange Vale	SJWD Retail	Total Population
2005	66,943	40,000	5,516	17,738	29,007	159,204
2010	68,753	42,500	5,638	18,531	29,790	165,212
2015	69,200	45,000	5,638	19,161	30,572	169,571
2020	70,000	45,000	5,638	19,623	31,355	171,616
2025	70,148	45,000	5,638	19,911	32,137	172,834
2030	70,148	45,000	5,638	20,023	32,137	172,946

Table 1 - 3: Per Capita Demand for Family Agencies (gpcd)

Family Agency	Per Capita Demand
Citrus Heights	300
Fair Oaks	326
Folsom	224
Orange Vale	251
SJWD Retail	575
TOTAL	1,676

For each agency's projection analysis, the historical demand, previous demand projections, and the demand projections determined from the approach described above are presented in the appendix. Previous demand projections include those contained in the agency previous master plans, or similar documents, projections from the 2005 SJWD Retail Water Master Plan Update, the 2000 Water Forum, and the 2003 Regional Water Master Plan. The service areas are all approaching a level of full development so it is expected that population growth will be at a moderate pace and that demand will grow at a moderate rate due to conservation measures and implementation of best management practices (BMPs). Projected average demand for each of the member agencies through the planning period is summarized in Table 1 - 4.

Table 1 - 4: Summary of Projected Average Demand (acre-ft / year)

Year	Citrus Heights	Fair Oaks	Folsom	Orange Vale	SJWD Retail	Total Demand
2005	22,500	14,611	1,382	4,982	18,691	62,166
2010	23,108	15,525	1,413	5,205	19,196	64,447
2015	23,258	16,438	1,413	5,381	19,700	66,190
2020	23,527	16,438	1,413	5,511	20,204	67,093
2025	23,577	16,438	1,413	5,592	20,708	67,728
2030	23,577	16,438	1,413	5,624	20,708	67,760

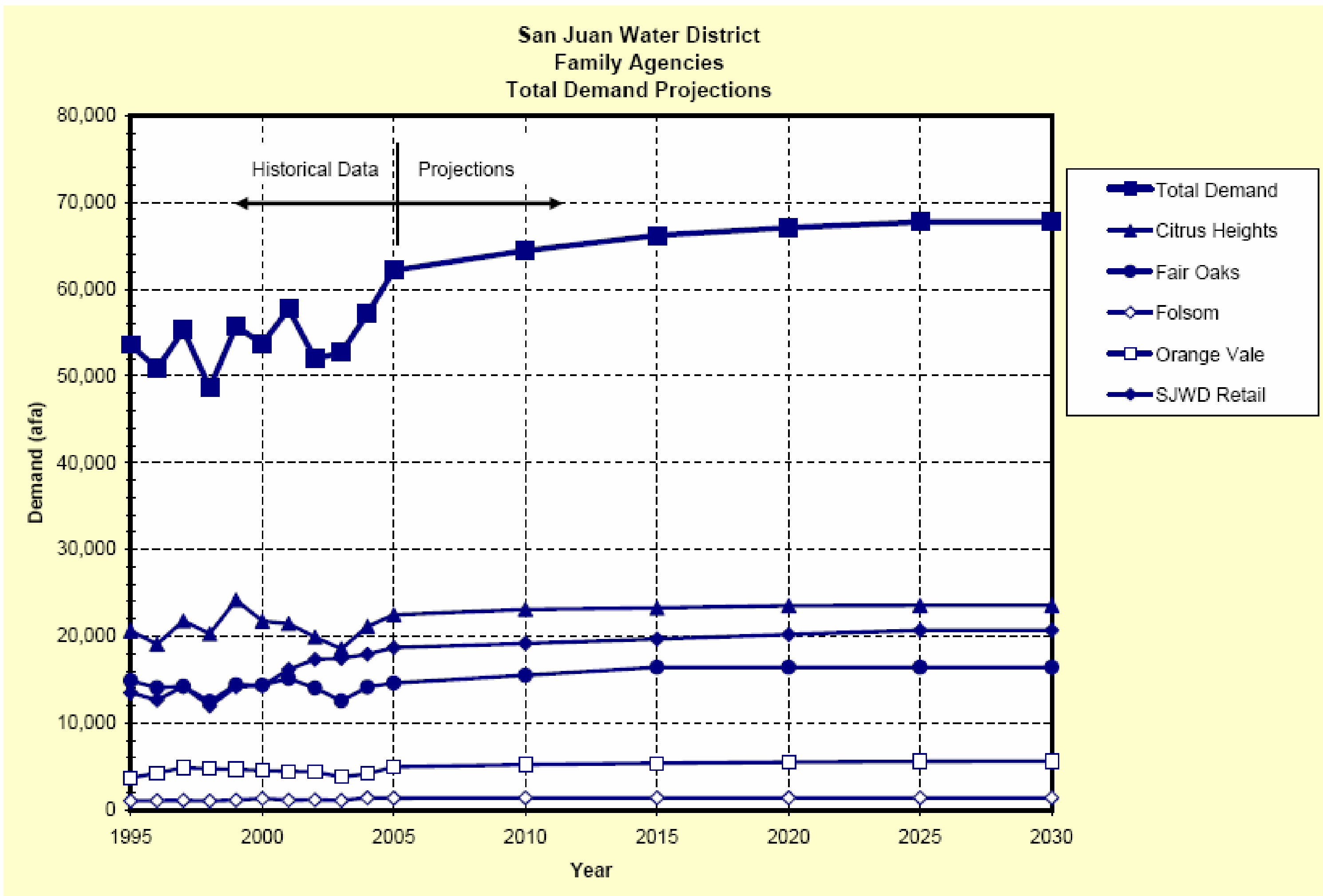
The historical and projected demands are presented graphically on Figure 1 - 2. The moderate projected growth in demand is readily apparent on the figure.

Peaking factors applied to the average flows yield maximum day and peak hour flows were then used to analyze the system for its ability to transmit the necessary flows. The peaking factors used in our analysis and the associated 2030 flows are presented in Table 1 - 5. The maximum day peaking factors are close to 2.0, and the peak hour factors range from 2.9 to 3.6.

Table 1 - 5: Peaking Factors and Associated 2030 Flows (mgd)

Family Agency	Max Day Factor	Peak Hour Factor	Max Day Flow	Peak Hour Flow
Citrus Heights	2.1	2.9	44.0	61.1
Fair Oaks	2.0	3.0	29.4	44.0
Folsom	2.0	3.6	2.5	4.5
Orange Vale	2.0	3.6	10.1	18.1
SJWD Retail	1.8	3.1	35.3	60.8
		Total Flow	121.3	188.5

Figure 1 - 2: Total Demand Projections for SJWD Family Agencies



Demand Type Breakdown

For each agency's demand type analysis, demand information from the agencies and from the District for surface water as well as groundwater is included in the appendix. Generally, for surface water, the District numbers were used to verify the agency data.

Orange Vale's surface water demand values were used since they were close to the District values, as were the values from Fair Oaks. Folsom surface water demand data was not available except from the District so the values used come from District meter readings. For Citrus Heights, the two data sets were less consistent, and the District data for surface water was used since it showed generally higher demand and would provide for a more conservative projection.

The City of Folsom does not use groundwater wells in the Ashland area, which is served by the District's wholesale system. Orange Vale only uses groundwater for emergencies, reducing its groundwater demand essentially to zero. It is understood that Orange Vale does not have the ability to chlorinate its groundwater supply. Citrus Heights uses groundwater only occasionally to meet peaking demands. Fair Oaks uses some groundwater on a regular basis -- mostly to meet peak demands.

Dry Year Use

Dry year use is important to the WMPP2 effort because, under the Water Forum Agreement, surface water diversion during dry years will be reduced. There is a "ramp down" function from normal years when surface water diversions up to the District's allocation will be allowed, to the driest years, when diversions must be ramped down to not exceed the 1995 baseline.

For the Dry Year analysis, an analysis of the driest year is included in the appendix. In this analysis, it was assumed that total system demand for each agency would remain the same as for normal years, which is consistent with the Regional Water Master Plan. As mentioned above, the surface water supplied would equal that received by each agency in 1995. Using the projected demand and the 1995 surface water demand, the demand on supplemental supply, namely groundwater, was estimated. This demand was then be compared to the groundwater availability for each agency.

The groundwater availability was estimated from installed well capacity, which was derated to 80 percent to account for mechanical outages and under-performing wells. In addition, because a "Dry Year" would not be declared until March, increased groundwater production would only occur for 9 months, and production on an annual basis would be only 75 percent of the derated capacity. Table 1 - 6 presents the analysis of a driest year in terms of supply and demand in 2030.

Some of the groundwater wells listed as being in service have never been fully tested to understand their ability to withstand the demand of a driest year period. One of the wells in

Orange Vale runs on diesel fuel, which may be a limiting factor in the event of an extended dry period, possibly reducing its available groundwater supply.

Table 1 - 6: 2030 Driest Year Analysis

Family Agency	Demand (afa)	Surface Water (afa)	Supplemental Need (afa)	Groundwater Available (afa)
SJWD Retail	20,708	13,525	7,183	0
Citrus Heights	23,577	18,332	5,245	3,774
Fair Oaks	16,438	13,781	2,657	8,807
Folsom	1,413	1,063	350	0
Orange Vale	5,624	4,150	1,474	3,383
TOTAL	67,760	50,851	16,909	15,964

Presented in Table 1 - 7 are the various existing and proposed groundwater wells within the family agencies' service areas. Included in the table are the well name, capacity, energy source, and year constructed.

Table 1 - 7: Groundwater Wells

Family Agency	Well Name	Energy Source	Existing or Proposed	Year Built	Well Capacity (gpm)
Citrus Heights	Sunrise	SMUD	Existing	1991	900
	Palm Ave (1A)	SMUD	Existing	1991	1,500
	Sylvan (8)	SMUD, diesel	Existing	1991	1,500
	Metro Farms (12)	SMUD	Proposed	2005	900
				Subtotal	4,800
Fair Oaks	Town		Existing		1,500
	Chicago		Existing		1,000
	Heather		Existing		1,500
	New York		Existing		1,500
	Casabella		Existing		1,500
	Park		Existing		1,500
	Well 7		Existing		1,500
	Well 9		Proposed		1,500
				Subtotal	13,000
Orange Vale	Well #1	Diesel	Existing	1977	2,500
	Well #2	electric	Existing	1991	996
				Subtotal	3,496
				TOTAL	21,296

LEVELS OF SERVICE

Discussions were conducted with each of the member agencies to determine the desired level of service from the District. Citrus Heights, Folsom, and Orange Vale all desire to have their water demands met by surface water in the future. Citrus Heights and Orange Vale will use groundwater to supplement the surface water in drier years and during peak flow conditions. Folsom and SJWD Retail do not have groundwater available and so will rely on surface water to meet all needs.

Fair Oaks has expressed a desire to have approximately seventy percent of its demand met by surface water and will meet the remaining demand with groundwater. This represents a shift in water management for the service area from a strong reliance on surface water to an increase in reliance on groundwater. This shift will reduce the demand load on the surface water system, making more water available to the other members of the Family of Agencies. Table 1 - 8 summarizes the level of service desired by the Family Agencies.

Table 1 - 8: Percent of Annual Average Demand Met Through Surface Water

Family Agency	Percent of Annual Average Demand Met Through Surface Water (1)
Citrus Heights	95
Fair Oaks	70
Folsom	100
Orange Vale	100
SJWD Retail	100

Note:

1. Percent of maximum day and peak hour demands met through surface water is presented and discussed in TM 2.

PRELIMINARY CONCLUSIONS

From the information developed during the historical and projected demands evaluation, the following preliminary conclusions can be drawn:

- The area has reached a high level (90 percent +/-) of full development, and future increase in water demand is estimated at approximately 10 percent.
- Water use on a per capita basis has declined over the long term, from 450-500 gallons per capita per day in the 1960's to 300 +/- gpcd.
- These demand projections are mostly consistent with similar projections developed in the Regional Master Plan and through the Water Forum process.
- Recent historical use of groundwater has been minimal. This would be consistent with policies developed through the Regional Master Plan and Water Forum Process to maximize surface water use under normal and wet years and reserve groundwater supplies for use during dry years.
- Citrus Heights, Folsom, Orange Vale, and SJWD Retail will continue to service their demand primarily through surface water and Fair Oaks will meet approximately 70 percent of their demand with surface water, using groundwater to satisfy the remaining demand.

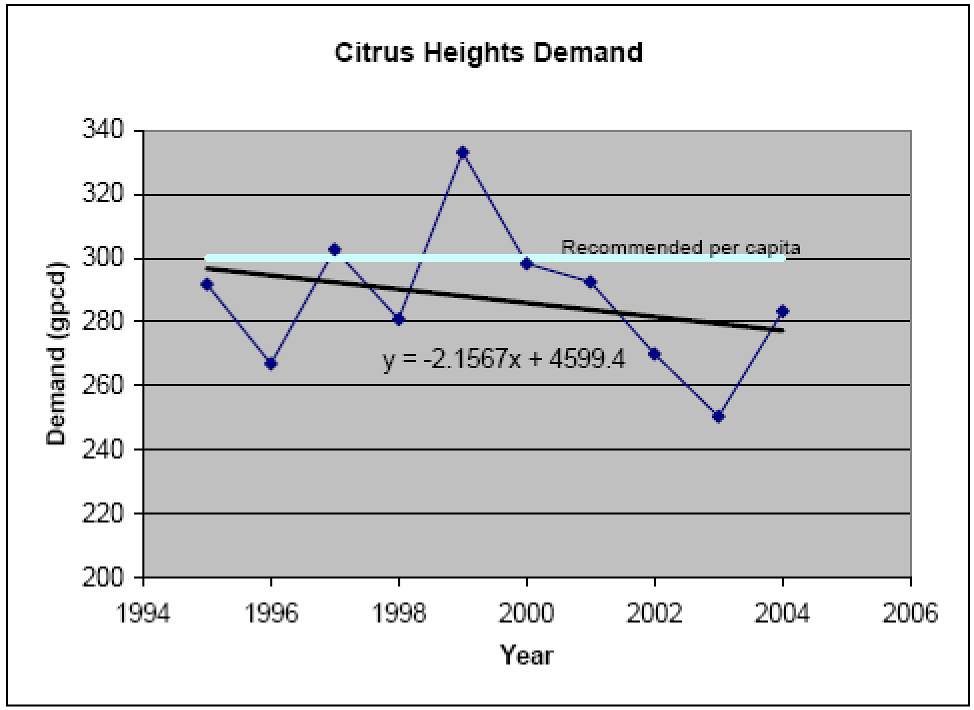
APPENDIX

HISTORICAL AND PROJECTED DEMAND ANALYSIS

The analysis is presented in the following figures:

Figure 1A - 1 Citrus Heights – Historical Per Capita Analysis

Citrus Heights			
Year	Population	Demand (afa)	Per Capita demand (gpcd)
1995	63,134	20,631	292
1996	63,952	19,116	267
1997	64,248	21,781	303
1998	64,543	20,300	281
1999	64,839	24,184	333
2000	65,134	21,757	298
2001	65,496	21,454	293
2002	65,858	19,914	270
2003	66,220	18,569	250
2004	66,581	21,122	283
		Historical AVG	287
		Historical STDEV	23
		Trendline 2004 Value	277
		Recommended	300



Notes:
Population data for 1995, 1996, and 2000 supplied in visit with Bob Churchill on December 16, 2004.
Other population numbers interpolated or extrapolated based on that conversation.
Demand numbers from same visit.

Figure 1A - 2 Citrus Heights – Historical and Projection Comparisons

	Citrus Heights									
Year	Historical Population	Projected Population	Historical Demand (afa)	Projected Demand (afa)	1998 Water System Master Plan	Per Capita demand (gpcd)	1995 SJWD Master Plan Projection	Water Forum Agreement Projection	Regional Water Master Plan Projection	B&V Recommended Projection (afa)
1995	63,134		20,631			292	18,671		18,600	
1996	63,952		19,116			267	19,159			
1997	64,248		21,781			303	19,648			
1998	64,543		20,300			281	20,136			
1999	64,839		24,184			333	20,625			
2000	65,134		21,757			298	21,114			
2001	65,496		21,454			293	21,602			
2002	65,858		19,914			270	22,091			
2003	66,220		18,569			250	22,580			
2004	66,581		21,122			283	23,068			
2005		66,943				0	23,557			22,500
2010		68,753		26,000		338	26,000			23,108
2015		69,200				0				23,258
2020		70,000		32,000		408				23,527
2025		70,148			23,092	294		20,083		23,577
2030		70,148				0			21,300	23,577

1995 Value/10-Year Ave: 0.9880

Notes:
Historical population data for 1995, 1996, and 2000 supplied in visit with Bob Churchill on December 16, 2004.
Other historical population numbers interpolated or extrapolated based on that conversation.
Actual and projected demand (2010 and 2020) numbers from same visit.
Projected demand for 2025 from Citrus Heights Water District Water System Master Plan, April 1998.

Figure 1A - 3 Citrus Heights – Demand Projections

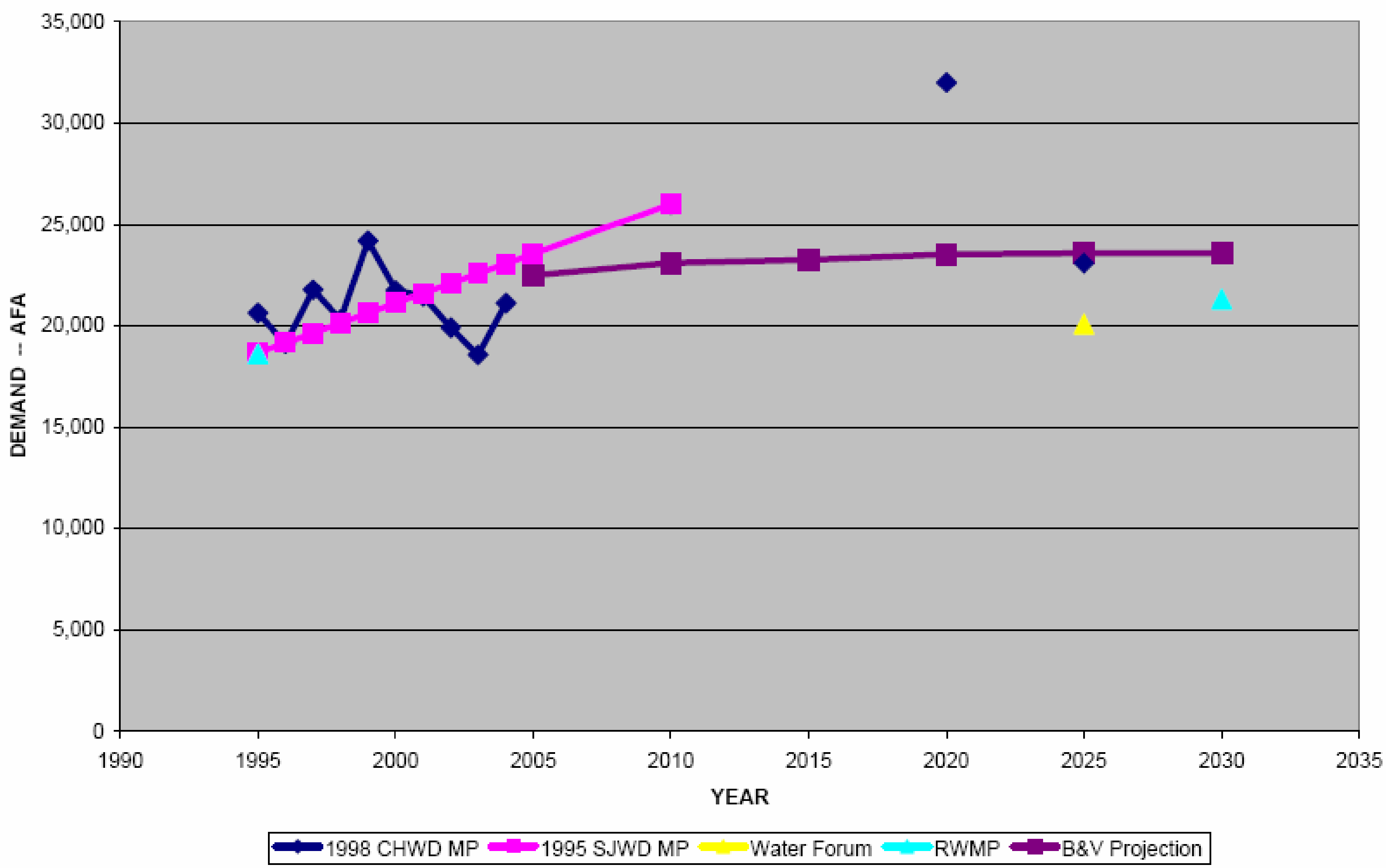
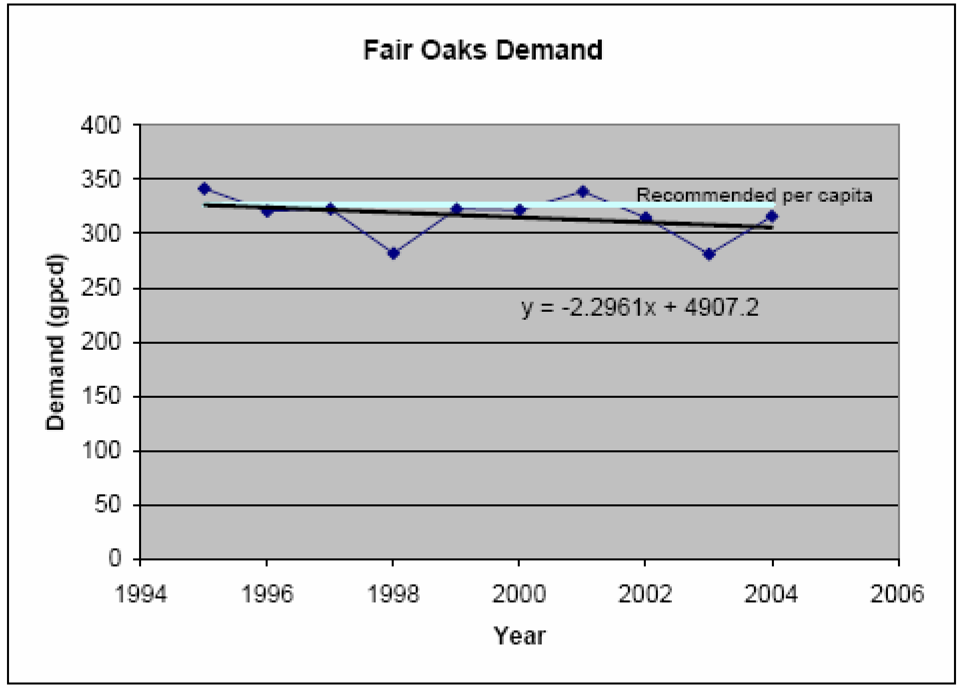


Figure 1A - 4 Fair Oaks – Historical Per Capita Analysis

Fair Oaks			
Year	Population	Demand (afa)	Per Capita demand (gpcd)
1995	38,940	14,890	341
1996	39,184	14,076	321
1997	39,429	14,253	323
1998	39,676	12,515	282
1999	39,925	14,423	323
2000	39,930	14,377	322
2001	39,935	15,148	339
2002	39,935	14,067	315
2003	39,950	12,574	281
2004	40,000	14,153	316
		Historical AVG	316
		Historical STDEV	20
		Trendline 2004 Value	306
		Recommended	326



Notes:
Population and demand values taken from Fair Oaks Water District Urban Water Management Plan, June 2001.
Population values from 2000 through 2004 received from Fair Oaks.

Figure 1A - 5 Fair Oaks – Historical and Projection Comparisons

	Fair Oaks								
Year	Historical Population	Projected Population	Historical Demand (afa)	Projected Demand (afa)	Per Capita demand (gpcd)	1995 SJWD Master Plan Projection	Water Forum Agreement Projection	Regional Water Master Plan Projection	B&V Recommended Projection (afa)
1995	38,940		14,890		341	15,534		15,201	
1996	39,184		14,076		321	15,845			
1997	39,429		14,253		323	16,156			
1998	39,676		12,515		282	16,467			
1999	39,925		14,423		323	16,778			
2000	39,930		14,377		322	17,089			
2001	39,935		15,148		339	17,401			
2002	39,935		14,067		315	17,712			
2003	39,950		12,574		281	18,023			
2004	40,000		14,153		316	18,334			
2005		40,000		17,667	394	18,645			14,611
2010		42,500		18,130	381	20,200			15,525
2015		45,000		18,500	367				16,438
2020		45,000		18,500	367				16,438
2025		45,000			0		17,158		16,438
2030		45,000			0			18,500	16,438

1995 Value/10-Year Ave: 1.0600

Notes:
Historical population and demand values taken from Fair Oaks Water District Urban Water Management Plan, June 2001.
Projected demand values from same document.

Figure 1A - 6 Fair Oaks – Demand Projections

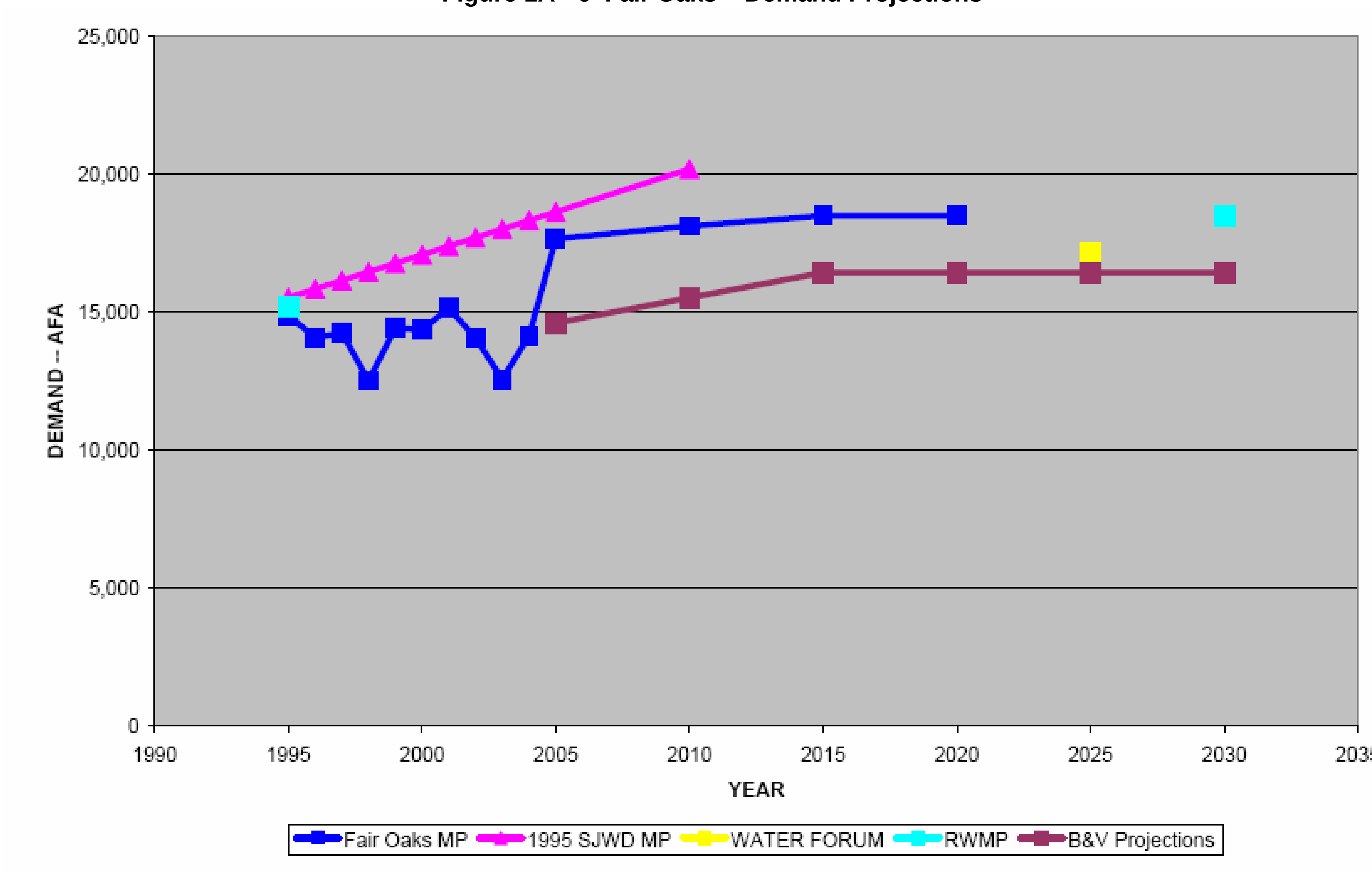
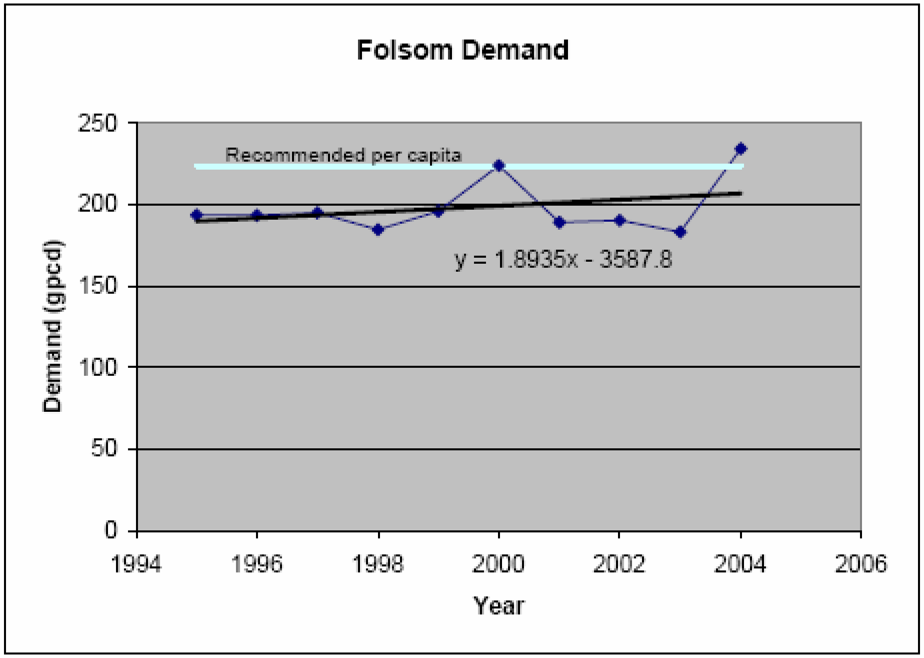


Figure 1A - 7 Folsom – Ashland Service Area – Historical Per Capita Analysis

Folsom			
Year	Population	Demand (afa)	Per Capita demand (gpcd)
1995	4,905	1,063	194
1996	4,968	1,076	193
1997	5,046	1,102	195
1998	5,124	1,059	185
1999	5,202	1,141	196
2000	5,280	1,324	224
2001	5,376	1,138	189
2002	5,394	1,149	190
2003	5,394	1,107	183
2004	5,394	1,415	234
		Historical AVG	198
		Historical STDEV	17
		Trendline 2004 Value	207
		Recommended	224



Notes:
Current population value from Dana Strahan of City of Folsom and historical values calculated below.
Demand values from 1995 SJWD Master Plan. Searching for more accurate values.

Figure 1A - 8 Folsom – Ashland Service Area – Historical and Projection Comparisons

	Folsom - Ashland Service Area								
Year	Historical Population	Projected Population	Historical Demand (afa)	Projected Demand (afa)	Per Capita demand (gpcd)	1995 SJWD Master Plan Projection	Water Forum Agreement Projection	Regional Water Master Plan Projection	B&V Recommended Projection (afa)
1995	4,905		1,063		194	1,515		17,900	
1996	4,968		1,076		193	1,515			
1997	5,046		1,102		195	1,515			
1998	5,124		1,059		185	1,515			
1999	5,202		1,141		196	1,515			
2000	5,280		1,324		224	1,515			
2001	5,376		1,138		189	1,515			
2002	5,394		1,149		190	1,515			
2003	5,394		1,107		183	1,515			
2004	5,394		1,415		234	1,515			
2005		5,516		1,515	245	1,515			1,382
2010		5,638		1,515	240	1,515			1,413
2015		5,638		1,515	240				1,413
2020		5,638		1,515	240				1,413
2025		5,638		1,515	240		38,661		1,413
2030		5,638		1,515	240			2,100	1,413

1995 Value/10-Year Ave: 0.9185

Notes:
Current population value from Dana Strahan of City of Folsom and historical values calculated on Folsom - per capita worksheet.
Demand values from 1995 SJWD Master Plan. Searching for more accurate values.

Figure 1A - 9 Folsom – Ashland Service Area – Demand Projections

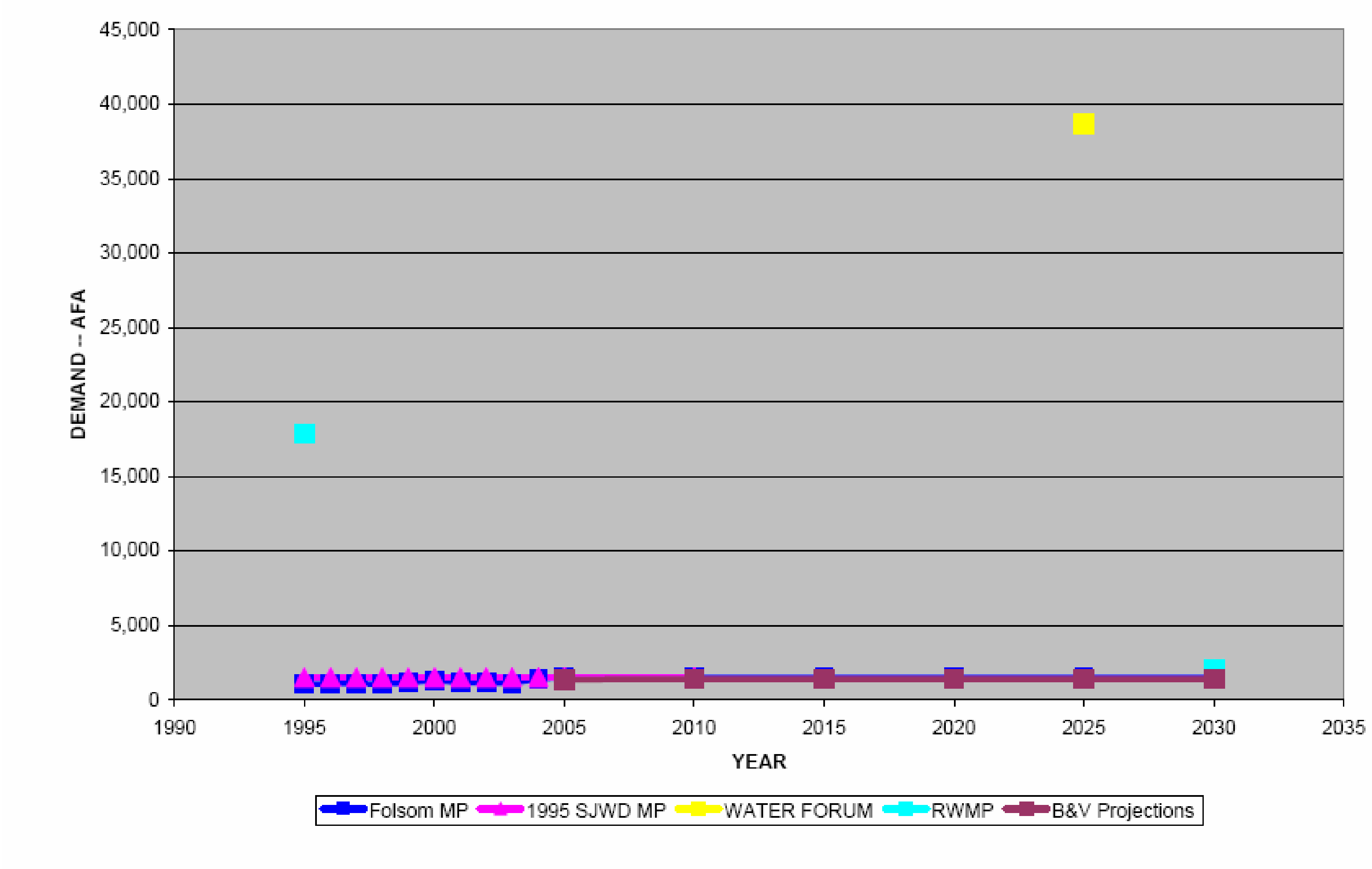
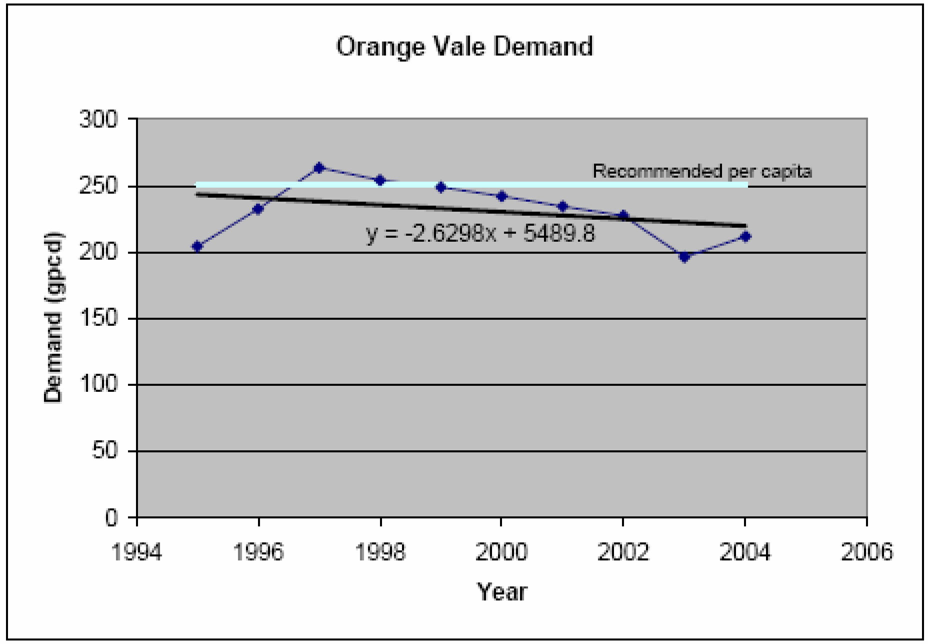


Figure 1A - 10 Orange Vale – Historical Per Capita Analysis

Orange Vale			
Year	Population	Demand (afa)	Per Capita demand (gpcd)
1995	16,078	3,678	204
1996	16,374	4,262	232
1997	16,491	4,869	264
1998	16,582	4,718	254
1999	16,757	4,670	249
2000	16,783	4,549	242
2001	16,987	4,457	234
2002	17,185	4,377	227
2003	17,376	3,816	196
2004	17,560	4,165	212
		Historical AVG	232
		Historical STDEV	22
		Trendline 2004 Value	229
		Recommended	251



Notes:
Red population values calculated from number of accounts received from Sharon Wilcox of Orange Vale * 3.25 people per account.
Black population values from Sharon Wilcox of Orange Vale Water Company.
Demand values from Table 1 of Orange Vale Water Company Engineer's Report, December 2004.

Figure 1A - 11 Orange Vale – Historical and Projection Comparisons

	Orange Vale								
Year	Historical Population	Projected Population	Historical Demand (afa)	Projected Demand (afa)	Per Capita demand (gpcd)	1995 SJWD Master Plan Projection	Water Forum Agreement Projection	Regional Water Master Plan Projection	B&V Recommended Projection (afa)
1995	16,078		3,678		204	5,464		7,093	
1996	16,374		4,262		232	5,641			
1997	16,491		4,869		264	5,818			
1998	16,582		4,718		254	5,995			
1999	16,757		4,670		249	6,172			
2000	16,783		4,549		242	6,349			
2001	16,987		4,457		234	6,527			
2002	17,185		4,377		227	6,704			
2003	17,376		3,816		196	6,881			
2004	17,560		4,165		212	7,058			
2005		17,738		4,981	251	7,235			4,982
2010		18,531		5,203	251	8,120			5,205
2015		19,161		5,380	251				5,381
2020		19,623		5,510	251				5,511
2025		19,911		5,591	251		8,205		5,592
2030		20,023		5,622	251			8,800	5,624
	1995 Value/10-Year Ave:		0.8443						
	San Juan Family Ave:		0.9527	4,150					

Notes:
Red population values calculated from number of accounts received from Sharon Wilcox of Orange Vale * 3.25 people per account.
Black historical population values from Sharon Wilcox of Orange Vale Water Company.
Projected population and demand values from Wood Rodgers for O'Vale - February 2005.

Figure 1A - 12 Orange Vale – Demand Projections

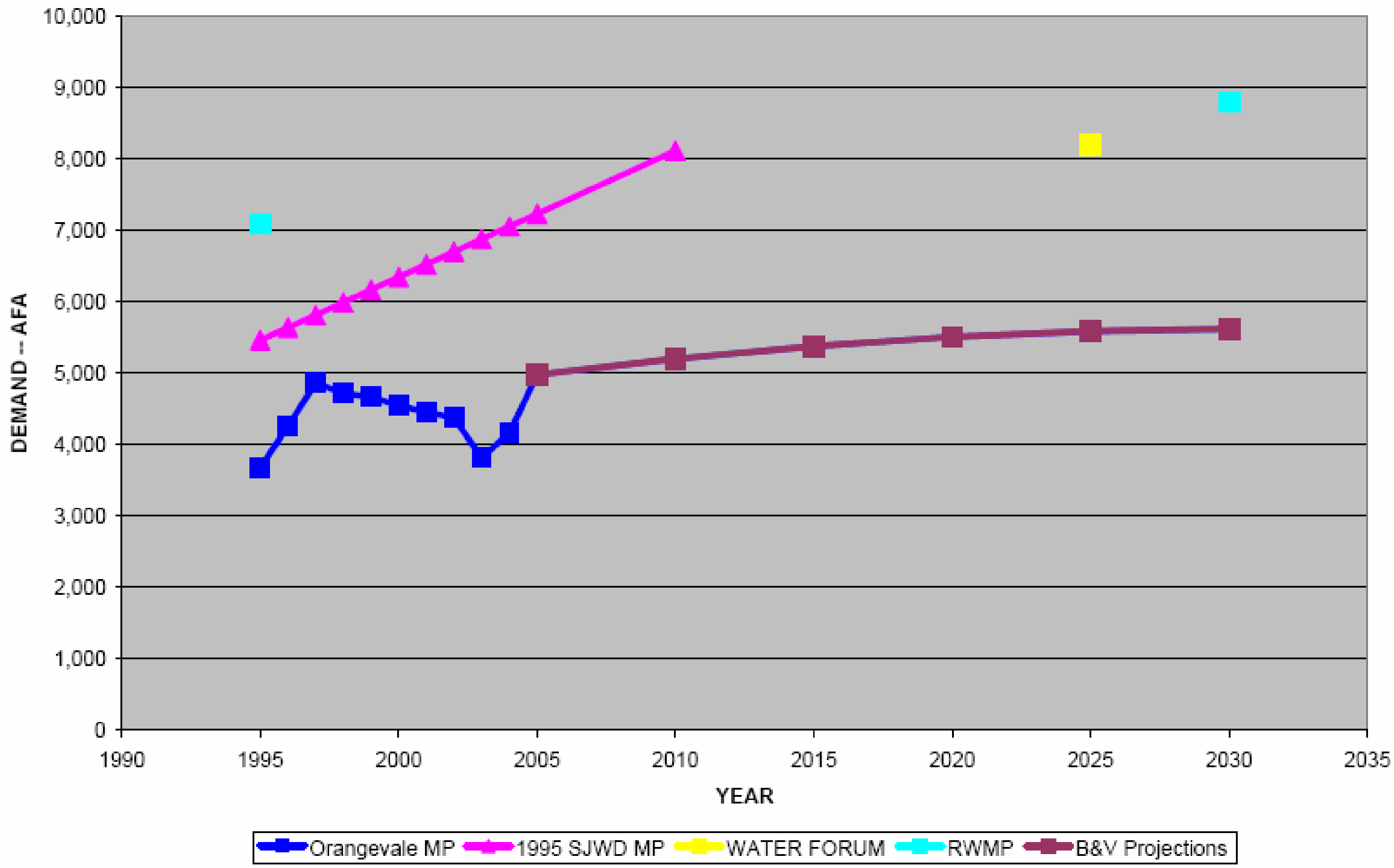
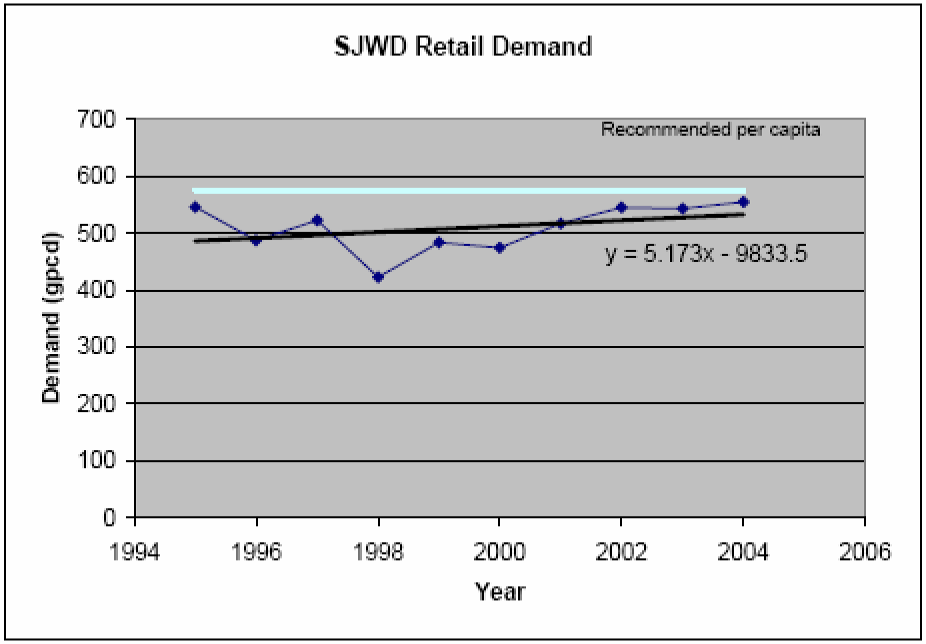


Figure 1A - 13 SJWD Retail – Historical Per Capita Analysis

SJWD Retail			
Year	Population	Demand (afa)	Per Capita demand (gpcd)
1995	22,101	13,525	546
1996	23,199	12,668	488
1997	24,282	14,214	523
1998	25,275	11,971	423
1999	26,161	14,182	484
2000	26,890	14,287	474
2001	27,959	16,192	517
2002	28,439	17,361	545
2003	28,694	17,454	543
2004	28,851	17,941	555
		Historical AVG	510
		Historical STDEV	42
		Trendline 2004 Value	533
		Recommended	575



Notes:
Data provided in Table 6-4 of the San Juan Water District Draft Retail Water Master Plan Update, January 2005.
Population for 2004 taken as average of 2003 and projected 2005 values.

Figure 1A - 14 SJWD Retail – Historical and Projection Comparisons

	SJWD Retail								
Year	Historical Population	Projected Population	Historical Demand (afa)	Projected Demand (afa)	Per Capita demand (gpcd)	1995 SJWD Master Plan Projection	Water Forum Agreement Projection	Regional Water Master Plan Projection	B&V Recommended Projection (afa)
1995	22,101		13,525		546				
1996	23,199		12,668		488				
1997	24,282		14,214		523				
1998	25,275		11,971		423				
1999	26,161		14,182		484				
2000	26,890		14,287		474				
2001	27,959		16,192		517				
2002	28,439		17,361		545				
2003	28,694		17,454	18,060	543	17,454			
2004	28,694		17,941		558				
2005		29,007			575				18,691
2010		29,790		20,100	575				19,196
2015		30,572			575				19,700
2020		31,355			575				20,204
2025		32,137		21,960	575	19,548			20,708
2030		32,137			575				20,708

Notes:
Historical population and demand figures from Chapter 6 of the SJWD Retail Water Master Plan Update, January 2005.

Figure 1A - 15 SJWD Retail – Demand Projections

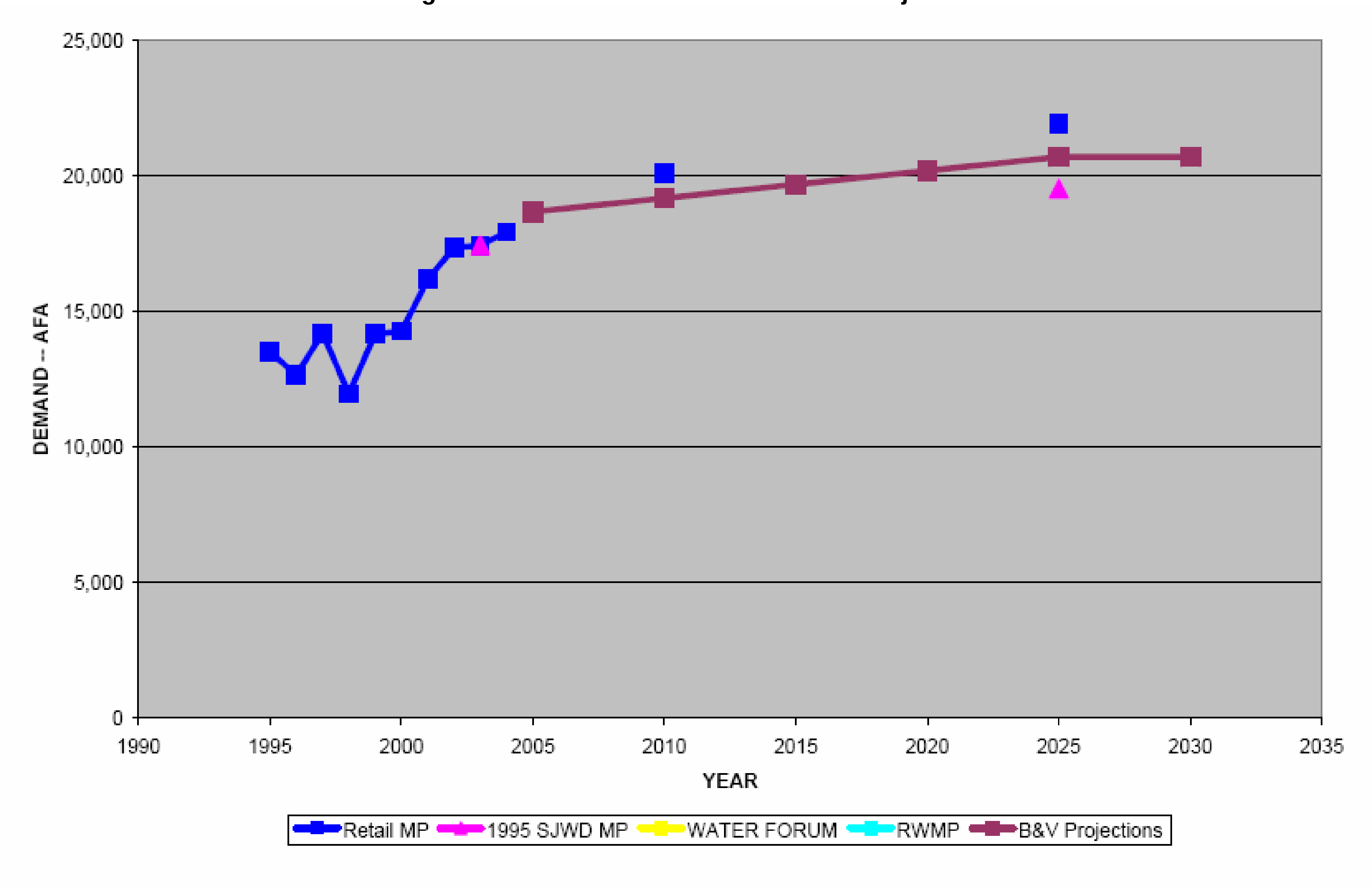


Figure 1A - 16 Population and Water Demand Projections

	Orange Vale						Citrus Heights					
Year	Population	Total Demand (afa)	1995 SJWD Master Plan Projection	2000 Water Forum Agreement Projection	Regional Water Master Plan Projection	Black & Veatch Recommended Projection (afa) (2)	Population	Total Demand (afa)	1995 SJWD Master Plan Projection	2000 Water Forum Agreement Projection	Regional Water Master Plan Projection	Black & Veatch Recommended Projection (afa) (2)
1995	16,078	3,678	5,464		7,093		63,134	20,631	18,671		18,600	
1996	16,374	4,262	5,641				63,952	19,116	19,159			
1997	16,491	4,869	5,818				64,248	21,781	19,648			
1998	16,582	4,718	5,995				64,543	20,300	20,136			
1999	16,757	4,670	6,172				64,839	24,184	20,625			
2000	16,783	4,549	6,349				65,134	21,757	21,114			
2001	16,987	4,457	6,527				65,496	21,454	21,602			
2002	17,185	4,377	6,704				65,858	19,914	22,091			
2003	17,376	3,816	6,881				66,220	18,569	22,580			
2004	17,560	4,165	7,058				66,581	21,122	23,068			
2005	17,738	4,981	7,235			4,982	66,943		23,557			22,500
2010	18,531	5,203	8,120			5,205	68,753	26,000	26,000			23,108
2015	19,161	5,380				5,381	69,200					23,258
2020	19,623	5,510				5,511	70,000	32,000				23,527
2025	19,911	5,591		8,205		5,592	70,148			20,083		23,577
2030	20,023	5,622			8,800	5,624	70,148				21,300	23,577

	SJWD Retail Service Area						Fair Oaks					
Year	Population	Total Demand (afa)	1995 SJWD Master Plan Projection	2000 Water Forum Agreement Projection	Regional Water Master Plan Projection	Black & Veatch Recommended Projection (afa) (2)	Population	Total Demand (afa)	1995 SJWD Master Plan Projection	2000 Water Forum Agreement Projection	Regional Water Master Plan Projection	Black & Veatch Recommended Projection (afa) (2)
1995	22,101	13,525					38,940	14,890	15,534		15,201	
1996	23,199	12,668					39,184	14,076	15,845			
1997	24,282	14,214					39,429	14,253	16,156			
1998	25,275	11,971					39,676	12,515	16,467			
1999	26,161	14,182					39,925	14,423	16,778			
2000	26,890	14,287					39,930	14,377	17,089			
2001	27,959	16,192					39,935	15,148	17,401			
2002	28,439	17,361					39,935	14,067	17,712			
2003	28,694	17,454	17,454				39,950	12,574	18,023			
2004	28,851	17,941					40,000	14,153	18,334			
2005	29,007					18,691	40,000	17,667	18,645			14,611
2010	29,790	20,100				19,196	42,500	18,130	20,200			15,525
2015	30,572					19,700	45,000	18,500				16,438
2020	31,355					20,204	45,000	18,500				16,438
2025	32,137	21,960	19,548			20,708	45,000			17,158		16,438
2030	32,137					20,708	45,000				18,500	16,438

	Folsom						
Year	Population	Total Demand (afa)	1995 SJWD Master Plan Projection	2000 Water Forum Agreement Projection (1)	Regional Water Master Plan Projection (1)	Black & Veatch Recommended Projection (afa) (2)	Total Demand
1995	4,905	1,063	1,515		17,900		53,603
1996	4,968	1,076	1,515				50,845
1997	5,046	1,102	1,515				55,261
1998	5,124	1,059	1,515				48,635
1999	5,202	1,141	1,515				55,700
2000	5,280	1,324	1,515				53,742
2001	5,376	1,138	1,515				57,692
2002	5,394	1,149	1,515				51,961
2003	5,394	1,107	1,515				52,706
2004	5,394	1,415	1,515				57,137
2005	5,516	1,515	1,515			1,382	62,166
2010	5,638	1,515	1,515			1,413	64,446
2015	5,638	1,515				1,413	66,190
2020	5,638	1,515				1,413	67,093
2025	5,638	1,515		38,661		1,413	67,728
2030	5,638	1,515			2,100	1,413	67,759

Sources:
(a) Citrus Heights Water District Water System Master Plan, April 1998, or documents given during meeting with member
(b) Orange Vale Water Company Engineer's Report, December 2004; Input from Wood Rodgers for O 'Vale - February 2005
(c) Fair Oaks Water District Urban Water Management Plan, June 2001
(d) City of Folsom Water Treatment Plant and Master Plan Update, September 2003
(e) Regional Water Master Plan projections from Table 7

Folsom demand calculations for 1996-2001 follow the equation: Population x Per Capita Water Use x .0011201 (conversion factor to afa)
Per Capita Water Use in above equation from City of Folsom Water Treatment Plant and Master Plan Update, September 2003, Table 3-10.

Orange Vale population for past few years based on 3.25 people per household, as suggested by Sharon Wilcox and Wood Rodgers - February 2005
2000 population value from GIS and SACOG census tract data
1995-2000 values taken from number of accounts * 3.25

Total Demand column is the sum of historical data as well as data projected by Black & Veatch.

(1) Folsom numbers from the Water Forum Agreement and the baseline for the RMP are for the entire city.
(2) The per-capita rates used for the B&V projections were

Citrus Hts	300
Fair Oaks	326
Folsom	224
OrangeVale	251
SJWD Retail	575

Figure 1A - 17 SJWD Family Agencies Total Demand Projections

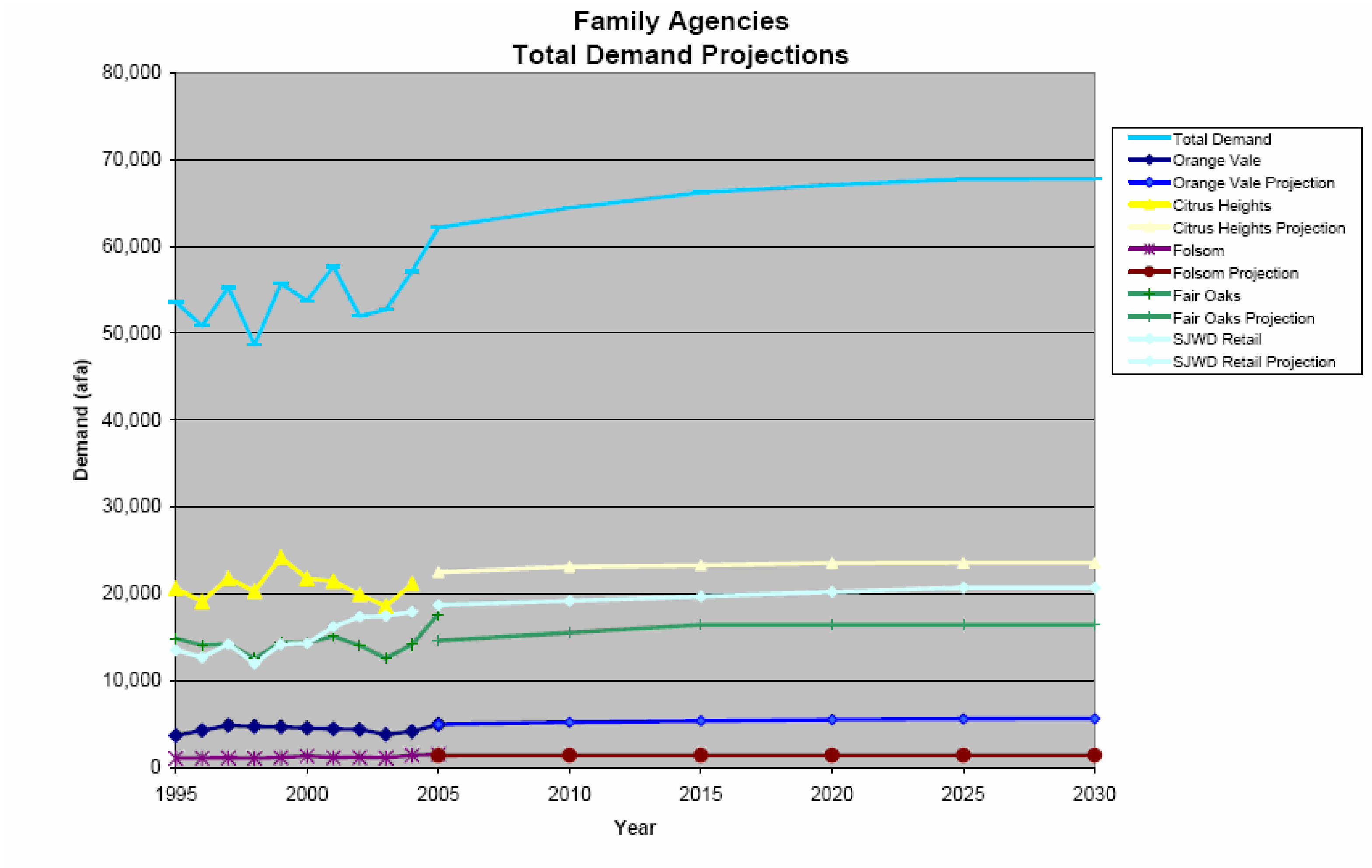


Figure 1A - 18 Populations and Water Demand Projections – Dry and Driest Year Scenarios

Year	Orange Vale: Population	Orange Vale: Total Demand (afa)	Orange Vale: Black & Veatch Recommended Projection (afa) (2)	Orange Vale: Dry Years Surface Water Demand (afa)	Orange Vale: Driest Year Surface Water Demand (afa)	Orange Vale: Groundwater Required (afa)	Orange Vale: Groundwater Available (afa)	Citrus Heights: Population	Citrus Heights: Total Demand (afa)	Citrus Heights: Black & Veatch Recommended Projection (afa) (2)	Citrus Heights: Dry Years Surface Water Demand (afa)	Citrus Heights: Driest Year Surface Water Demand (afa)	Citrus Heights: Groundwater Required (afa)	Citrus Heights: Groundwater Available (afa)	SJWD Retail: Population	SJWD Retail: Total Demand (afa)	SJWD Retail: Black & Veatch Recommended Projection (afa) (2)	SJWD Retail: Dry Years Surface Water Demand (afa)	SJWD Retail: Driest Year Surface Water Demand (afa)	SJWD Retail: Groundwater Required (afa)	SJWD Retail: Groundwater Available (afa)
1995	16,078	3,678			for O'Vale			63,134	20,631						22,101	13,525					
1996	16,374	4,262			use			63,952	19,116						23,199	12,668					
1997	16,491	4,869			.9285 of 10 year Ave			64,248	21,781						24,282	14,214					
1998	16,582	4,718						64,543	20,300						25,275	11,971					
1999	16,757	4,670						64,839	24,184						26,161	14,182					
2000	16,783	4,549						65,134	21,757						26,890	14,287					
2001	16,987	4,457						65,496	21,454						27,959	16,192					
2002	17,185	4,377						65,858	19,914						28,439	17,361					
2003	17,376	3,816						66,220	18,569						28,694	17,454					
2004	17,560	4,165						66,581	21,122						28,851	17,941					
2005	17,738	4,982	4,982		4,150	832	3,383	66,943	21,004	22,500		18,332	4,168	3,774	29,007	18,722	18,691		13,525	5,166	0
2010	18,531	5,205	5,205		4,150	1,055	3,383	68,753	23,108	23,108		18,332	4,776	3,774	29,790	19,227	19,196		13,525	5,671	0
2015	19,161	5,381	5,381		4,150	1,231	3,383	69,200	23,258	23,258		18,332	4,926	3,774	30,572	19,732	19,700		13,525	6,175	0
2020	19,623	5,511	5,511		4,150	1,361	3,383	70,000	23,527	23,527		18,332	5,195	3,774	31,355	20,237	20,204		13,525	6,679	0
2025	19,911	5,592	5,592		4,150	1,442	3,383	70,148	23,577	23,577		18,332	5,245	3,774	32,137	20,742	20,708		13,525	7,183	0
2030	20,023	5,624	5,624		4,150	1,474	3,383	70,148	23,577	23,577		18,332	5,245	3,774	32,137	20,742	20,708		13,525	7,183	0

Year	Folsom: Population	Folsom: Total Demand (afa)	Folsom: Black & Veatch Recommended Projection (afa) (2)	Folsom: Dry Years Surface Water Demand (afa)	Folsom: Driest Year Surface Water Demand (afa)	Folsom: Groundwater Required (afa)	Folsom: Groundwater Available (afa)	Fair Oaks: Population	Fair Oaks: Total Demand (afa)	Fair Oaks: Black & Veatch Recommended Projection (afa) (2)	Fair Oaks: Dry Years Surface Water Demand (afa)	Fair Oaks: Driest Year Surface Water Demand (afa)	Fair Oaks: Groundwater Required (afa)	Fair Oaks: Groundwater Available (afa)	Total Demand
1995	4,905	1,063						38,940	14,890						52,589
1996	4,968	1,076						39,184	14,076						50,879
1997	5,046	1,102						39,429	14,253						55,582
1998	5,124	1,059						39,676	12,515						48,544
1999	5,202	1,141						39,925	14,423						55,767
2000	5,280	1,324						42,000	14,377						53,742
2001	5,376	1,138						39,935	15,148						57,465
2002	5,394	1,149						39,935	14,067						51,961
2003	5,394	1,107						39,950	12,574						52,706
2004	5,394	1,415						40,000	14,153						56,924
2005	5,516	1,515	1,382		1,063	319	0	40,000	14,222	14,611		13,781	830	7,355	62,166
2010	5,638	1,515	1,413		1,063	350	0	42,500	14,292	15,525		13,781	1,744	8,807	64,446
2015	5,638	1,515	1,413		1,063	350	0	45,000	14,617	16,438		13,781	2,657	8,807	66,190
2020	5,638	1,515	1,413		1,063	350	0	45,000	14,617	16,438		13,781	2,657	8,807	67,093
2025	5,638	1,515	1,413		1,063	350	0	45,000	14,617	16,438		13,781	2,657	8,807	67,728
2030	5,638	1,515	1,413		1,063	350	0	45,000	14,617	16,438		13,781	2,657	8,807	67,759

Notes:
Surface water demand in driest years would revert to 1995 diversion.
Conversion from gpm to acre-ft/yr 1.613

Well Descriptions:
Citrus Heights - 3 wells: one @ 900 gpm and two @ 1500 gpm
Fair Oaks - 8 wells: total of 7600 gpm and one in planning stages to produce 1500 gpm
Folsom - 0 wells
Orange Vale - 2 wells: one @ 2500 gpm and one @ 996 gpm

Figure 1A - 19 SJWD Family Agencies Surface and Groundwater Projections

	Orange Vale				Citrus Heights			
Year	Surface Water Demand (afa)	SJWD Metered Demand (afa)	Ground Water Demand (afa)	Recommended Projection or Total	Surface Water Demand (afa)	SJWD Metered Demand (afa)	Ground Water Demand (afa)	Recommended Projection or Total
1995	3,678	3,640	0	3,678	18,332	20,542	89	20,631
1996	4,262	4,638	0	4,262	20,742	19,074	43	19,116
1997	4,869	4,815	0	4,869	21,298	21,305	476	21,781
1998	4,718	4,487	0	4,718	19,130	18,963	1,337	20,300
1999	4,670	4,690	0	4,670	20,343	21,473	2,711	24,184
2000	4,549	4,422	0	4,549	18,363	19,564	2,192	21,757
2001	4,457	4,467	0	4,457	20,554	20,865	588	21,454
2002	4,377	4,377	0	4,377	17,576	17,618	2,296	19,914
2003	3,816	3,816	0	3,816	17,938	17,996	573	18,569
2004	4,165	4,165	0	4,165	19,657	19,775	1,347	21,122
2005	4,981		0	4,981	19,657		1,347	21,004
2010	5,205		0	5,205	21,761		1,347	23,108
2015	5,381		0	5,381	21,911		1,347	23,258
2020	5,511		0	5,511	22,180		1,347	23,527
2025	5,592		0	5,592	22,230		1,347	23,577
2030	5,624		0	5,624	22,230		1,347	23,577

	Folsom				Fair Oaks				SJWD Retail				
Year	Surface Water Demand (afa)	SJWD Metered Demand (afa)	Ground Water Demand (afa)	Recommended Projection or Total	Surface Water Demand (afa)	SJWD Metered Demand (afa)	Ground Water Demand (afa)	Recommended Projection or Total	Surface Water Demand (afa)	SJWD Metered Demand (afa)	Ground Water Demand (afa)	Recommended Projection or Total	Total Demand
1995	1,515	1,063	0	1,063	14,795	13,781	95	14,890	13,525	13,525	0	13,525	53,787
1996	1,515	1,076	0	1,076	13,766	13,800	310	14,076	12,668	12,668	0	12,668	51,198
1997	1,515	1,102	0	1,102	13,771	14,093	482	14,253	14,214	14,214	0	14,214	56,218
1998	1,515	1,059	0	1,059	11,924	11,832	591	12,515	11,971	11,971	0	11,971	50,563
1999	1,515	1,141	0	1,141	14,235	14,301	188	14,423	14,182	14,182	0	14,182	58,599
2000	1,515	1,324	0	1,324	14,018	14,018	359	14,377	14,287	14,287	0	14,287	56,293
2001	1,515	1,138	0	1,138	15,040	14,813	108	15,148	16,192	16,192	0	16,192	58,388
2002	1,515	1,149	0	1,149	11,456	11,456	2,611	14,067	17,361	17,361	0	17,361	56,868
2003	1,515	1,107	0	1,107	12,333	12,333	240	12,574	17,454	17,454	0	17,454	53,519
2004	1,515	1,415	0	1,415	13,841	13,629	312	14,153	17,941	17,941	0	17,941	58,796
2005	1,515		0	1,515	13,911		312	14,222	18,722		0	18,722	60,444
2010	1,515		0	1,515	13,980		312	14,292	19,227		0	19,227	63,347
2015	1,515		0	1,515	14,305		312	14,617	19,732		0	19,732	64,504
2020	1,515		0	1,515	14,305		312	14,617	20,237		0	20,237	65,408
2025	1,515		0	1,515	14,305		312	14,617	20,742		0	20,742	66,043
2030	1,515		0	1,515	14,305		312	14,617	20,742		0	20,742	66,074

Notes:
Total historical values for Orange Vale uses the Orange Vale numbers since the data set is close to the SJWD numbers.
Total historical values for Citrus Heights uses SJWD numbers since they're higher, thus making this column more conservative.
Total historical values for Folsom uses SJWD numbers since other values for Folsom city are unavailable.
Total historical values for Fair Oaks uses Fair Oaks numbers since the data set is close to SJWD numbers.
SJWD Retail Demand values obtained from Chapter 6 of the Retail Water Master Plan and Black & Veatch projections.
Total Demand column is sum of historical data and data projected by Black & Veatch.

Regional Water Master Plan Projections

		Year 2030					
		Wet and Average Years		Drier Years		Driest Years	
	Baseline - 1995 (afa)	Surface Water (afa)	Supplemental Supplies (afa)	Surface Water (afa)	Supplemental Supplies (afa)	Surface Water (afa)	Supplemental Supplies (afa)
Citrus Heights	18,600	21,300	0	21,300 to 10,300	0 to 11,000	10,300	11,000
Fair Oaks	15,201	18,500	0	18,500 to 9,000	0 to 9,500	9,000	9,500
Orange Vale	7,093	8,800	0	8,800 to 4,300	0 to 4,500	4,300	4,500
Folsom	17,900	2,100	0	2,100 to 1,800	0 to 300	1,800	300
Total	58,794	50,700	0	50,700 to 25,400	0 to 24,800	25,400	25,300

note: 1995 value for Folsom is for the entire city, not just the area serviced by SJWD

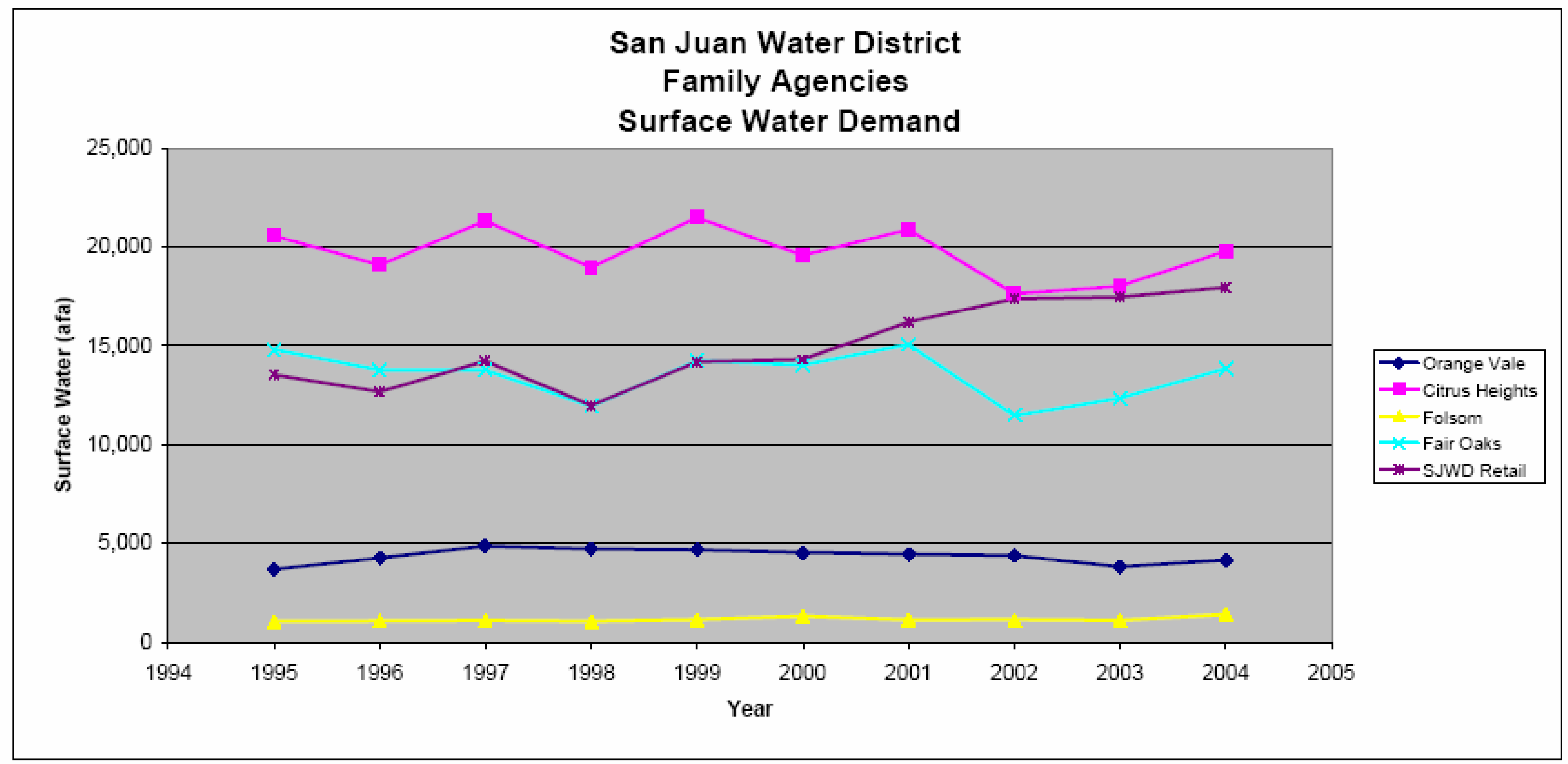


Figure 1A - 20 Peaking Values

Entity	Avg Day	Max Day	Peak Hour	
Citrus Heights	1.0	2.09	2.9	CHWD Water System Master Plan
Fair Oaks	1.0	2.0	3.0	FOWD Water System Master Plan
Folsom	1.0	2.0	3.6	COF Water Treatment Plant and Master Plan Update
Orange Vale	1.0	2.0	3.6	Wood Rodgers for Orange Vale Feb 2005
SJWD Retail	1.0	1.8	3.1	
Average	1.0	2.0	3.2	
Normalized AVG	1.0	2.0	3.1	

Figure 1A - 21 2005 Population Comparison

2005 Population Projections

Citrus Heights	66,579
Fair Oaks	43,000
Folsom	11,530
Orange Vale	17,470

2005 Actual Population

Citrus Heights	65,134	90% built-out	note: 2000 number
Fair Oaks	40,500	90% built-out	note: best-guess
Folsom	11,200	virtually built-out	note: based on consumption. 5,394 in Ashland.
Orange Vale	17,738	77% built-out	note: Wood Rodgers for Orange Vale - Feb 2005

Differences

Citrus Heights	2.17
Fair Oaks	5.81
Folsom	2.86
Orange Vale	-1.53

SJWD–Wholesale Master Plan Phase II
Water Storage and Transmission System Analysis

B&V Project 139074.0200
B&V File G.2
September 8, 2005
FINAL

To: Keith Durkin

Prepared By: Jay Hesby
Willard Pack
Christina Hartinger
Melissa Blanton

Reviewed By: Jim English

SUMMARY AND PURPOSE

San Juan Water District (SJWD or District) is developing the Wholesale Master Plan Phase 2 (WMPP2) as a follow up to the Water Forum and Regional Water Master Plan. Overall goals for WMPP2 are to assess the District's storage and transmission as related to the Family of Agencies (Citrus Heights Water District, Fair Oaks, the Ashland area of the City of Folsom, Orange Vale Water Company, and San Juan Water District Retail) and to develop a water supply plan for the Family of Agencies within the context of regional planning efforts. The major objectives of WMPP2 are to: (1) determine demands/level of service, (2) plan for normal operations, (3) plan for reduced water operations, and (4) allocate costs. Project deliverables include a series of technical memoranda (TMs) and a Final Report.

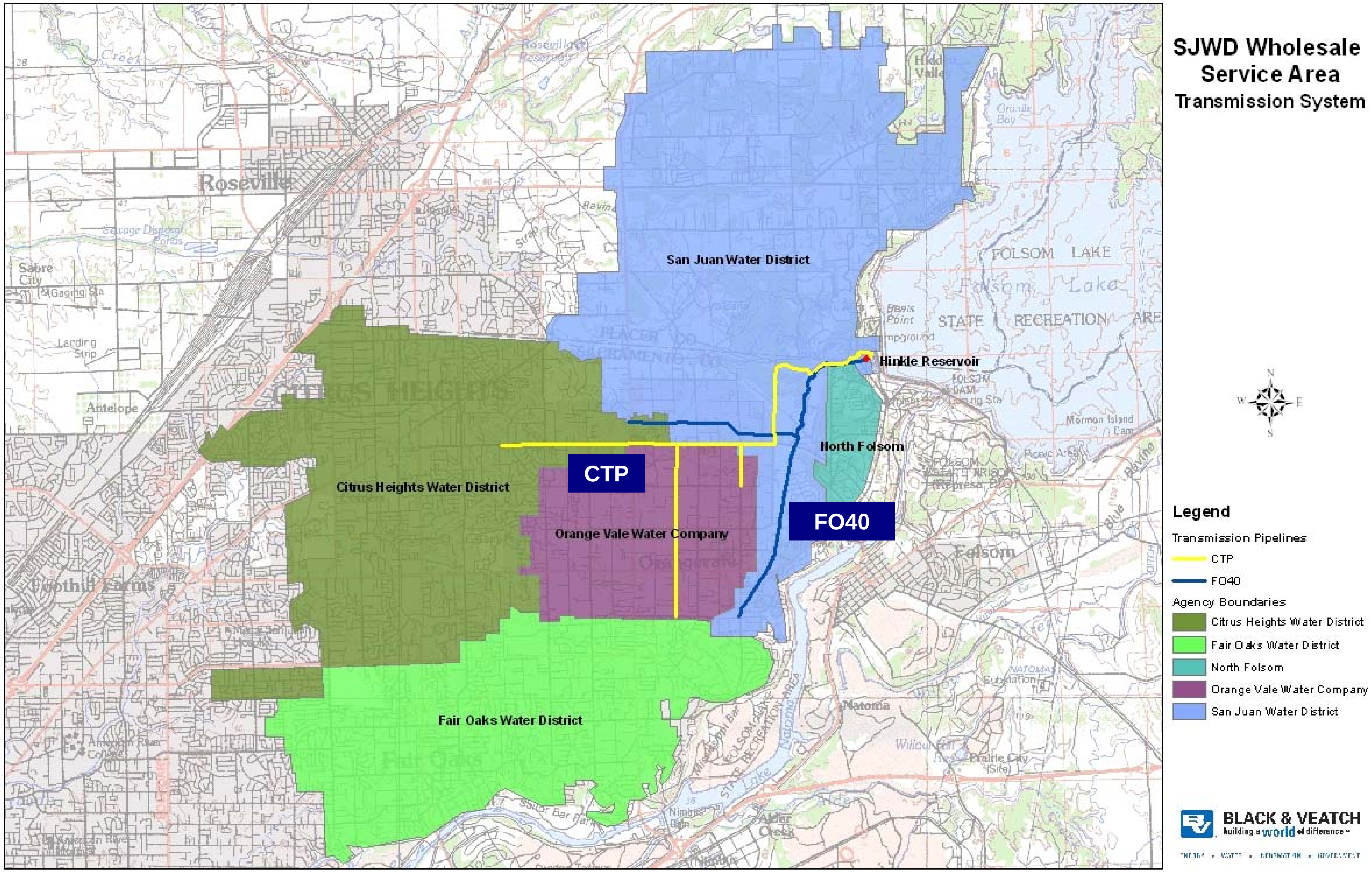
This TM, Water Storage and Transmission System Analysis, presents information to help the District plan for future flow requirements. The transmission system appears to be adequate to convey the flows projected in TM 1, Historical and Projected Demand and Level of Service, while maintaining enough pressure in the system. The storage within the service area appears adequate to handle normal operations, but not provide sufficient emergency storage to satisfy projected demands for an extended period of time.

TRANSMISSION SYSTEM EVALUATION

Description of Transmission System

The District delivers wholesale water to its service area through two pipelines. One is the Cooperative Transmission Pipeline (CTP). The other extends from Hinkle Reservoir through the Fair Oaks 40 (FO40) pipeline, named for the area served and the size of the pipeline. Figure 2-1 presents the wholesale service area with the two transmission pipelines shown, the CTP in yellow and the FO40 in blue.

Figure 2 - 1 SJWD Wholesale Service Area



The CTP is a distribution pipeline ranging from 78 inches to 39 inches in diameter. It extends approximately seven miles from Hinkle Reservoir to the points of connection with Orange Vale, Fair Oaks, Citrus Heights, and Sacramento Suburban Water District (SSWD). A figure and accompanying table showing interconnection and meter locations may be found in the Appendix: Figure 2A – 10 and Figure 2A - 11.

The CTP Agreement was entered into by the Family of Agencies to formulate a regional solution to their needs for surface water. The CTP itself is a direct result of the Agreement. The members of the Family of Agencies and the District helped fund the project. The members each purchased capacity within the pipeline by segment. When it was determined that the pipeline would handle extra capacity beyond that required by the member agencies, SSWD contributed to the cost of the project with the understanding that they would be able to use some of that extra capacity.

The operation of the system is such that the District does not have the ability to limit the amount of water to individual members of the Family of Agencies and SSWD. Flow meters with alarms are in place to monitor the flows to the members and to alert the District if a member agency withdraws more than contracted amounts from the system.

Projected Flows Used in the Evaluation

In TM No. 1, the historical and projected demands for the area serviced by the District were analyzed. It was determined that the Family of Agencies served by the District would require approximately 121.3 million gallons per day (mgd) in 2030 as a maximum day flow. The associated peak hour flow was calculated to be 188.5 mgd. Table 2 - 1 lists the projected max day and peak hour flows as well as the projected peak flows from Exhibit A of the CTP Agreement. The ratio of peak hour flow to maximum day flow was then calculated to be 1.55.

Exhibit A of the CTP Agreement lists flow for both the CTP as well as the other wholesale distribution piping. The flow listed in Table 2-1 represents the entire wholesale distribution system as shown in that exhibit.

Table 2 - 1 Projected Flow for Family of Agencies

Family Agency	Master Plan Projected Max Day Flows (mgd)	Master Plan Projected Peak hour Flows (mgd)	CTP Agreement Peak Flows (mgd)
Citrus Heights	44.0	61.1	52.9
Fair Oaks	29.4	44.0	36.1
Folsom	2.5	4.5	N/A
Orange Vale	10.1	18.1	21.7
SJWD Retail	35.3	60.8	52.2
Total	121.3	188.5	162.9

It was originally assumed that SSWD would require approximately 59 mgd through the CTP, as was suggested they were entitled in the CTP Agreement. Adding that flow to the aforementioned max day and peak hour flows yields a maximum day flow of approximately 180 mgd and a peak hour flow of 247.5 mgd. However, it has been seen that the flow to SSWD has regular fluctuation and that a peaking factor would need to be applied to their projected flow as well. Applying the same peaking factor obtained from the projected 2030 flows for the Family of Agencies, namely 1.55, to a maximum day flow of 180 mgd, yields a peak hour flow of 279.7 mgd. Similarly, reducing the peak hour flow of 247.5 mgd by the same peaking factor yields a maximum day flow of 159.3 mgd. These flows are presented in Table 2 - 2.

Table 2 - 2 Projected Flow for Family of Agencies and SSWD

Family Agency	Projected Max Day without peaking SSWD (mgd)	Projected Peak Hour without peaking SSWD (mgd)	Projected Max Day with SSWD max day at 59 (mgd)	Projected Peak Hour with SSWD max day at 59 (mgd)	Projected Max Day with SSWD peak hour at 59 (mgd)	Projected Peak Hour with SSWD peak hour at 59 (mgd)
Citrus Heights	44.0	61.1	44.0	61.1	44.0	61.1
Fair Oaks	29.4	44.0	29.4	44.0	29.4	44.0
Folsom	2.5	4.5	2.5	4.5	2.5	4.5
Orange Vale	10.1	18.1	10.1	18.1	10.1	18.1
SJWD Retail	35.3	60.8	35.3	60.8	35.3	60.8
SSWD	59.0	59.0	59.0	91.2	38.0	59.0
Total	180.3	247.5	180.3	279.7	159.3	247.5

Table 2 - 3 presents a comparison of the flows listed as entitlements to each member of the Family of Agencies in the CTP Agreement as well as the projected peak hour flows from the projections summarized in TM No.1. The master plan projected peak hour flows are generally more than the CTP Agreement flows. The differences range from -3.6 mgd to 8.6 mgd and -17 percent to 22 percent. The total flow difference amounts to 25.6 mgd or 12 percent. The master plan projected maximum day and peak hour flows as well as the CTP agreement flows were used in the evaluation of the transmission system.

Table 2 - 3 Projected Flow Comparison

Family Agency	CTP Agreement Peak Flows (mgd)	Master Plan Projected Peak Hour with SSWD peak hour at 59 (mgd)	Peak Hour – CTP Difference	
			Flow (mgd)	Percent (%)
Citrus Heights	52.9	61.1	8.2	16%
Fair Oaks	36.1	44.0	7.9	22%
Folsom	N/A	4.5		--
Orange Vale	21.7	18.1	-3.6	-17%
SJWD Retail	52.2	60.8	8.6	16%
SSWD (1)	59.0	59.0	0	0%
TOTAL	221.9	247.5	25.6	12%
Notes: (1) Peaking factors not calculated for SSWD				

Though the projected peak hour flows are higher than the CTP Agreement flows, it has been found that the system will be able to convey those higher flows and still meet the hydraulic grade line (HGL) requirements (see discussion below).

Transmission System Modeling

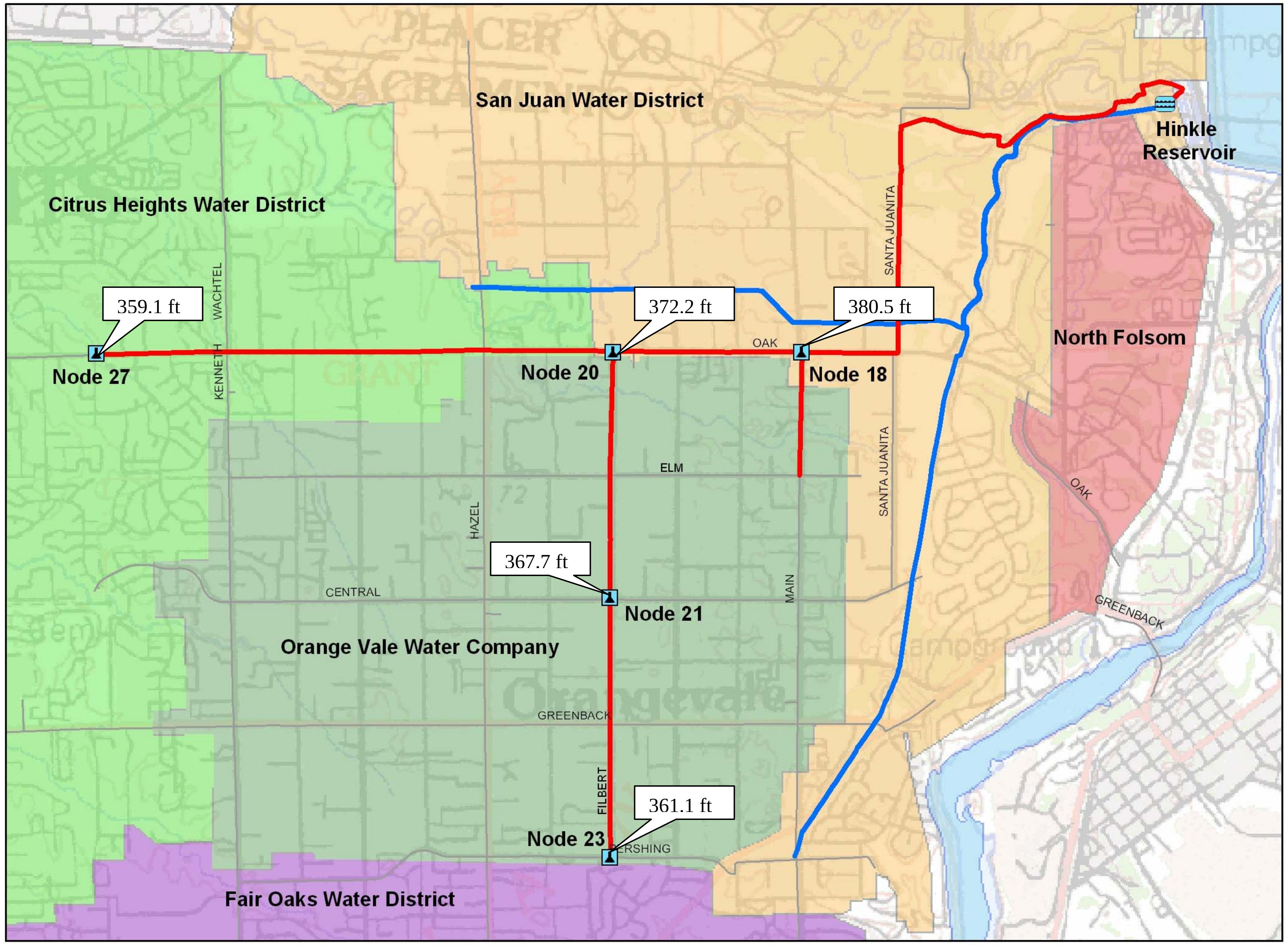
The District maintains a model of the transmission system in the H2O Net format. Applying projected maximum day and peak hour flows (from the left two columns of Table 2 - 2) to the existing model yields an understanding of how the system is likely to perform. HGL requirements were established at various locations within the system as shown in Table 2 - 4 and on Figure 2 - 2. The model results were compared to the requirements.

Table 2 - 4 CTP Agreement Required Hydraulic Grade Line

Node	Location	Required Minimum HGL (ft)
18	Oak and Main	380.5
20	Oak and Filbert	372.2
21	Filbert and Central	367.7
23	Filbert and Pershing	361.1
27	C-Bar-C Park	359.1

The model was run with the water surface elevation in Hinkle Reservoir set at 398 feet. The model output is presented in three figures in the Appendix: maximum day flow results on Figure 2A - 7, peak hour flow results on Figure 2A - 8, and CTP Agreement flows results on Figure 2A - 9.

Figure 2 - 2 SJWD Transmission System



In the CTP Agreement, flow to each member of the Family of Agencies is expected at specific nodes in the wholesale distribution system. Multiple nodes provide flow to each of the member agencies. The percentage of flow to each member agency was calculated for each of the nodes in the system. That percentage was then applied to the projected flows, both max day and peak hour, and the resultant flows were then used in the model for each node in the system.

The comparison between required HGL and modeled HGL values is presented in Table 2 - 5. If the water surface elevation in the reservoir rises above the level modeled, which is common, the projected HGL at the various nodes will increase accordingly.

Table 2 - 5 Hydraulic Grade Line Comparison

Node	Location	Required Minimum HGL (ft)	Master Plan Projected Flows				CTP Agreement Flows	
			Max Day		Peak Hour			
			HGL (ft)	Difference (ft)	HGL (ft)	Difference (ft)	HGL (ft)	Difference (ft)
18	Oak and Main	380.5	382	1.5	375	-5.5	377	-3.5
20	Oak and Filbert	372.2	379	6.7	371	-1.2	373	0.8
21	Filbert and Central	367.7	377	9.3	366	-1.7	369	1.3
23	Filbert & Pershing	361.1	373	11.9	357	-4.1	363	1.9
27	C-Bar-C Park	359.1	371	11.9	361	1.9	364	4.9

The maximum day flows produce an HGL at each node that is higher than the required minimum HGL. The peak hour flows do not meet the minimum required HGL except at the node at C-Bar-C Park. It is possible that modifications to the transmission system may be required in order for peak hour flows to meet the minimum required HGL throughout the system. However, the differences are slight and may be considered to fall within the accuracy of the model. The HGL requirements and the values obtained during the peak hour flow analysis were discussed at a workshop held with the members of the Family of Agencies and SJWD. It was agreed that the difference between the modeled and required HGL is acceptable. See Figure 2-3 for a graphical representation of the HGL Comparisons.

The CTP Agreement modeled flows produce an acceptable HGL at each of the nodes with the exception of the node at Oak and Main. The flows listed in the CTP Agreement are higher than the projected maximum day flow, but lower than the projected peak hour flow, as was shown in Table 2 - 1.

To summarize the findings, Figure 2 – 3, Figure 2 – 4, and Figure 2 - 5 present schematics of the District's transmission system with projected maximum day flows, peak hour flows and the HGL requirements.

Figure 2 - 3 HGL Comparisons

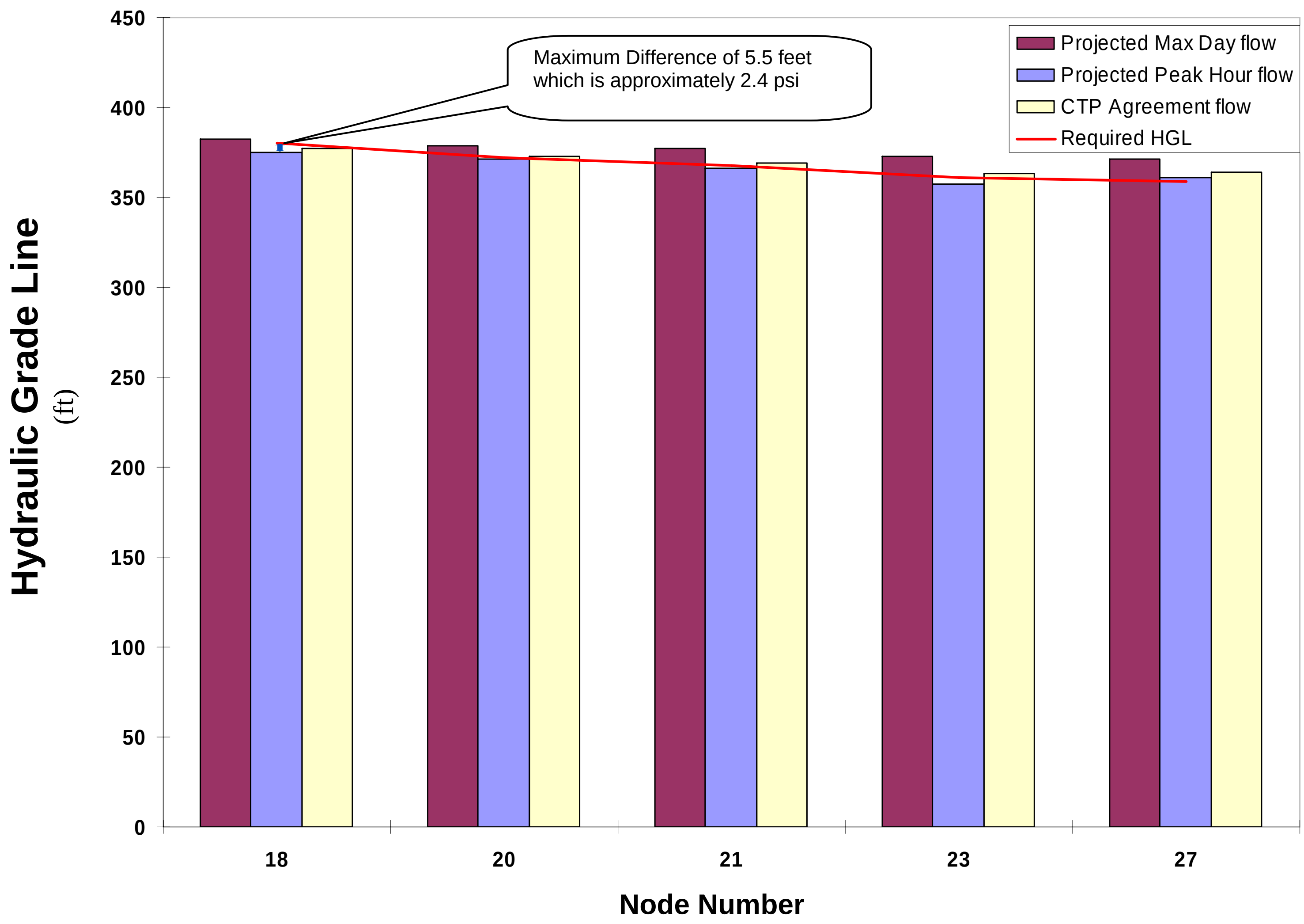


Figure 2 - 4 SJWD Wholesale Service Area – Maximum Day Flows (180 mgd Total)

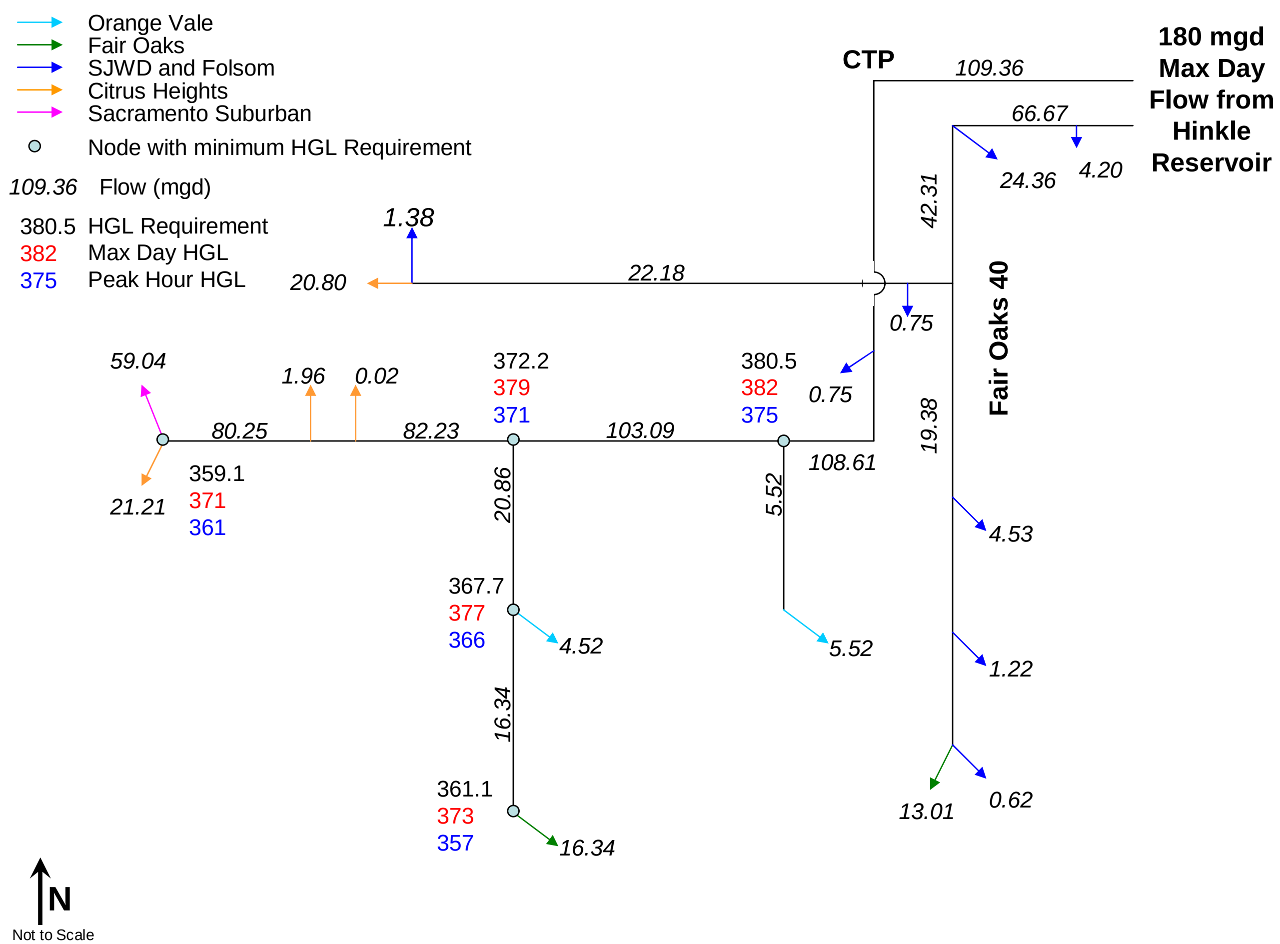
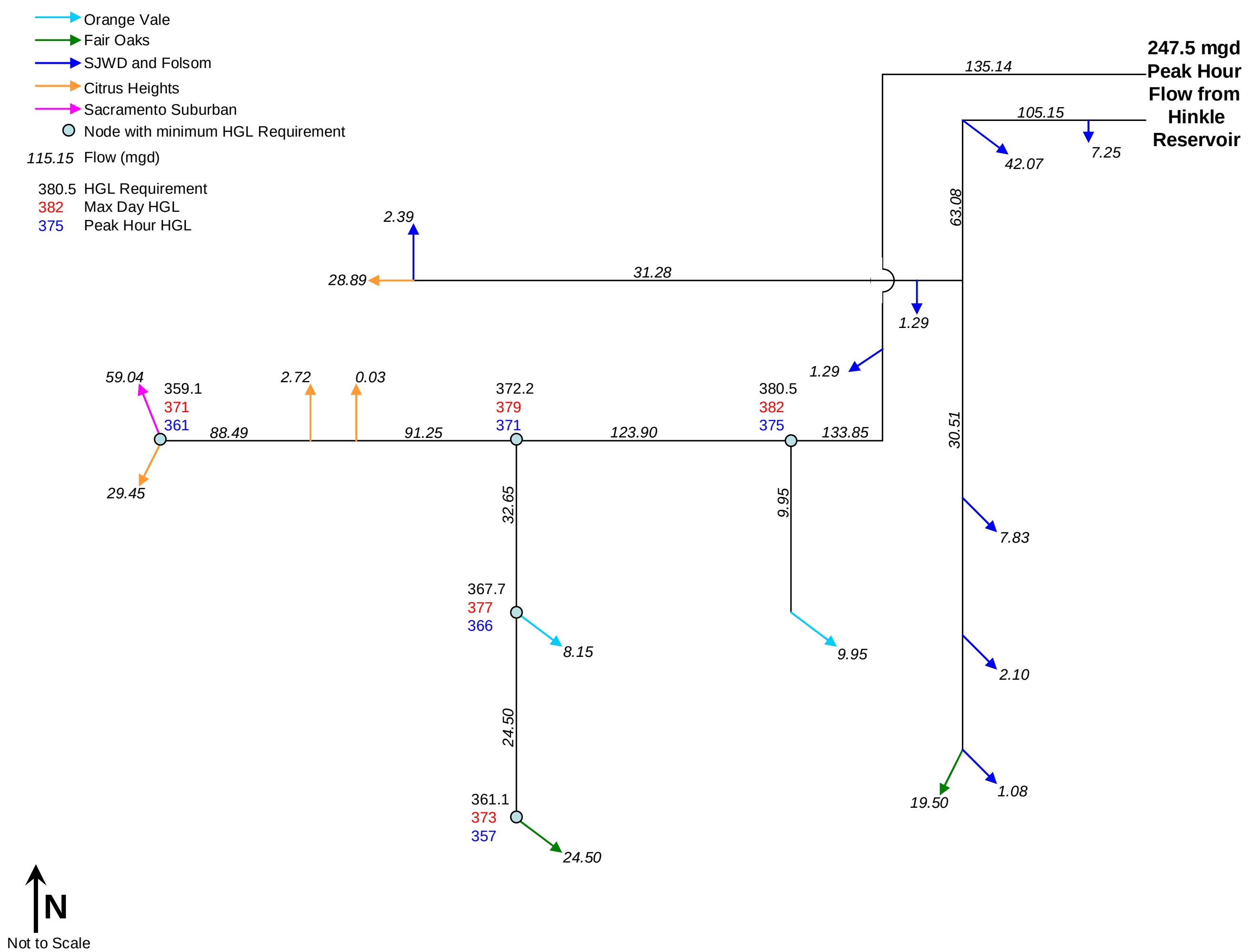


FIGURE 2 - 5 SJWD WHOLESALE SERVICE AREA – PEAK HOUR FLOWS (247.5 MGD TOTAL)



STORAGE ANALYSIS

Currently, storage for the majority of the wholesale system is only available at Hinkle Reservoir, though individual agencies are examining the potential for future storage in their respective service areas. Fair Oaks has an existing storage tank with a volume of 3 million gallons. Orange Vale is considering opportunities for a reservoir as a joint venture or regional solution within their service area. If additional storage in the wholesale system is recommended in this wholesale master transmission facility plan, then joint venturing with planned facilities may be a viable alternative.

Hinkle Reservoir has a nominal volume of 62 million gallons (MG), which occurs at a water depth of 20 feet. When the water depth in the reservoir drops below 7 feet, the floating cover drops to a level at which it may become entangled within the trash racks over the outlet. If the cover becomes entangled, it could damage the cover and the outlet. The volume of water in the reservoir when the water depth is 7 feet is approximately 19.7 MG. Approximately 42.3 MG is thus available as usable storage within the reservoir. This storage is used to accommodate the diurnal flow variations under normal operations (i.e. operational storage) as well as emergency raw water supply and/or plant outages (i.e. emergency storage).

Figure 2-6. Hinkle Reservoir

The current water treatment plant capacity is approximately 120 mgd. With planned hydraulic and process improvements, the plant is expected to be able to treat approximately 140 mgd of surface water. The plant may be expanded to a maximum of 180 mgd in the future (which is the total projected maximum day flow in year 2030). In order to provide a comprehensive evaluation, storage requirements for the three plant capacities were analyzed.

Diurnal Flow Variation

To understand how the treatment plant will serve the system at the three capacities of 120, 140, and 180 mgd, a diurnal curve was developed with each of those values as the maximum day flow.

Existing flow data were obtained from the District for the past 15 months. The flow was reported in 5-minute intervals. The meter at the intersection of Oak Avenue and Filbert Avenue was selected to represent the system for analysis of the diurnal curve. The flows measured at that location indicate that approximately 40% of the total flow passes through that meter. The other meters represented in the data set represent smaller portions of the total flow or are located in areas that are upstream of smaller portions of the distribution system. Thus, use of the meter at Oak and Filbert provides the most complete set of information for flow analysis.

While analyzing the data, it became apparent that the peak flow of 55.2 mgd occurred at the meter located at Oak and Filbert on June 14, 2004. Analyses were made on the data to determine the method that best fit the diurnal flow variations in such a way that the resulting diurnal flow curve could be adequately extrapolated to show projected peak hour and maximum day flows. This diurnal curve was then scaled to obtain the diurnal curves for 120 mgd, 140 mgd, and 180 mgd from the treatment plant.

Required Operation Storage

Using these three diurnal curves and assumed constant rates of treated water supply (180, 140, and 120 mgd), the net input or takeout volumes from Hinkle Reservoir were calculated in hourly increments. It was then determined what minimum storage in the reservoir would be required at the start of the day to handle the daily needs of the area. The required volume of equalization storage would then be equal to the maximum required operational storage volume for any 24-hour cycle.

Using this approach, it was determined that the required storage volumes for the system operating at the 120, 140, and 180 mgd scenarios were 10 MG, 11 MG, and 15 MG, respectively, which is approximately 8% of the maximum day flow. These values are the absolute minimum values required of operational storage for flow equalization under the given assumptions. It is the recommendation of Black & Veatch that the District plan for more operating storage, specifically 150% of those storage volumes listed previously, namely 15, 16.5, and 22.5 MG. The storage analysis results are summarized in Table 2 - 6.

Table 2 - 6 Storage Analysis Results

Scenario	Minimum Required Storage (MG)	Recommended Storage for Normal Operations (MG)	Available Emergency Storage (MG)	Emergency Storage Time of Service (hr)
120 mgd	10	15	27.3	5.5
140-mgd	11	16.5	25.8	4.4
180-mgd	15	22.5	19.8	2.6

Emergency Storage

In order to provide time, in the event of an emergency, for the members of the Family of Agencies to begin their emergency procedures, it is desirable that the District have 12 to 24 hours of emergency storage to meet maximum day flows.

The storage in Hinkle Reservoir above the amount required for operational storage is considered emergency storage. The emergency storage available is 27.3, 25.8, and 19.8 MG for each of the scenarios, 120, 140, and 180 mgd. The emergency storage available when the demand on the system is at 120 mgd would allow for service to the wholesale customers for 5.5 hours. At 140 mgd, the available storage of 25.8 MG would provide service for 4.4 hours. At a demand of 180 mgd, the available storage in Hinkle Reservoir would provide service for approximately 2.6 hours.

As shown in Table 2 - 6, the amount of emergency storage available in Hinkle Reservoir can be determined by subtracting the amount recommended for normal operations from the total available storage of 42.3 mg. Thus, the amount of emergency storage available will only provide water to the wholesale service area for approximately 5.5 hours, operating at 120 mgd. This is less than the amount of emergency storage recommended to allow sufficient time for response to unforeseen supply interruptions or treatment plant outages. As the demand on the system increases to 140 and 180 mgd, it appears that Hinkle Reservoir ultimately would be able to provide only 2.6 hours of service.

Table 2 - 7 summarizes the needs of the individual agencies to meet their emergency storage requirements for 12 and 24 hours based on projected year 2030 maximum day demands. Emergency storage requirements for SSWD were not considered in this evaluation. The storage requirements to meet the 12- and 24-hr demands are listed for each of the agencies, assuming Hinkle Reservoir is used to meet 2.6 hours of emergency service and that SSWD still removes just over 59 mgd from the system, or 6.4 million gallons.

Table 2 - 7 Emergency Storage Requirements

Family Agency	Emergency Storage Available from Hinkle Reservoir (million gallons)	2030 Max Day 12-hr Demand (million gallons)	2030 Max Day 24-hr Demand (million gallons)	Additional Storage Requirement to meet 12-hr Demand (million gallons)	Additional Storage Requirement to meet 24-hr Demand (million gallons)
Citrus Heights	4.9	22.0	44.0	17.1	39.1
Fair Oaks	3.2	14.7	29.4	11.5	26.2
Folsom	0.3	1.2	2.5	0.9	2.2
Orange Vale	1.1	5.1	10.1	4.0	9.0
SJWD Retail	3.9	17.7	35.3	13.8	31.4
SSWD	6.4	Not Considered			
TOTAL	19.8	60.7	121.3	47.3	107.9

The values listed in allow for water flowing to SSWD through the CTP. Since SSWD is not a member of the Family of Agencies for the District and contracts allow its use to be diminished in times of need, it would be possible to eliminate flow to that agency and thus increase the storage available to the Family of Agencies. Table 2 - 8 summarizes the storage requirements for each Agency if SSWD refrains from withdrawing water from the CTP, leaving the water in the system for the Family Agencies.

Table 2 - 8 Emergency Storage Requirements without SSWD

Family Agency	Emergency Storage Available from Hinkle Reservoir (million gallons)	2030 Max Day 12-hr Demand (million gallons)	2030 Max Day 24-hr Demand (million gallons)	Additional Storage Requirement to meet 12-hr Demand (million gallons)	Additional Storage Requirement to meet 24-hr Demand (million gallons)
Citrus Heights	7.2	22.0	44.0	14.8	36.8
Fair Oaks	4.7	14.7	29.4	10.0	24.7
Folsom	0.5	1.2	2.5	0.7	2.1
Orange Vale	1.6	5.1	10.1	3.5	8.5
SJWD Retail	5.8	17.7	35.3	11.9	29.5
TOTAL	19.8	60.7	121.3	40.9	101.5

Table 2 - 8 did not include the availability of groundwater within Citrus Heights, Fair Oaks, and Orange Vale. Discussion will be held between the members of the Family of Agencies to determine the amount of time required to begin groundwater production in the event of an emergency. If the agencies were to start well use at the time of the emergency and the wells were producing the supply listed in TM No. 1, then the required storage will be reduced to the values listed in Table 2 - 9.

Table 2 - 9 Emergency Storage Requirements without SSWD and Using Groundwater

Family Agency	2030 Max Day 12-hr Demand (MG)	2030 Max Day 24-hr Demand (MG)	Emergency Supply available from Hinkle Reservoir (MG)	Groundwater Provided by Agency wells (mgd)	Additional Storage Requirement to meet 12-hr Demand (MG)	Additional Storage Requirement to meet 24-hr Demand (MG)
Citrus Heights	22.0	44.0	7.2	6.9	11.4	29.9
Fair Oaks	14.7	29.4	4.7	10.4	4.8	14.3
Folsom	1.2	2.5	0.5	0.0	0.7	2.0
Orange Vale	5.1	10.1	1.6	5.5	0.8	3.0
SJWD Retail	17.7	35.3	5.8	0.0	11.9	29.5
TOTAL	60.7	121.3	19.8	22.8	29.5	78.7

During the draft process of this TM, a workshop was held during which the storage requirements of the Family of Agencies were addressed. It was discussed that storage may be a viable alternative to ease emergency situations. Enhancing the groundwater availability within the service areas was discussed more favorably as a method of providing an alternative source for water for emergency and drought situations, which is discussed in TM 4. Further analyses will be done to determine the feasibility of creating more wells and pumping the required water from the ground as well as exploring alternatives for supplemental storage within the system.

PRELIMINARY CONCLUSIONS

Based on the transmission and storage evaluation, the following preliminary conclusions were developed:

- The transmission system is adequate for transmission of the projected average flows of 180 mgd along with peak hour flows of 247.5 mgd without losing required pressure in the system which meets the projected 2030 demands of the Family of Agencies with a constant flow of 59 mgd to SSWD.
- The projected peak hour flows in the wholesale system are more than those planned for in the CTP Agreement and the projected maximum day flows are less than those planned for in the CTP Agreement.
- Under normal operations of Hinkle Reservoir, 15 MG of storage would be required when the system is providing the maximum day flow of 120 mgd to the service area and 22.5 MG would be required when the system is providing 180 mgd.
- 27.3 MG of emergency storage is available when the system is operating at 120 mgd, providing for approximately 5.5 hours of service. The situation worsens to 19.8 MG of emergency storage when operated at 180 mgd, allowing approximately 2.6 hours of operation.
- Further analysis in a later technical memorandum will be done to determine the feasibility of increased groundwater pumping and supplemental storage to meet emergency storage needs beyond 2.6 hours.

APPENDIX

TRANSMISSION AND STORAGE ANALYSIS

The analysis is presented as follows:

Figure 2A - 1 Diurnal Flow Curve – Taken from June 14, 2004, measured flows at Oak Ave. and Filbert Ave

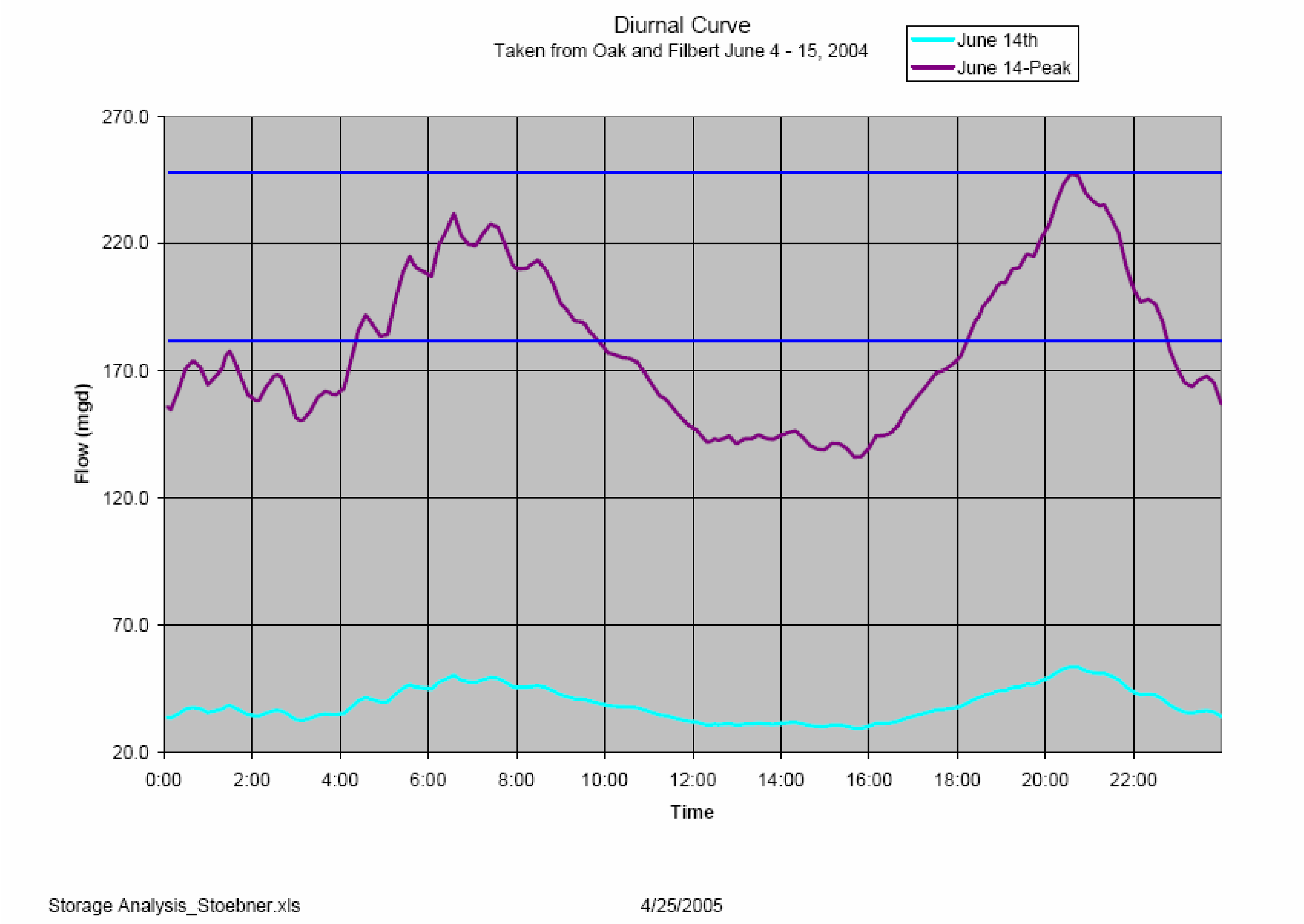


Figure 2A - 2 Demand Curve – 180 mgd Analysis

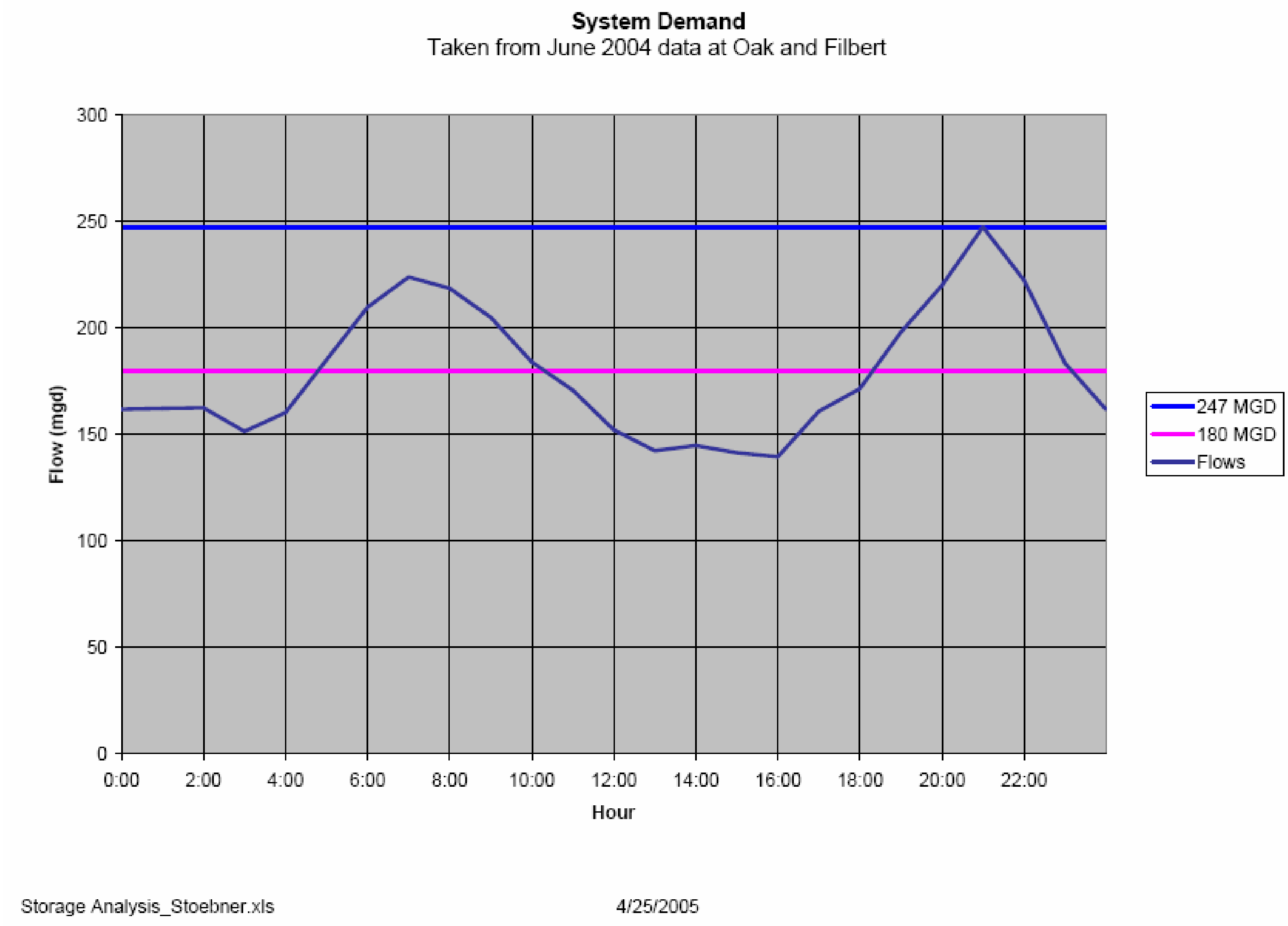
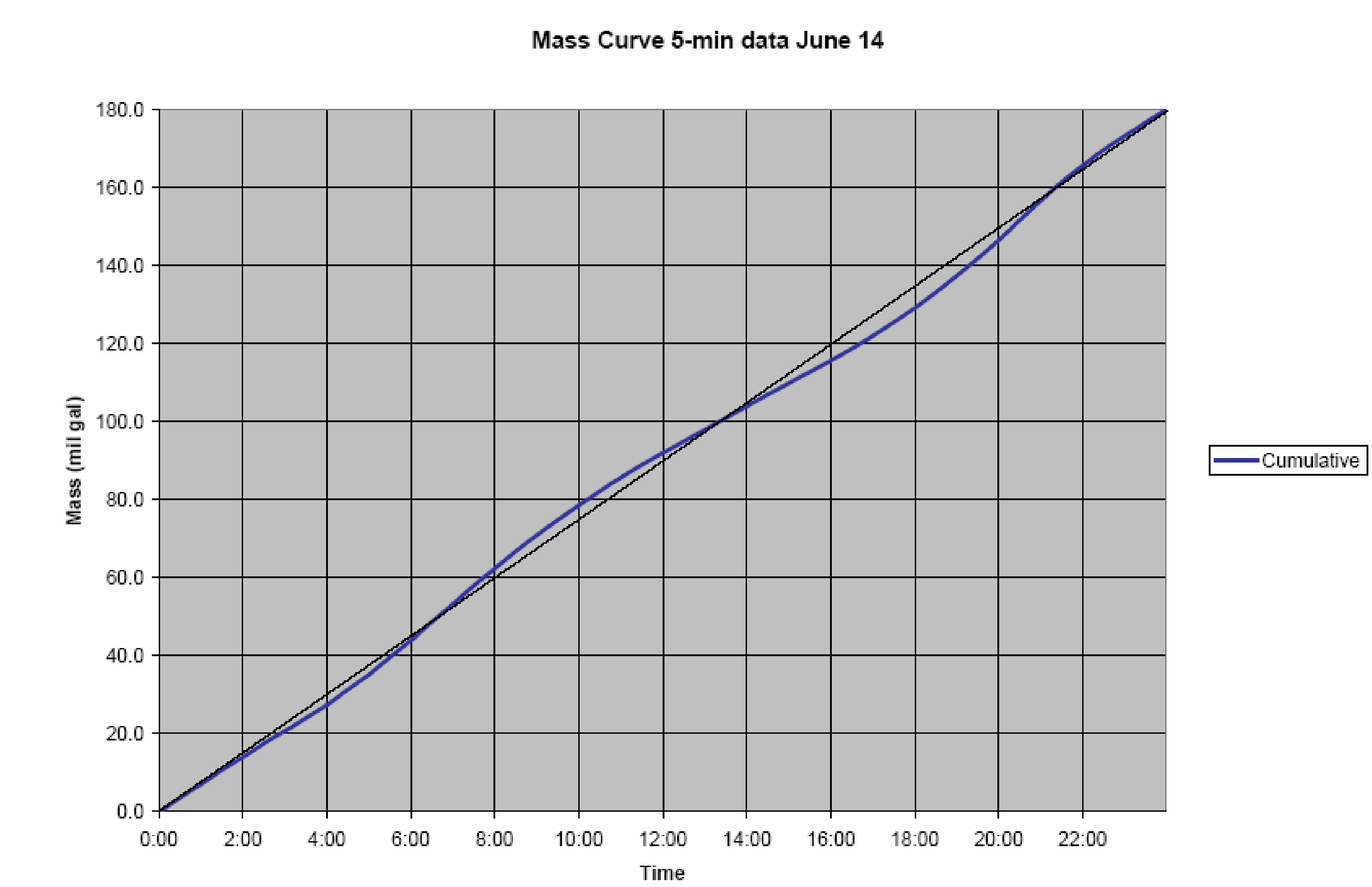


Figure 2A - 3 Mass Curve – 180 mgd Analysis



Storage Analysis_Stoebner.xls 4/25/2005

Figure 2A - 4 180 mgd Storage Analysis

Hour Ending	Time	Demand (mgd)	Hourly Demand (mil gal)	Cumulative Demand (mil gal)	Plant Rate (mgd)	Hourly Plant Rate (mil gal)	Reservoir Req't (mil gal)	Reservoir Volume (mil gal)
0	0:00	152.78	6.37	6.37	180.0	7.50	-1.13	10.13
100	1:00	158.25	6.59	12.96	180.0	7.50	-0.91	9.22
200	2:00	157.49	6.56	19.52	180.0	7.50	-0.94	8.29
300	3:00	135.35	5.64	25.16	180.0	7.50	-1.86	6.43
400	4:00	150.19	6.26	31.42	180.0	7.50	-1.24	5.18
500	5:00	189.93	7.91	39.33	180.0	7.50	0.41	5.60
600	6:00	225.93	9.41	48.75	180.0	7.50	1.91	7.51
700	7:00	246.15	10.26	59.00	180.0	7.50	2.76	10.27
800	8:00	238.51	9.94	68.94	180.0	7.50	2.44	12.71
900	9:00	219.01	9.13	78.07	180.0	7.50	1.63	14.33
1000	10:00	188.71	7.86	85.93	180.0	7.50	0.36	14.69
1100	11:00	167.98	7.00	92.93	180.0	7.50	-0.50	14.19
1200	12:00	136.57	5.69	98.62	180.0	7.50	-1.81	12.38
1300	13:00	120.09	5.00	103.62	180.0	7.50	-2.50	9.89
1400	14:00	124.18	5.17	108.80	180.0	7.50	-2.33	7.56
1500	15:00	118.59	4.94	113.74	180.0	7.50	-2.56	5.00
1600	16:00	115.35	4.81	118.54	180.0	7.50	-2.69	2.31
1700	17:00	135.67	5.65	124.20	180.0	7.50	-1.85	0.46
1800	18:00	168.99	7.04	131.24	180.0	7.50	-0.46	0.00
1900	19:00	209.10	8.71	139.95	180.0	7.50	1.21	1.21
2000	20:00	240.43	10.02	149.97	180.0	7.50	2.52	3.73
2100	21:00	279.71	11.65	161.62	180.0	7.50	4.15	7.89
2200	22:00	243.93	10.16	171.79	180.0	7.50	2.66	10.55
2300	23:00	187.22	7.80	179.59	180.0	7.50	0.30	10.85
2400	0:00	152.78	6.37	185.95	180.0	7.50	-1.13	9.72
		279.71	11.65			180.0	-0.41	14.69
		179.59	179.59					0.00
								14.69

Storage Analyses.xls 6/28/2005

Figure 2A - 5 140 mgd Storage Analysis

Hour Ending	Time	Demand (mgd)	Hourly Demand (mil gal)	Cumulative Demand (mil gal)	Plant Rate (mgd)	Hourly Plant Rate (mil gal)	Reservoir Req't (mil gal)	Reservoir Volume (mil gal)
0	0:00	118.83	4.95	4.95	140	5.83	-0.88	7.88
100	1:00	123.08	5.13	10.08	140	5.83	-0.70	7.18
200	2:00	122.50	5.10	15.18	140	5.83	-0.73	6.45
300	3:00	105.27	4.39	19.57	140	5.83	-1.45	5.00
400	4:00	116.81	4.87	24.44	140	5.83	-0.97	4.03
500	5:00	147.72	6.16	30.59	140	5.83	0.32	4.35
600	6:00	175.72	7.32	37.91	140	5.83	1.49	5.84
700	7:00	191.45	7.98	45.89	140	5.83	2.14	7.99
800	8:00	185.51	7.73	53.62	140	5.83	1.90	9.88
900	9:00	170.34	7.10	60.72	140	5.83	1.26	11.15
1000	10:00	146.78	6.12	66.83	140	5.83	0.28	11.43
1100	11:00	130.65	5.44	72.28	140	5.83	-0.39	11.04
1200	12:00	106.22	4.43	76.70	140	5.83	-1.41	9.63
1300	13:00	93.40	3.89	80.60	140	5.83	-1.94	7.69
1400	14:00	96.59	4.02	84.62	140	5.83	-1.81	5.88
1500	15:00	92.24	3.84	88.46	140	5.83	-1.99	3.89
1600	16:00	89.72	3.74	92.20	140	5.83	-2.10	1.80
1700	17:00	105.52	4.40	96.60	140	5.83	-1.44	0.36
1800	18:00	131.43	5.48	102.07	140	5.83	-0.36	0.00
1900	19:00	162.63	6.78	108.85	140	5.83	0.94	0.95
2000	20:00	187.00	7.79	116.64	140	5.83	1.96	2.90
2100	21:00	217.55	9.06	125.71	140	5.83	3.23	6.14
2200	22:00	189.72	7.91	133.61	140	5.83	2.07	8.21
2300	23:00	145.61	6.07	139.68	140	5.83	0.23	8.44
2400	0:00	118.83	4.95	144.63	140	5.83	-0.88	7.56
		217.55	9.06			140.0	-0.32	11.43
		139.68	139.68					0.00
								11.43

Storage Analyses.xls 6/28/2005

Figure 2A - 6 120 mgd Storage Analysis

Hour Ending	Time	Demand (mgd)	Hourly Demand (mil gal)	Cumulative Demand (mil gal)	Plant Rate (mgd)	Hourly Plant Rate (mil gal)	Reservoir Req't (mil gal)	Reservoir Volume (mil gal)
0	0:00	101.85	4.24	4.24	120	5.00	-0.76	6.75
100	1:00	105.50	4.40	8.64	120	5.00	-0.60	6.15
200	2:00	105.00	4.37	13.01	120	5.00	-0.63	5.52
300	3:00	90.23	3.76	16.77	120	5.00	-1.24	4.28
400	4:00	100.12	4.17	20.95	120	5.00	-0.83	3.45
500	5:00	126.62	5.28	26.22	120	5.00	0.28	3.73
600	6:00	150.62	6.28	32.50	120	5.00	1.28	5.00
700	7:00	164.10	6.84	39.34	120	5.00	1.84	6.84
800	8:00	159.01	6.63	45.96	120	5.00	1.63	8.47
900	9:00	146.00	6.08	52.04	120	5.00	1.08	9.55
1000	10:00	125.81	5.24	57.29	120	5.00	0.24	9.79
1100	11:00	111.98	4.67	61.95	120	5.00	-0.33	9.46
1200	12:00	91.05	3.79	65.75	120	5.00	-1.21	8.25
1300	13:00	80.06	3.34	69.08	120	5.00	-1.66	6.59
1400	14:00	82.79	3.45	72.53	120	5.00	-1.55	5.04
1500	15:00	79.06	3.29	75.83	120	5.00	-1.71	3.33
1600	16:00	76.90	3.20	79.03	120	5.00	-1.80	1.54
1700	17:00	90.45	3.77	82.80	120	5.00	-1.23	0.30
1800	18:00	112.66	4.69	87.49	120	5.00	-0.31	0.00
1900	19:00	139.40	5.81	93.30	120	5.00	0.81	0.81
2000	20:00	160.28	6.68	99.98	120	5.00	1.68	2.49
2100	21:00	186.47	7.77	107.75	120	5.00	2.77	5.25
2200	22:00	162.62	6.78	114.52	120	5.00	1.78	7.03
2300	23:00	124.81	5.20	119.73	120	5.00	0.20	7.23
2400	0:00	101.85	4.24	123.97	120	5.00	-0.76	6.48
		186.47	7.77			120.0	-0.27	9.79
		119.73	119.73					0.00
								9.79

Storage Analyses.xls 6/28/2005

Figure 2A - 7 Modeling Output for Maximum Day Flows

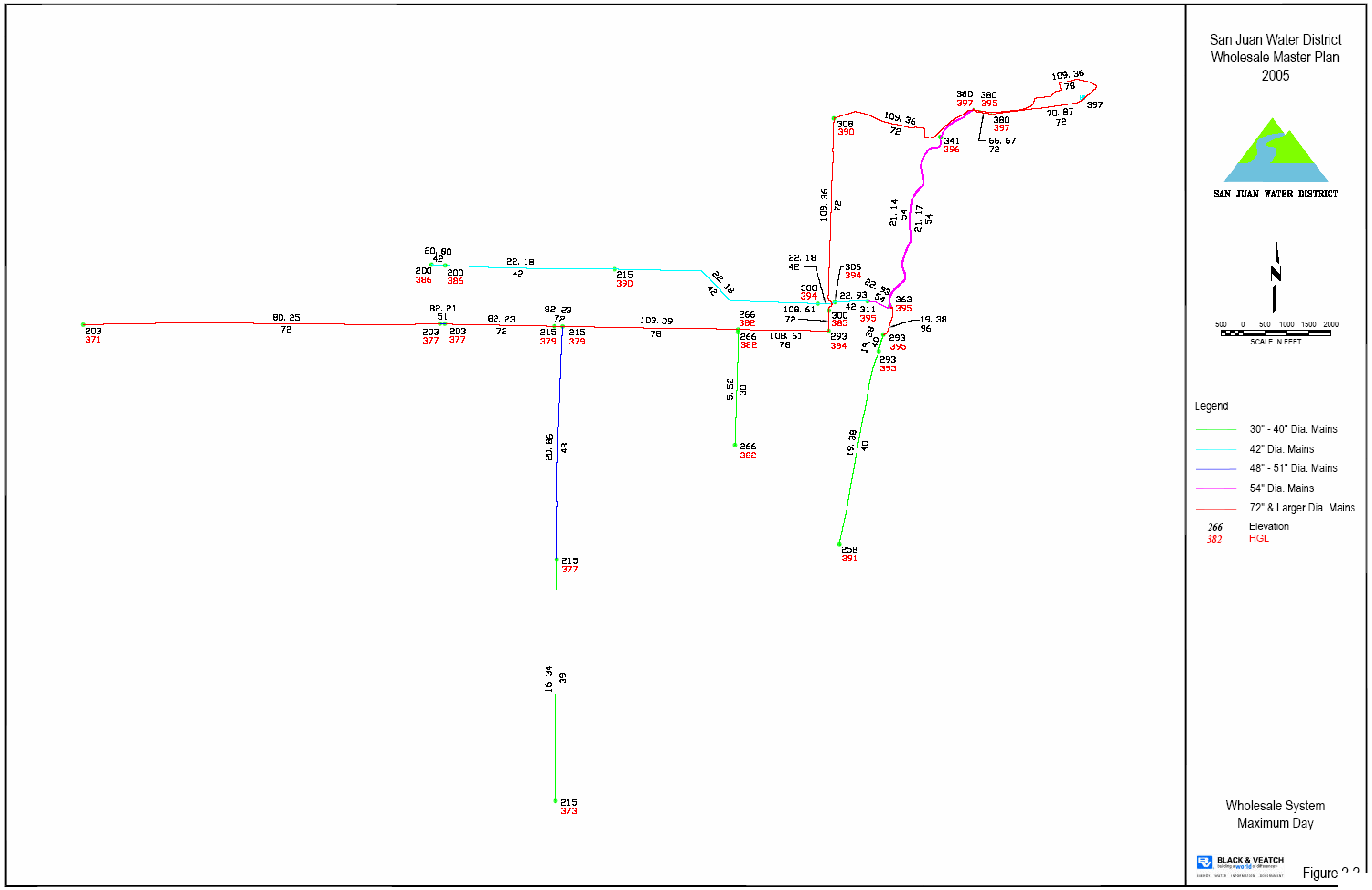


Figure 2A - 8 Model Output for Peak Hour Flows

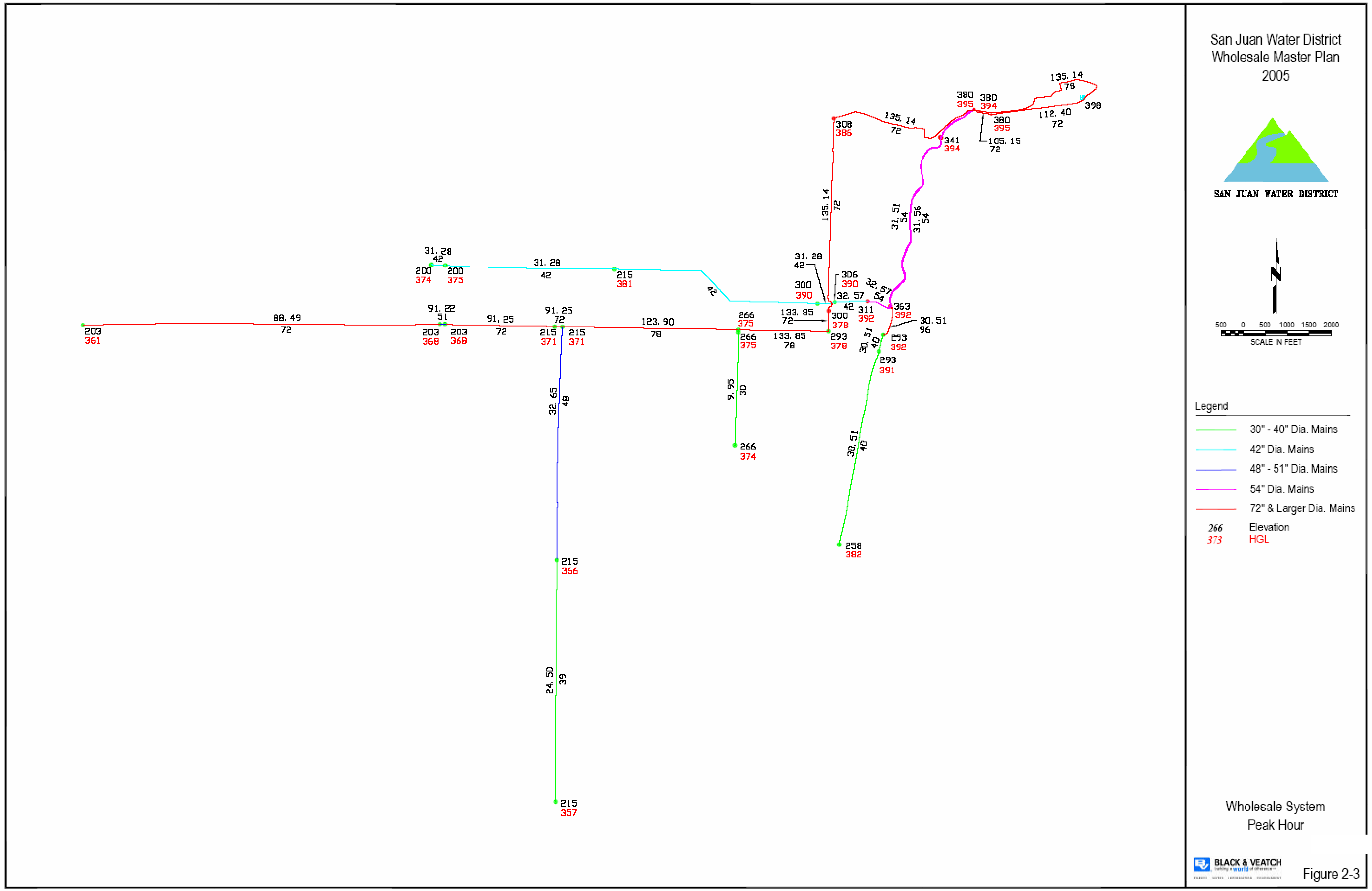


Figure 2A - 9 Model Output for CTP Agreement Flows

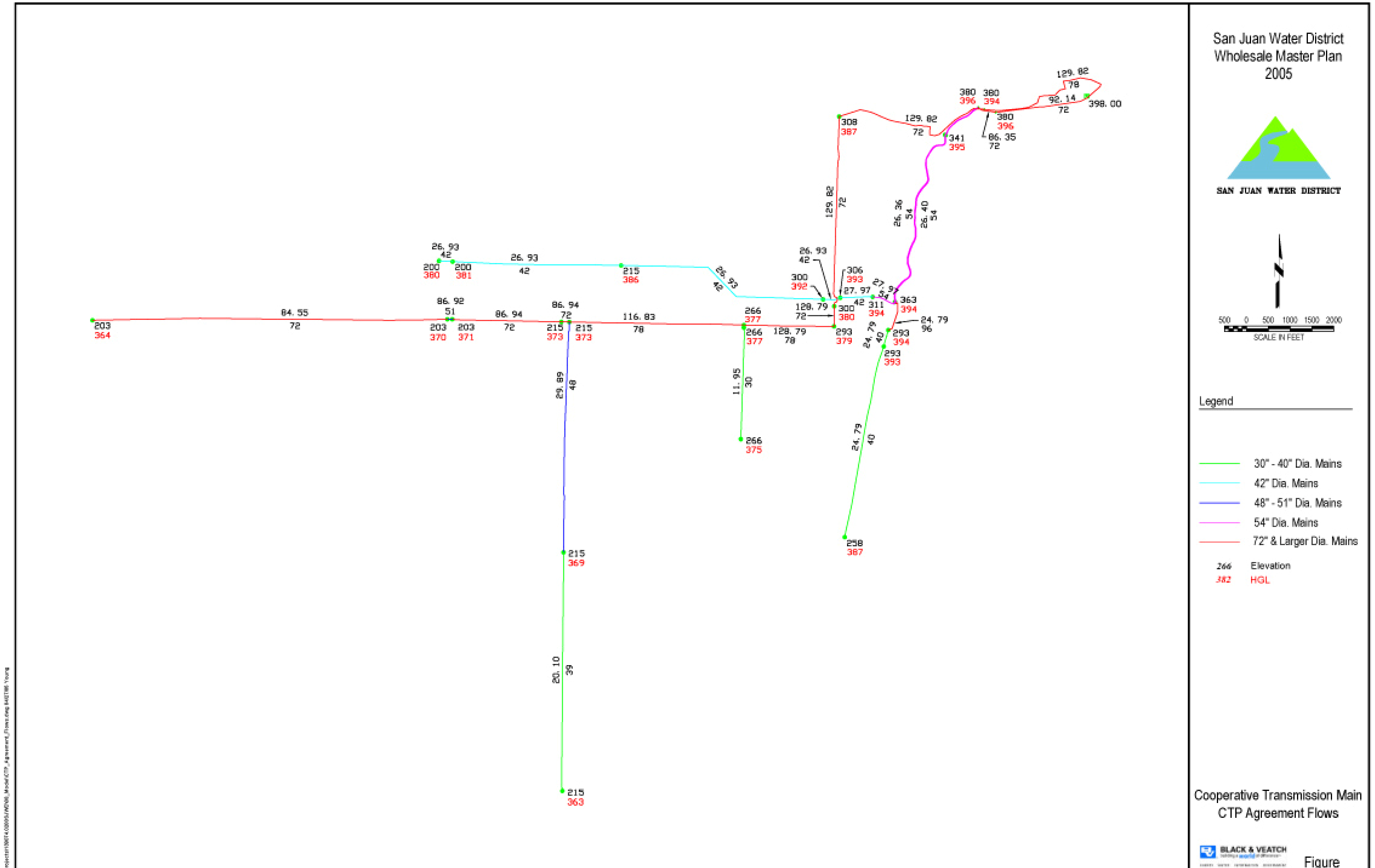


Figure 2A - 10 Wholesale Transmission Pipeline with Interconnections

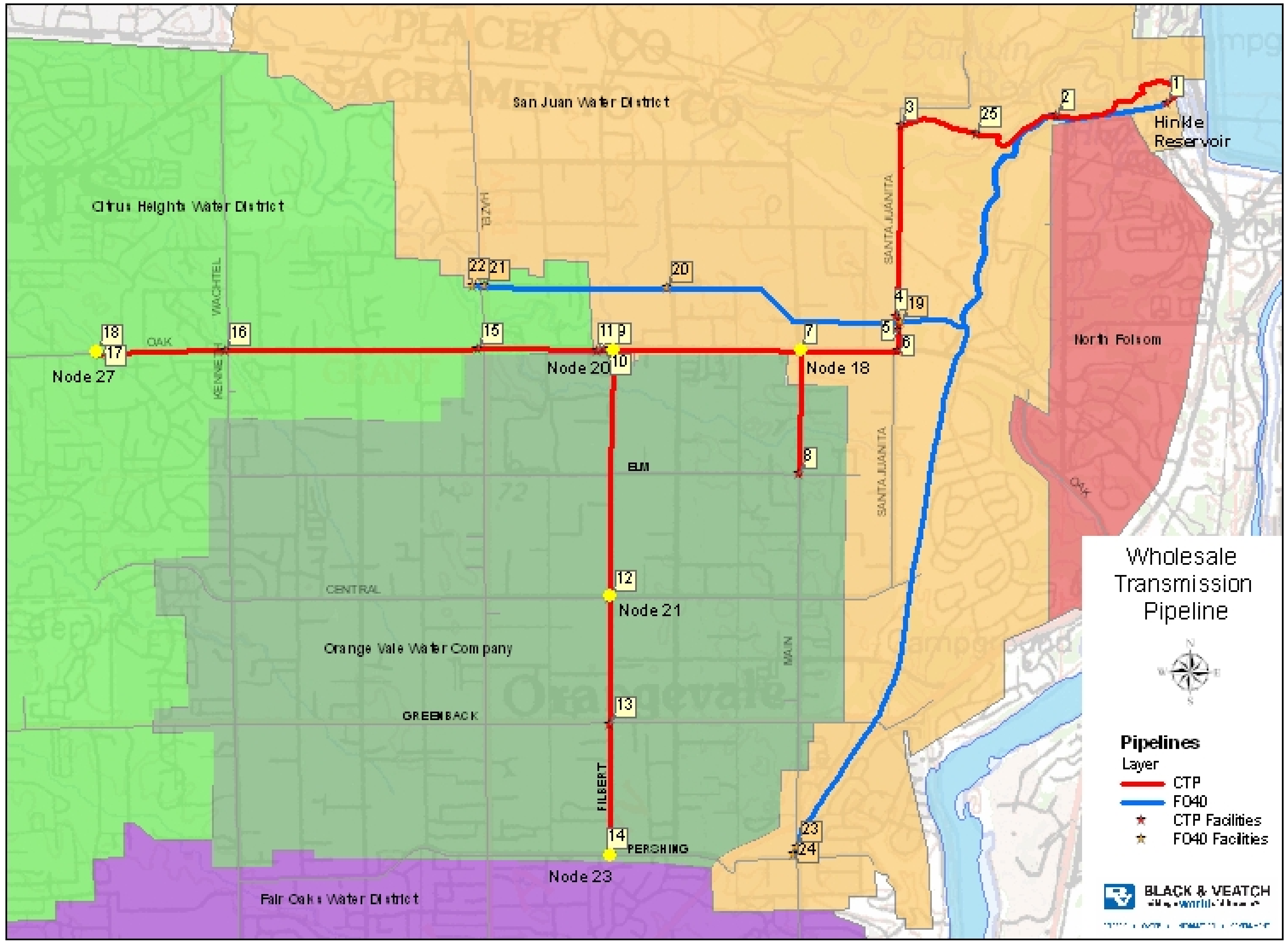


Figure 2A - 11 Interconnections and Meter Locations of the CTP and FO40

Point	Item	Elevation	Comment
1	Hinkle Reservoir	381.5	Storage for the system
2	78" x 42" Tee	373	Connection for SJWD - nearby probe meter access manway
3	72" x 72" Wye	294.5	Blind connection to north
4	72" x 42" Tee	295.5	Connection for CHWD
5	72" x 18" Tee	295	Connection for SJWD
6	72" x 72" Tee	283.5	Connection to FO40 - Valve shut
7	78" x 30" Tee	251	Connection to 30" line in Main Ave
8	30" to 24" reducer	255	Connection to existing 24" water line for OVWC
9	78" x 48" Tee	199.5	Connection to 48" line in Filbert Ave
10	Water Meter	201.5	Probe meter
11	72" x 8" Tee	205.5	Connection to CHWD
12	48" x 24" Tee	255.9	Connection to OVWC - downstream probe meter access manway
13	39" x 16" Tee	237.5	Connection to OVWC at Greenback - unused
14	39" x 30" Wye	216	Connection to existing 27" water line for FOWD
			probe meter and 30" saddle type propeller meter downstream
15	72" x 18" Tee	200	Connection to CHWD
16	72" x 48" Tee	182.5	Blind connection for future CHWD
17	72" x 24" Cross	190	Connection for CHWD
			probe meter and 48" saddle type propeller meter in connection
18		189	Connection to SSWD
19	Water Meter		
20	42" x 12" Tee	381	Connection to SJWD - usually turned off
21		375	Connection to SJWD and OVWC with Eden Oaks meter
22		374	Connection to CHWD
23	Water Meter		Meter for FOWD at Main Ave
24			Connection to FOWD
25	72” x 36” Tee	320	Future connection to Roseville

BLACK & VEATCH
TECHNICAL MEMORANDUM NO. 3

SJWD–Wholesale Master Plan Phase 2
Water Storage and Transmission System Analysis
Cost Update

B&V Project 139074.0200
B&V File G.2
November 9, 2005
FINAL

To: Keith Durkin

Prepared By: Willard Pack
Christina Hartinger
Jay Hesby
Melissa Blanton

Reviewed By: Jim English

PURPOSE AND SUMMARY

San Juan Water District (SJWD or District) is developing the Wholesale Master Plan Phase 2 (WMPP2) as a follow-on to the Water Forum and Regional Water Master Plan, to assess the District's storage and transmission as related to the Family of Agencies (Citrus Heights Water District, Fair Oaks Water District, the Ashland area of the City of Folsom, Orange Vale Water Company, and San Juan Water District Retail), and to develop a water supply plan for the Family of Agencies within the context of the regional planning efforts. Key project objectives are to: (1) determine demands/level of service, (2) plan for normal operations, (3) plan for reduced water operations, and (4) allocate costs

This technical memorandum (TM) presents an update of cost estimates for the rehabilitation of the Fair Oaks 40 Pipeline. Previous estimates were presented in the report *Conceptual Design Memorandum: Rehabilitation of the American River Canyon Crossing of the Fair Oaks 40-inch Pipeline and Rehabilitation of the Fair Oaks 40 Pipeline*, prepared by Bookman-Edmonston Engineering, Inc. in October 1998. The total project cost identified in the 1998 report was $472,200.

Costs were updated by two methods. The first method, using the 20-City Average Engineering News Record (ENR) Building Cost Index (BCI), developed an updated total project cost of $575,000. The second method utilized a combination of the BCI and the Black & Veatch cost database. This method developed an updated total project cost of $1,045,900. The latter estimate was determined to more accurately reflect cost conditions in the project area.

Cost allocations were then developed for the three Family of Agencies members that would contribute to the rehabilitation project: Fair Oaks, San Juan, and Orange Vale. It is recommended that the updated numbers be incorporated in the Fair Oaks 40 Pipeline Rehabilitation portion of the District's capital improvements plan.

BACKGROUND

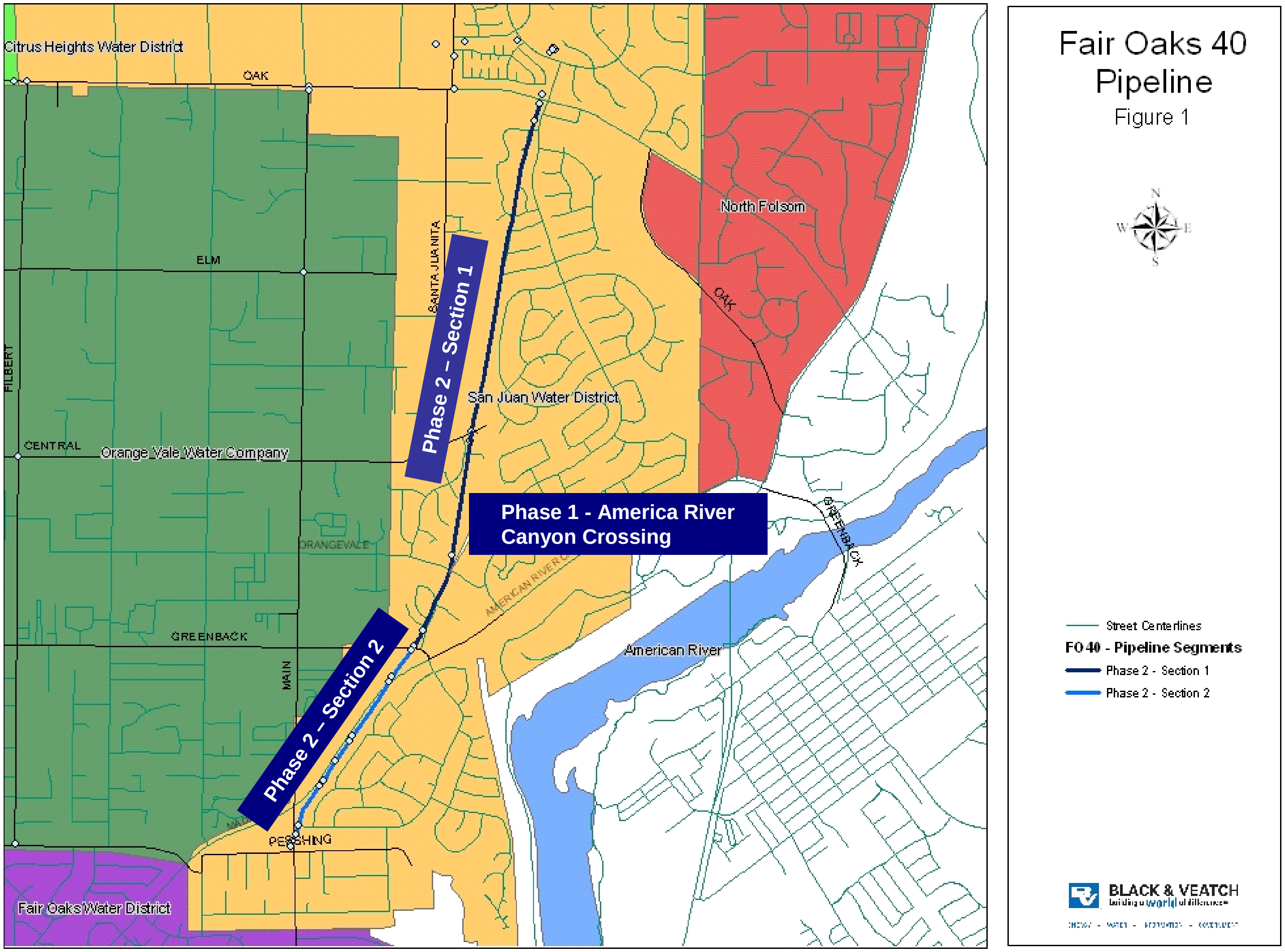
The Fair Oaks 40 Pipeline is a 40-inch, 11,000-foot (or 2-mile) long potable water pipeline delivering water from Hinkle Reservoir to the Fair Oaks Water District, Orange Vale Water Company, and several retail customers of the San Juan Water District.

As shown on Figure 3 - 1, the pipeline is divided into three sections for the purposes of this work. Phase 1 consists of the 60-foot pipeline section at the American River Canyon Crossing; Phase 2-Section 1 consists of the 1.5-mile pipeline section from approximately Oak Avenue to Greenback Lane; and Phase 2-Section 2 consists of the 0.5-mile pipeline section south of Greenback Lane. These designations are adopted from the Bookman Edmonston Report.

The pipeline section at the American River Canyon Crossing in Phase 1 was supported by a timber trestle. Over time, the timbers have deteriorated to the point that the pipeline is experiencing stresses beyond those recommended by the AWWA for pipe on above-ground supports. The report by Bookman-Edmonston was commissioned to analyze various means of improving the crossing's reliability. Options examined included replacing the existing crossing with a buried pipeline; adding a reinforced concrete central pier to the existing span; and, adding steel plate reinforcement and concrete supports to the existing span near the canyon walls to reduce and redistribute the stresses in the pipe. It was determined that the pipeline was in good condition, but that new supports were required to relieve the increased stresses in the pipe walls. Since the option of adding steel plate reinforcement and concrete supports was the least expensive and would adequately satisfy the needs of the crossing, it was the preferred alternative.

Phase 2 was to provide repairs along the buried sections of the pipeline. The pipeline is a mortar-lined, asphalt-coated steel pipe. The joints are swaged bell-and-spigot type with lead packing. The cement mortar lining is cracked at the joints and leaks have occurred at joints throughout the life of the project. In the past, it was feasible to excavate the ground around the leaks and weld a steel band around the leaking joints to seal the leaks. However, with growth in the area, it is becoming increasingly more difficult to continue this practice of leak repair without disrupting the desired standard of life for the community. The rehabilitation project was requested to seal the pipe against consistent leakage without the need for regular maintenance and repair as was traditionally done. The recommended repair was to install an internal joint seal at each pipe joint. Based on a typical joint spacing of 40 feet, the 2-mile long pipeline would require installation of 275 joint seals. It is expected that a seal similar to a Weko Seal or a Creamer In-Weg Seal would be applied to the interior of each of the joints. The joint is covered by a rubber seal that is held in place with two stainless steel rings, which are forced to expand against the inside of the host pipe and locked in place. Each joint seal is then tested with compressed air for tightness after installation.

Figure 3 - 1: Fair Oaks 40 Pipeline



ESTIMATED COSTS IN 1998 REPORT

In the Bookman-Edmonston Report, several tables were presented showing cost estimates for the project to rehabilitate the Fair Oaks 40 Pipeline. Not only was the cost of each pipeline segment presented, but cost allocations were presented in tables showing the cost to each of the agencies receiving water through the pipeline. Table 3 - 1, Table 3 - 2, and Table 3 - 3 present the information as it appeared in Section 5 of the report. Table 3 - 1 shows the cost allocation by Fair Oaks 40 section. The estimated total project cost of $472,200 includes construction cost as well as allowance for engineering, administration, and legal services.

Three agencies use water in the Fair Oaks 40 Pipeline: Fair Oaks, San Juan, and Orange Vale. The turnout for Orange Vale is located at Greenback Lane. Therefore, all three agencies use water that flows through Phase 1 and Phase 2 - Section 1. Only Fair Oaks and San Juan use the water that flows through Phase 2 - Section 2. It was decided that the cost allocation should follow the water allocation within the pipeline. Table 3 - 2 and Table 3 - 3 present, respectively, the cost allocation summary as a percent of total cost and the cost allocation summary in dollars.

Table 3 - 1: Cost Allocation by Fair Oaks 40 Section (1998 Report)

Section		Pipeline Length	Percent of Total Length	Total Cost of Phase	Cost of Section
Phase 1	American River Canyon Crossing	60 feet (1)	100.00%	$72,200	$72,200
Phase 2 - Section 1	Pipeline from Oak Avenue to Greenback Lane	1.5 miles	75.00%	$400,000	$300,000
Phase 2 - Section 2	Pipeline section south of Greenback Lane	0.5 miles	25.00%	$400,000	$100,000
Total Cost of Fair Oaks 40 Rehabilitation					*$472,200*

Note:
(1) Number not included in Table 1 of Bookman-Edmonston Report. Information obtained from report text.

Table 3 - 2: Fair Oaks 40 Cost Allocation Summary (as % of total cost) (1998 Report)

Method	District			Total
	Fair Oaks	San Juan	Orange Vale	
Base - Extra Capacity (3-year average)	92.44%	4.97%	2.59%	100.00%
Base - Extra Capacity (1994)	92.59%	4.76%	2.65%	100.00%
Percent Annual Consumption (3-year average)	92.36%	5.03%	2.60%	100.00%
Percent Annual Consumption (1994)	92.77%	4.69%	2.54%	100.00%

Table 3 - 3: Fair Oaks 40 Cost Allocation Summary (in $) (1998 Report)

Method	District			Total
	Fair Oaks	San Juan	Orange Vale	
Base-Extra Capacity (3-year average)	$436,503	$23,448	$12,249	$472,200
Base-Extra Capacity (1994)	$437,196	$22,479	$12,525	$472,200
Percent Annual Consumption (3-year avg.)	$436,142	$23,775	$12,283	$472,200
Percent Annual Consumption (1994)	$438,071	$22,128	$12,000	$472,200

UPDATED COSTS

A simple approach to update the previous cost estimates is to use the 20-City Average ENR BCI. The cost index for October 1998, the date on the Bookman-Edmonston Report, was 3423. April 2005 has a cost index of 4168. Applying the factor of 1.218 (i.e. ratio of 4168 to 3423), the total project cost of $472,200 may be updated to $575,000. The respective costs of Phase 1, Phase 2 – Section 1 and Phase 2 – Section 2 are $87,900, $365,300, and $121,800.

While cost index provides trending of construction costs, B&V experience indicates it may not accurately reflect the local pricing of specialty construction such as pipeline rehabilitation. Therefore, an independent cost estimate of the pipeline rehabilitation in Phase 2 (i.e. install 275 joint seals along 2-mile long pipeline) was performed using B&V cost database. As presented in Table 3 - 4, the estimated cost of Phase 2 pipeline rehabilitation is $958,000. This cost includes 25 percent estimating contingency and 35 percent allowance for engineering, administration, and legal services.

Presented in Table 3 - 5 is a comparison of the updated costs using the ENR BCI and those from the independent analysis. The ENR BCI updated cost for the entire project is $575,000, i.e. approximately 122 percent of that presented in the original report. Using a combination of B&V cost database for Phase 2, the rehabilitation of the pipeline, and ENR BCI for Phase 1, the American River Crossing, the updated cost is $1,045,900, i.e. approximately 221 percent of the cost presented in the original report. It is recommended that the District use the updated cost of $1,045,900 in the planned capital improvements program.

Table 3 - 4: Estimated Cost of Pipeline Rehabilitation

	Cost
Estimated Construction Cost per Pipe Joint	
General requirements	$185
Surface preparation of existing pipe and removal of existing grout = 5 hours at $84 per hour	$420
Install joint seals including materials, labor, general contractor markup of 10%	$1,100
Testing = 2 hours at x $84 per hour	$160
Confined space entry and access points	$200
Subtotal	$2,065
Estimating Contingency @ 25%	$515
Estimated Construction Cost per Pipe Joint	$2,580
Estimated Construction Cost of 275 Joints	$709,500
Allowance for Engineering, Administration and Legal Services @ 35%	$248,500
Estimated Project Cost of Phase 2 Pipeline Rehabilitation	$958,000

Table 3 - 5: Comparison of Updated Costs

Section	1998 Report	ENR Construction Cost Index		B&V Cost Database	
		Updated Cost	Percent Increase	Updated Cost	Percent Increase
Phase 1	$72,200	$87,900	122%	$87,900	122%
Phase 2-Section 1	$300,000	$365,300	122%	$718,500	240%
Phase 2-Section 2	$100,000	$121,800	122%	$239,500	240%
Total	*$472,200*	$575,000	122%	$1,045,900	221%

Table 3 - 6, Table 3 - 7, and Table 3 - 8 present the updated costs in the same format as the information appeared in Section 5 of the Bookman-Edmonston Report. Table 3 - 6 presents the cost allocation of the Fair Oaks 40 Pipeline by pipeline section. Phase 2 has been divided into two sections, Section 1 encompassing approximately 75 percent of the phase and Section 2 encompassing the remaining 25 percent of the phase. Table 3 - 7 summarizes the percentage of

flow for each of the three agencies in each of the three phase sections described above. Table 3 - 8 allocates the cost of each section by the percentage of flow used by each agency in each section.

The variation of cost allocation among the methods is minimal. The Bookman-Edmonston Report indicates that the base-extra capacity method of cost allocation is preferred.

Table 3 - 6: Cost Allocation by Fair Oaks 40 Section – 2005 Update

Section	Pipeline Length	Percent of Total Length	Total Cost of Phase	Cost of Section
Phase 1	60 ft	100.00%	$87,900	$87,900
Phase 2-Section 1	1.5 miles	75.00%	$958,000	$718,500
Phase 2-Section 2	0.5 miles	25.00%	$958,000	$239,500
Total Cost of Fair Oaks 40 Rehabilitation/Replacement				*$1,045,900*

Table 3 - 7: Fair Oaks 40 Cost Allocation Summary (as % of total cost) – 2005 Update

Method	District			Total
	Fair Oaks	San Juan	Orange Vale	
Base-Extra Capacity (3-year average)	92.44%	4.97%	2.59%	100.00%
Base-Extra Capacity (1994)	92.59%	4.76%	2.65%	100.00%
Percent Annual Consumption (3-year avg.)	92.36%	5.03%	2.60%	100.00%
Percent Annual Consumption (1994)	92.77%	4.69%	2.54%	100.00%

Table 3 - 8: Fair Oaks 40 Cost Allocation Summary (in $) – 2005 Update

Method	District			Total
	Fair Oaks	San Juan	Orange Vale	
Base-Extra Capacity (3-year average)	$966,830	$51,981	$27,089	$1,045,900
Base-Extra Capacity (1994)	$968,399	$49,785	$27,716	$1,045,900
Percent Annual Consumption (3-year avg.)	$966,096	$52,610	$27,194	$1,045,900
Percent Annual Consumption (1994)	$970,281	$49,053	$26,566	$1,045,900

SJWD–Wholesale Master Plan Phase 2
Plan for Meeting Reduced Surface Water Delivery

B&V Project 139074.0200
B&V File G.2
December 18, 2006
FINAL

To: Keith Durkin

Prepared By: Jay Hesby
David Carlson
Nhicolas Ly

Reviewed By: Jim English
Melissa Blanton

EXECUTIVE SUMMARY

Purpose

San Juan Water District (District) is developing the Wholesale Master Plan Phase 2 (WMPP2) as a follow up to the Water Forum and Regional Water Master Plan. Overall goals for WMPP2 are to assess the District's storage and transmission as related to the Family of Agencies (Citrus Heights Water District, Fair Oaks Water District, the Ashland area of the City of Folsom, Orange Vale Water Company, and San Juan Water District Retail) and to develop a water supply plan for the Family of Agencies within the context of regional planning efforts. The major objectives of WMPP2 are to: (1) determine demands/level of service, (2) plan for normal operations, (3) plan for reduced water operations, and (4) allocate costs of any additional required facilities. Project deliverables include a series of technical memoranda (TMs) and a Final Report.

This TM, Plan for Meeting Reduced Surface Water Delivery, presents information on options to meet demands when the supply of surface water is reduced.

Scope

Delivery of surface water from Folsom Reservoir to the Family of Agencies will be reduced to levels less than the projected demands under scenarios of Emergency, "Drier Years," and "Driest Years" (Conference Years, when the unimpaired inflow is less than 400,000 AF). Several strategies were evaluated for meeting the demand under these scenarios. Demand reduction (conservation) and establishment of Best Management Practices (BMPs) have been aggressively pursued by the District and the Family of Agencies. In addition to documenting existing demand reduction policies, the evaluation considered increased groundwater pumping, additional storage, and improved reliability of surface water. An assessment of these strategies and a preliminary recommendation is presented.

The General Managers of the Family of Agencies established reliability goals that the system must meet.

These goals entail:

- Water supply equal to 100 percent of annual average demand during drier and driest years. Available water supply should consider well capacity de-rated to 80 percent of actual to account for mechanical outages, declining production, etc. This capacity should be de-rated further to 75 percent to account for only part of the year being available for pumping during Drier and Driest Years scenarios.
- Water treatment capacity equal to at least 110 percent of maximum day demand.
- Emergency supply equal to 100 percent of maximum day demand for 12 hours with largest source out of service.
- Emergency supply equal to 50 percent of average day demand for extended outage of largest source.

These goals must be met under conditions of reduced surface water supply that could occur during emergencies, "Drier" years, and "Driest" (Conference) years. Emergency conditions were defined as any unanticipated, partial or complete, interruption in service from the system. Examples include mechanical, structural, electrical, or control failures at U.S. Bureau of Reclamation (USBR) or District facilities, whether caused by natural disasters, terrorist actions or other factors. Consistent with the Water Forum Agreement (WFA), "Drier Years" were defined as years when the projected inflow to Folsom Reservoir is less than 950,000 acre-feet (AF) and equal to or greater than 400,000 AF. Also consistent with the WFA, "Driest Years" (Conference Years) were defined as levels at Folsom Reservoir below 400,000 AF of inflow.

Key Findings

Table ES - 1 indicates the water available with the current surface and ground water supplies. Values are presented in units of million gallons per day (mgd).

Table ES - 1: Current Water Availability

Family Agency	Surface Water			Groundwater (mgd)	
	Normal Year (mgd)	Drier Year (mgd)	Driest Year (mgd) (1)	Normal, Drier & Driest Year (mgd)	Emergency Outage (mgd)
Citrus Heights	21.0	21.0 – 16.4	16.4	5.3	6.8
Fair Oaks	14.7	14.7-12.3	12.3	6.4	8.2
Folsom	1.3	1.3 – 0.9	0.9	**0.0**	**0.0**
Orange Vale	5.0	5.0 – 3.7	3.7	2.7	3.5
District's Retail	19.6	19.6-12.1	12.1	**0.0**	**0.0**
Water for Conjunctive Use	**12.9**	**12.9 - 1.5**	**1.5**	**0.0**	**0.0**
Total Flow	**74.5**	**74.5-46.9**	**46.9**	**14.4**	**18.5**

1. Surface Water allocated to each member to meet Driest Year Demand in excess of available groundwater.

The evaluation of the ability of these supplies to meet the reliability goals found:

Drier and Driest Years. No additional groundwater or storage is required to meet demands during Drier and Driest Years.

12-Hour Emergency. To meet the goal of providing water sufficient to supply the maximum day (max-day) demand for 12 hours, 38.0 million gallons (MG) of storage or 103.0 mgd of groundwater is required. However, the storage is only usable if the location is downstream of the outage point. The additional groundwater is only usable with pump back provisions and if the outages are upstream of the connection.

Extended Emergency. Additional storage would be ineffective in meeting an extended emergency outage. To meet extended emergency demands, 12.0 mgd of additional groundwater would be required. However, the groundwater is only usable with some pump back provisions (such as portable pumps) and if the outages are upstream of the connection.

Conclusions and Recommendations

Extended emergency needs can only be met with groundwater if the emergency entails a loss of the surface water supply. The minimum additional groundwater, could be in the form of underground storage, required would be 11.6 mgd. This capacity of additional groundwater is equivalent to 6.0 mgd over the 12 hour emergency outage. As a result, the storage required under this outage scenario could be reduced to 32 MG (6.0 MG subtracted from the max-day storage assumed for the 12-hour emergency).

It is recommended that a minimum of 12 mgd of additional well capacity and 32 MG of storage be added to the system. An evaluation of interconnects and pump back provisions should be conducted to evaluate the optimal methods to fully utilize this additional capacity.

The following additional activities should also be undertaken to fully realize the benefit of the recommended improvements:

1. The amount of groundwater currently available should be maintained by periodically testing the wells to confirm capacity, routine maintenance, and well redevelopment, if necessary.

2. The Family Members should install the proposed wells at the indicated capacity.

3. The number, size, and location of additional storage facilities should be evaluated further.

4. The improvements at the WTP being evaluated by others should be implemented.

5. The potential for additional interties with all surrounding utilities and between the Family of Agencies should be investigated further.

1.0. INTRODUCTION

1.1. Overview

This section discusses the framework of existing agreements within which the proposed plan for meeting reduced surface water delivery requirements will be implemented. Documents reviewed in developing the plan are identified. In addition, a brief description is provided of the organization of this TM, as well as a list of abbreviations and acronyms used herein.

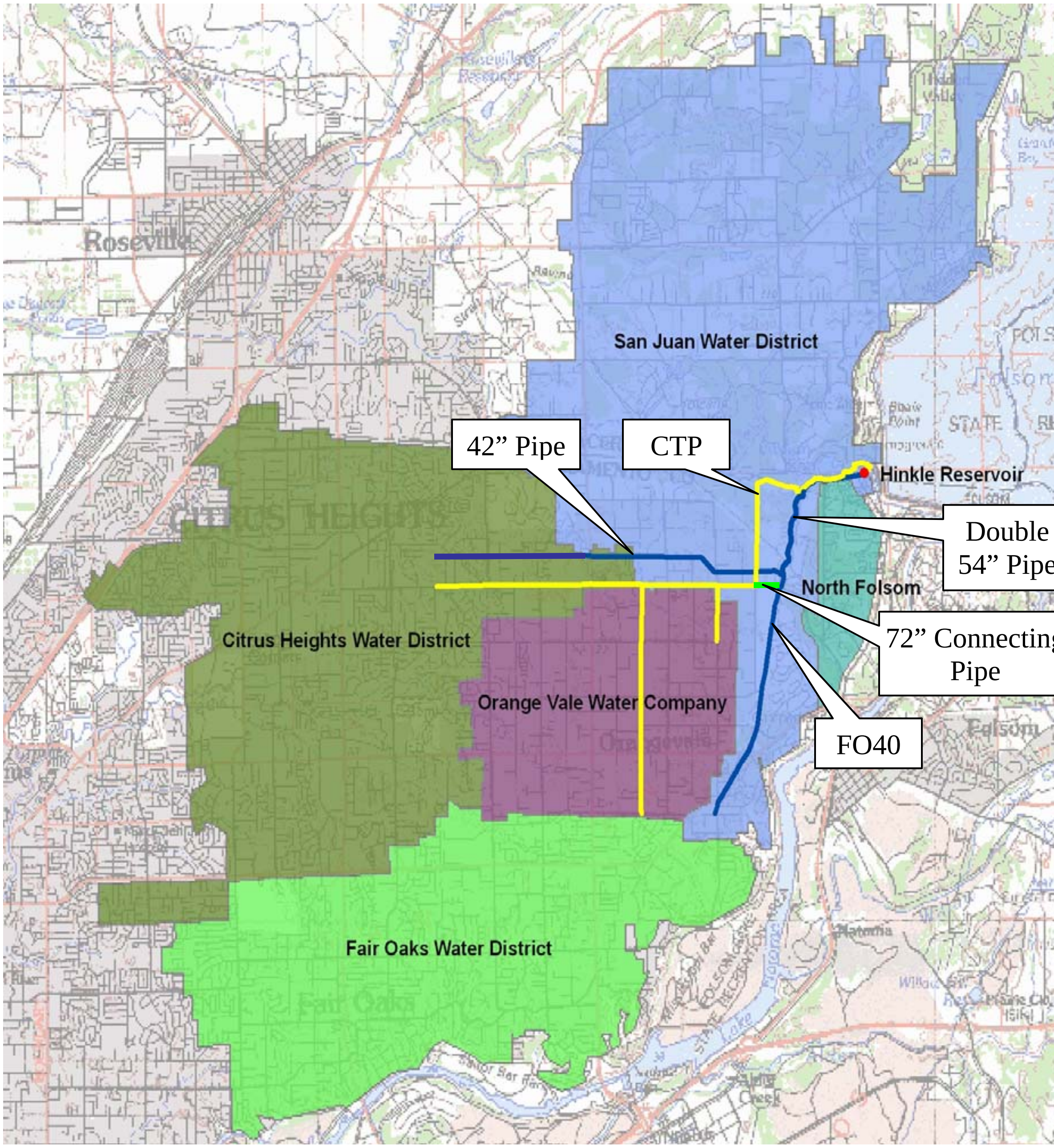
1.2. Background

The District provides wholesale treated water supplies to Fair Oaks Water District (Fair Oaks), Citrus Heights Water District (Citrus Heights), Orange Vale Water Company (Orange Vale), the City of Folsom (Folsom) north of the American River (the Ashland area), and the San Juan Water District retail service area. Collectively, these entities are referred to as the Family of Agencies. The District's wholesale service area is shown on Figure 4 - 1. This figure also shows the Cooperative Transmission Pipeline (CTP) and the Fair Oaks 40 (FO40) Pipeline. The District also treats and conveys surface water, when capacity is available, to Sacramento Suburban Water District (SSWD).

The District is signatory to the WFA, an agreement among a diverse group of business and agricultural leaders, environmentalists, citizen groups, water managers, and local governments in Sacramento, Placer, and El Dorado counties. The WFA has two co-equal objectives: (1) provide a reliable and safe water supply for the region's economic health and planned development through to the year 2030 and (2) preserve the fishery, wildlife, recreational, and aesthetic values of the Lower American River.

In addition, the District is one of the American River Basin Cooperating Agencies (ARBCA), who developed a Regional Water Master Plan to ensure a reliable, high-quality water supply for the next 30 years and beyond. The plan encourages resource conservation, regional planning, and increased water efficiency and productivity. As part of this plan, the District agreed to a regional conjunctive use program to optimize the use of surface water during wet years and save groundwater for drier years.

Figure 4 - 1: District Wholesale Service Area



1.3. Project Description

The overall goals of WMPP2 are to assess the District's storage and transmission as related to the Family of Agencies and to develop a water supply plan within the context of the regional planning efforts described above. The major objectives of WMPP2 are to:

- Determine demands/level of service
- Plan for normal operations
- Plan for reduced water operations
- Allocate costs

These objectives are being explored through development of a series of evaluations to be presented in TMs and incorporated into a Final Report. Workshops and reviews of Administrative and Final Drafts of the Final Report will enable extensive review and input by the Family of Agencies.

1.4. Related Documents

Several reports, information files, and other documents were reviewed in development of WMPP2. These are listed in Table 4 - 1.

Table 4 - 1: Documents Review for WWMP2

Type	Document
Regional Reports and Agreements	▾ American River Cooperating Agencies Regional Water Master Plan Final Report, Fall 2003 ▾ SJWD Water Forum Purveyor Specific Agreement ▾ SJWD Wholesale Master Plan Water Supply and Treatment, September 2001 ▾ Agreement for Ownership, Utilization, Operation and Maintenance of the Cooperative Transmission Pipeline Project, July 1, 1997, as amended December 3, 2001 ▾ Water Forum Agreement (January 2000)
Agency-Specific Documents	▾ Citrus Heights Water System Master Plan, April 1998 ▾ Orange Vale Engineer's Report, November 2000 ▾ Fair Oaks Water System Master Plan Final Draft Report (June 1998) and Urban Water Management Plan (June 2001) ▾ Folsom Water Treatment Plant (WTP) and Master Plan Update (September 2003) ▾ Water Demand TM for San Juan Water District Retail Service Area, July 19, 2005
Other	▾ Existing System Maps ▾ Groundwater Well Data

1.5. Organization of This TM

This introductory section (Section 1) provides background information and presents the rationale for WMPP2. Section 2 presents the demands for the Family of Agencies, and Section 3 presents reliability goals that must be met. Section 4 describes the currently available surface water entitlements and groundwater supplies available to meet the reliability goals. Sections 5 and 6 provide the scenarios under which the supply of surface water might be reduced and strategies available to meet demand under these scenarios. Finally, Section 7 presents conclusions and recommendations.

1.6. Abbreviations and Acronyms

A list of abbreviations used in this TM is presented below.

AF	acre-feet
afa	acre-feet annually
AFY	acre-feet per year
ARBCA	American River Basin Cooperating Agencies
BMPs	Best Management Practices
Citrus Heights	Citrus Heights Water District
CTP	Cooperative Transmission Pipeline
CVP	Central Valley Project
DHS	California Department of Health Services
District	San Juan Water District
EID	El Dorado Irrigation District
Fair Oaks	Fair Oaks Water District
FO40	Fair Oaks 40 Pipeline
Folsom	City of Folsom
max-day	maximum day
mgd	million gallons per day
MG	million gallons
Orange Vale	Orange Vale Water Company
PCWA	Placer County Water Agency
SJWD	San Juan Water District
SSWD	Sacramento Suburban Water District
TMs	technical memoranda
USBR	United States Bureau of Reclamation
VA	Vulnerability Assessment
Water Forum	Sacramento Area Water Forum
WFA	Water Forum Agreement
WMPP2	Wholesale Master Plan Phase 2
WTP	water treatment plant

2.0. DEMANDS TO BE MET

2.1. Overview

This section summarizes the results of TM No. 1 which established the annual demands that will need to be met through Year 2030. These demands are converted to daily flow rates to allow evaluation of reduced surface water delivery scenarios.

2.2. Projections

As discussed in Section 1, the District provides wholesale treated surface water supplies to five entities collectively known as the Family of Agencies. The District's wholesale service area is shown on Figure 4 - 1 and Figure 4 - 2. The District also conveys water, when capacity is available, to SSWD.

Demand projections, through the Year 2030, are based on population projections and estimated per capita use, as developed in TM No. 1. The annual average projected demand was summarized in Table 1 - 4 of TM No. 1 and is presented again in Table 4 - 2. Table 4 - 3 presents the associated 2030 flows.

The total projected average demand does not include the volume of water used for conjunctive use and groundwater stabilization programs in accordance with the agreements discussed in Section 4.

Table 4 - 2: Summary of Projected Average Demand in Acre-feet per Year (AFY)

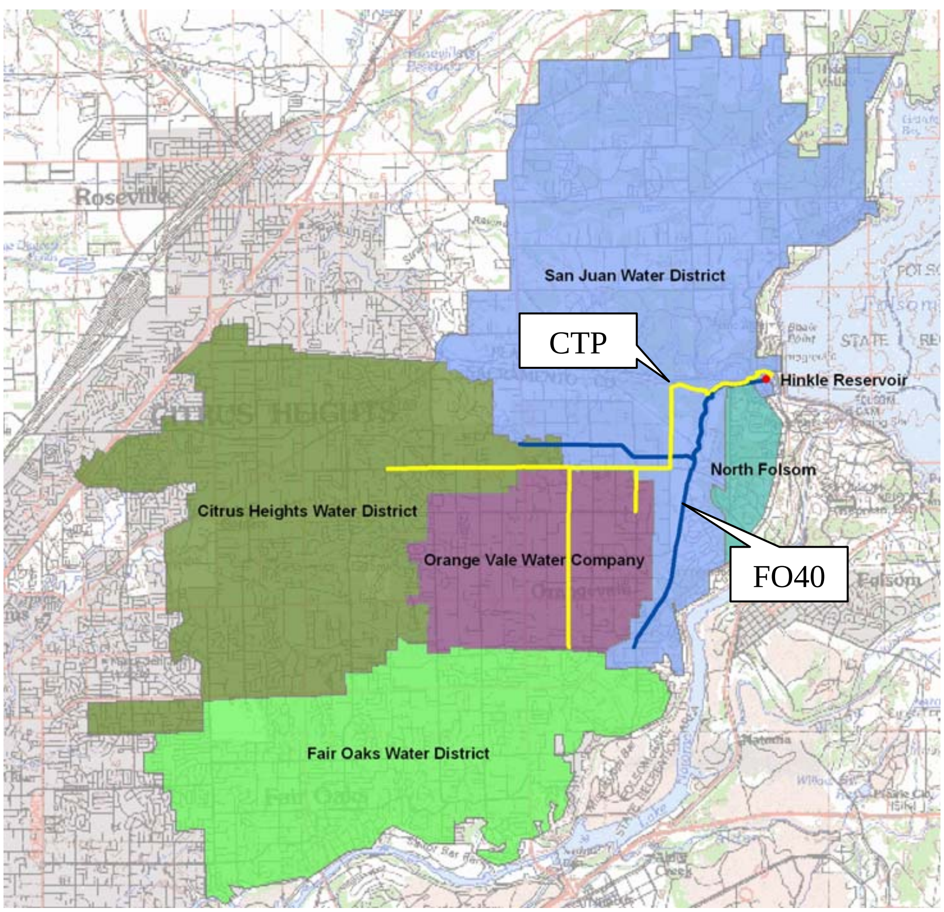
Year	Citrus Heights	Fair Oaks	Folsom	Orange Vale	SJWD Retail	Total Projected Average Demand (1) (2)(3)
2005	20,036	14,611	1,382	4,982	18,691	59,702
2010	23,108	15,525	1,413	5,205	19,196	64,447
2015	23,258	16,438	1,413	5,381	19,700	66,190
2020	23,527	16,438	1,413	5,511	20,204	67,093
2025	23,577	16,438	1,413	5,592	20,708	67,728
2030	23,577	16,438	1,413	5,624	21,970	69,022

1. Does not account for water required for conjunctive use and groundwater stabilization programs.
2. Does not indicate entitlements necessary to meet firm supply for peak year demands.
3. Projected demand is base on the population projections and estimated per capita use as developed in TM – 1.

Table 4 - 3: Associated 2030 Flows

Family Agency	Average Day Flow (mgd)	Max Day Flow (mgd)	Peak Hour Flow (mgd)
Citrus Heights	21.0	44.0	61.1
Fair Oaks	14.7	29.4	44.0
Folsom	1.3	2.5	4.5
Orange Vale	5.0	10.1	18.1
District Retail	19.6	35.3	60.8
SSWD	59.0	59.0	59.0
Total Flow w/ SSWD	**121**	**180**	**248**
Total Flow w/o SSWD	**61.6**	**121**	**189**
Note: Average Day demands = AFY from Table 4 - 2 X (8.927 x 10^{-4})			

Figure 4 - 2: District Wholesale Service Area



3.0. RELIABILITY GOALS

3.1. Overview

This section documents the reliability goals established by the General Managers of the Family of Agencies.

3.2. Goals

The General Managers of the Family of Agencies established the following reliability goals:

1) Water supply equal to 100 percent of annual average demand during drier and driest years. Available water supply should consider well capacity de-rated to 80 percent of actual to account for mechanical outages, declining production, etc. This capacity should be de-rated further to 75 percent to account for only part of the year being available for pumping during Drier and Driest Years scenarios.
2) Water treatment capacity equal to at least 110 percent of maximum day demand.
3) Emergency supply equal to 100 percent of maximum day demand for 12 hours with largest source out of service.
4) Emergency supply equal to 50 percent of average day demand for extended outage of largest source.

This District is currently in compliance with the first goal and will be in compliance with the second goal following completion of planned improvements at the water treatment plant. Additional supply will be necessary to meet the third and fourth goals. The remainder of this TM outlines the evaluation of the goals and the ability of the District to meet them.

4.0. CURRENTLY AVAILABLE SURFACE WATER ENTITLEMENTS AND GROUNDWATER SUPPLIES

4.1. Overview

This section presents the District's approach to conjunctive use and describes entitlements to surface water, including constraints and reductions to the entitlements due to agreements with Placer County Water Agency (PCWA), the USBR, and the Sacramento Area Water Forum (Water Forum). Information is also presented on the groundwater availability for each Family Member Agency. Together these two supply sources represent the amount of water currently available to meet demand under a variety of conditions.

4.2. Conjunctive Use

The District, through its involvement in the Water Forum and the Regional Water Master Plan, has made conjunctive use a part of its sustainable supply strategy. The District has taken a position to use more surface water during wet years, and to rely more on groundwater during driest years. Since the District does not have access to groundwater it relies on family members to make up the difference of surface versus groundwater during the driest years.

Working in cooperation with the family of agencies, the District has participated in two joint effort pilot programs to demonstrate the ability of the family to do conjunctive use programs. The first was with the Sacramento Area Flood Control Agency and the second with the Environmental Water Account.

Future conjunctive use programs may include the use of Aquifer Recovery Systems to further benefit the sustainability and stability of the groundwater resource.

4.3. Surface Water Entitlements

The District acquired its first and oldest water rights entitlements through the acquisition of the North Fork Ditch Company during the District's formation in 1954. The 33,000 AFY of Pre-1914 entitlements is the oldest adjudicated water rights on the American River. The water may be used anywhere within the District's boundaries, and beyond if desired; it comes without any cost, and it is not constrained except that the diversion rate may not exceed a daily average of 75 cubic feet per second.

Following the construction of Folsom Dam in 1955 as part of the Central Valley Project (CVP), the District entered into negotiations with the USBR to acquire its second supply entitlement to meet the future demands within the boundaries of its service area. In the early 1960s, the District successfully completed an agreement for up to 40,000 AFY of additional supplies. The entitlement amount was determined through an agreed upon formula that would allow for the reduction of the entitlement if the demand was not necessary.

In 1967, the USBR exercised its right to reduce the contract amount, and lowered the CVP water entitlement from 40,000 AFY to 11,200 AFY. While the District provided the USBR with additional studies to support the need for full entitlement and continued to challenge the decision, no increases were allowed.

In the mid-1970s, PCWA offered a temporary supply agreement (if needed by the District), while negotiations with the USBR continued. By the early 1980s, after exhausting its efforts to increase the CVP water entitlement, the District entered into a contract with PCWA for its third entitlement, a diversion of up to 25,000 AFY of American River Middle Fork Project water to be diverted at Folsom Dam. The water entitlement was stipulated for use in Placer County only and could not be used in the Sacramento County portion of the District's service area.

In 1992, federal legislation was passed to add the District's fourth and final entitlement, 13,000 AFY of CVP water under a separate USBR agreement.

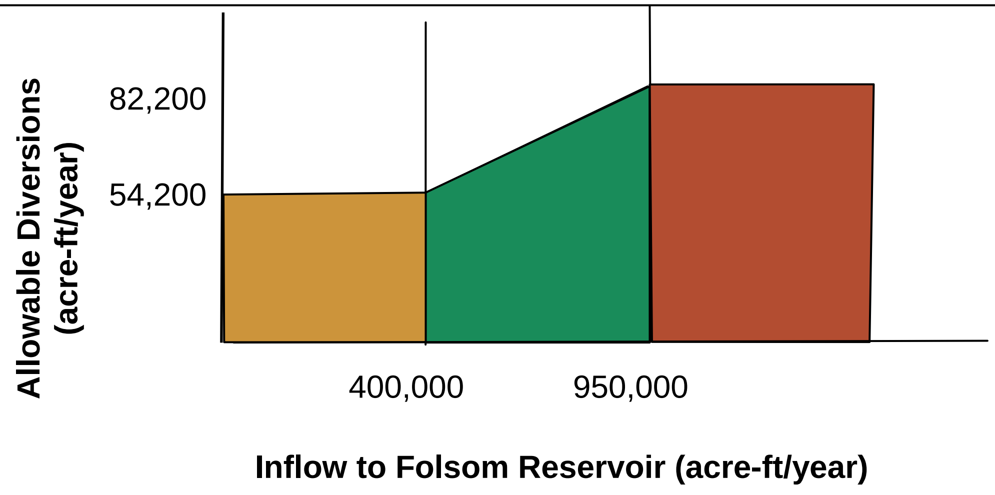
With the exception of the District's Pre-1914 entitlement, each entitlement has constraints and conditions which have a direct impact on the amount of actual water supply available under certain conditions.

In addition to meeting entitlement agreement requirements, the District is bound by agreements as a signatory to the WFA.

The District diverts its surface water entitlements from Folsom Lake and can divert variable amounts depending on the projected annual inflow to the Lake. These diversions are shown on Figure 4 - 3.

The District's treatment capacity is approximately 120 mgd. In accordance with previous studies, the plant capacity can be increased to 140 mgd with structural and hydraulic improvements and acceptance by the California Department of Health Services (DHS) of increased filter rates. Maximum capacity which could be achieved at this site with current technology is approximately 180 mgd.

Figure 4 - 3: District Entitlements from Folsom Lake



From the Water Forum Agreement, January 2000, Purveyor Specific Agreements, Page 292

4.4. Groundwater

Citrus Heights, Fair Oaks, and Orange Vale all operate and maintain groundwater wells within their service areas. Figure 4 - 4 shows the location of these wells. Table 4 - 4 lists the availability of groundwater (from existing and proposed wells) for each Agency. The well capacity information provided by each Agency is in Appendix A.

The groundwater total well capacity provided by the agencies was derated to 80 percent to account for mechanical outages and underperforming wells. In addition, because a “Dry Year” would not be declared until March, increased groundwater production would only occur for 9 months and, on an annual basis, would be only 75 percent of the derated capacity.

Figure 4 - 4: Existing and Planned Well Locations

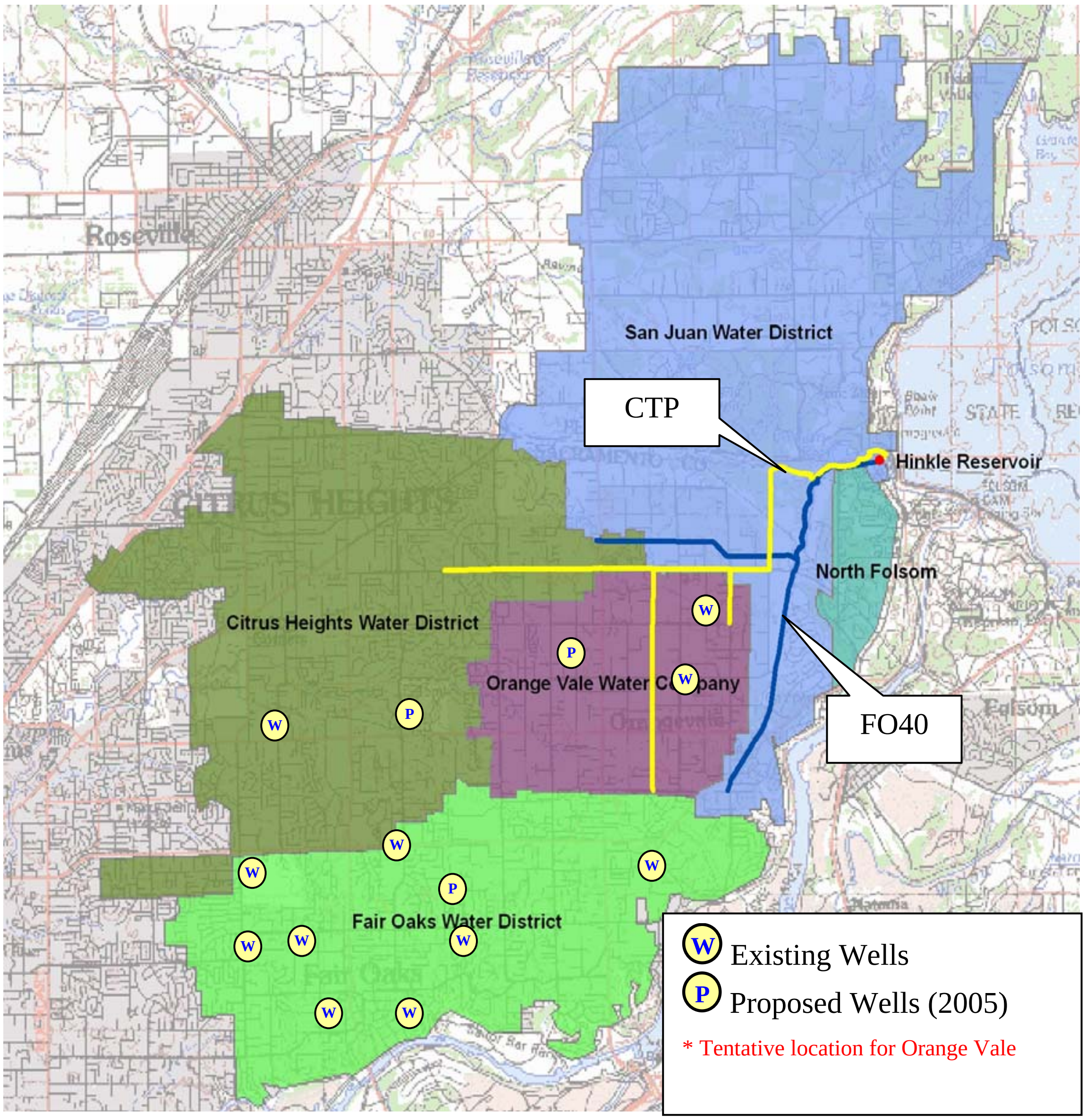


Table 4 - 4: Groundwater Availability

Agency	Well Capacity (mgd)			Derated Capacity[1] (80 %) (mgd)	75% of Derated Capacity[2] (mgd)
	Existing	Planned	Total		
Citrus Heights	5.6	3.0[3]	8.6	6.8	5.3
Fair Oaks	10.5	0.0	10.5	8.2	6.4
Folsom	0.0	0.0	0.0	0.0	0.0
Orange Vale	2.8	1.5	4.3	3.5	2.7
District's Retail	0.0	0.0	0.0	0.0	0.0
TOTAL	**18.9**	**4.5**	**23.4**	**18.5**	**14.4**

Note: 1) Derated to 80% to account for mechanical outages, declining production, etc.
2) Derated further to 75% to account for only part of the year being available for pumping.
3) Proposed for 2006 and 2007.
4) Proposed, but no date specified.

The evaluation of the available groundwater assumes that each Agency will maintain the wells in a manner that ensures the indicated capacity will be available when needed. This maintenance should include periodic testing of the wells to confirm the capacity as well as routine maintenance of the equipment and well redevelopment if necessary. It further assumes that the proposed wells are installed as planned.

In the evaluation of reduced surface water deliveries, the 75% of Derated Capacity (last column in Table 4 - 4) would be available to meet the demands during Drier Years, and Driest Year. However, the Derated Capacity (third column in Table 4 - 4) would be available to meet both 12 hour Emergency and Extended Emergency outage scenarios due to the ability to operate the wells when necessary as opposed for waiting for a declaration of Drier or Driest Year.

5.0. SHORTAGE SCENARIOS

5.1. Overview

This section describes the conditions that could result in a reduced volume of surface water being available to the Agencies. These reductions would result from reduced inflows into Folsom Lake or from emergency outages. The paragraphs below describe the amount of water available pursuant to the WFA and USBR agreements during reduced inflows to Folsom Lake, the location of outages representing the emergency scenarios, and the resulting impact to available supplies.

5.2. Normal

The normal condition (Most Years) is defined in the WFA as years when the projected March through November unimpaired inflow to Folsom Reservoir is greater than 950,000 AF. In these years, the District may divert and use up to 82,200 AF.

5.3. Drier Year

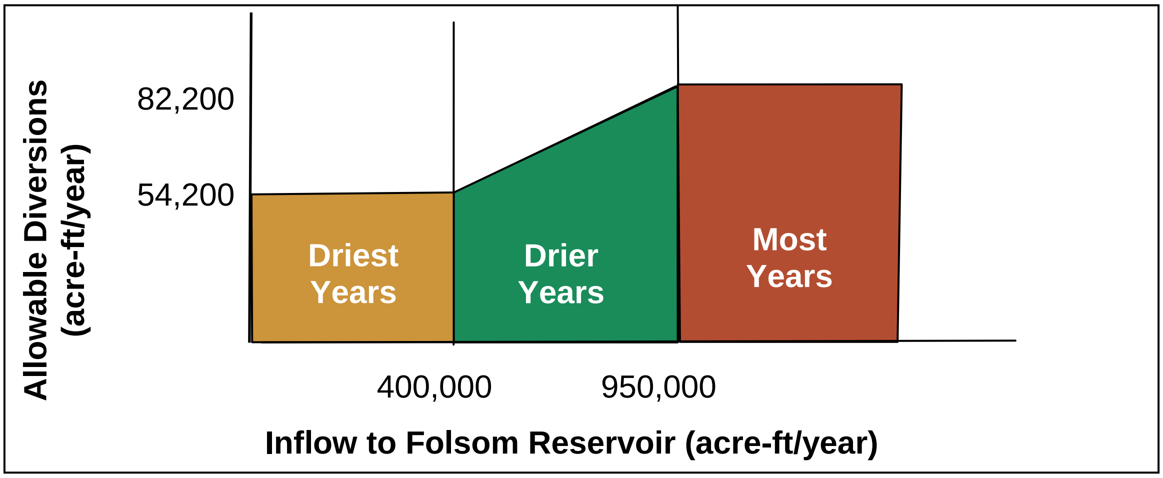
Consistent with the WFA, "Drier Years" are defined as years when the projected March through November unimpaired inflow to Folsom Reservoir is less than 950,000 AF and equal to or greater than 400,000 AF. In these years, the District will divert and use a decreasing amount of surface water from 82,200 AF to 54,200 AF in proportion to the decrease in the unimpaired inflow to Folsom Reservoir. The USBR could invoke a 25% reduction even in years not requiring a WFA reduction.

5.4. Driest Year

Also consistent with the WFA, "Driest Years" are defined as years when the projected March through November unimpaired inflow is less than 400,000 AF. In these years, the District will reduce its diversion to 54,200 AF, equivalent to its baseline amount. The water supply agreement also acknowledges that, in years when inflow is less than 400,000 AF, insufficient water may be available to provide the purveyors with the driest year's quantities specified in their agreements and provide the expected driest year's flows to the mouth of the American River. In such years, the District would participate in a conference with other stakeholders on how the available water should be managed (thus, this scenario is known as a Conference Year).

Figure 4 - 5 shows drier and driest year definitions which are linked to inflow to Folsom Reservoir.

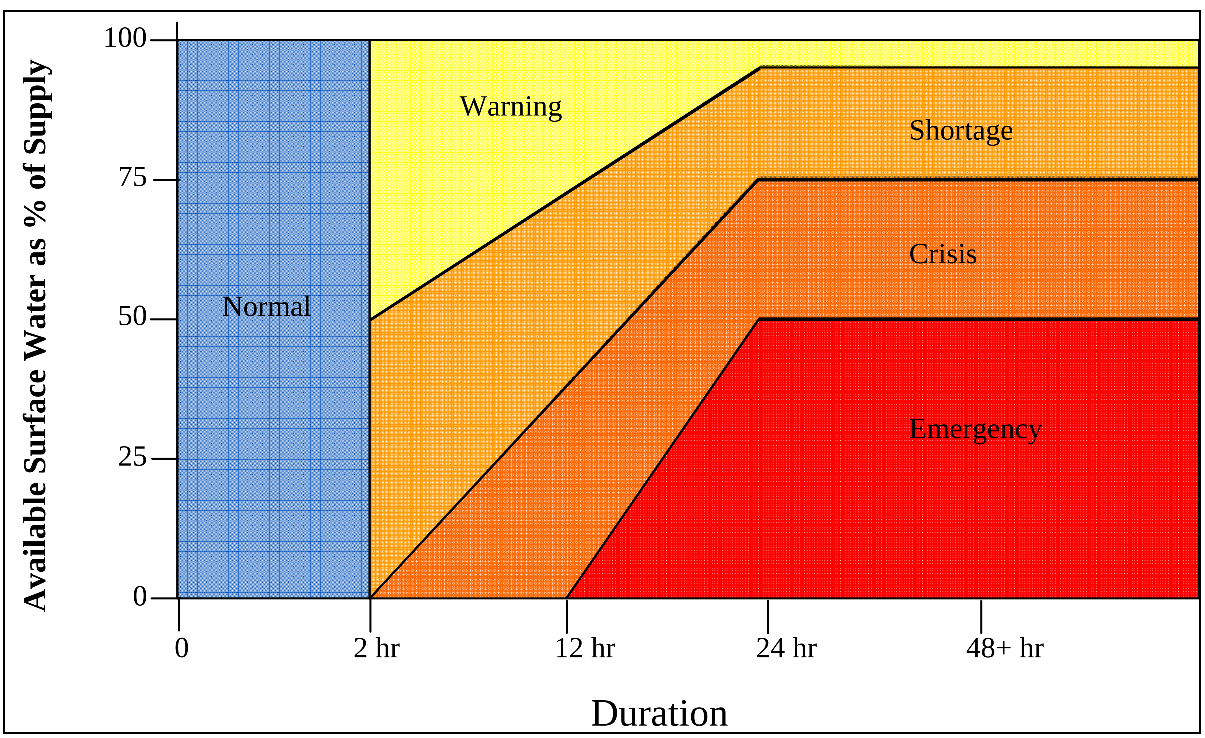
Figure 4 - 5: Drier and Driest Year Definitions



5.5. Emergency

Emergency conditions are defined as any unanticipated, partial or complete, interruption in service from the system. Examples include mechanical, structural, electrical, or control failures at USBR or District facilities, whether caused by natural disasters, terrorist actions, or other factors. Figure 4 - 6 shows emergency conditions characterized by severity and duration.

Figure 4 - 6: Characterizations of Emergency Conditions



Emergencies could include supply interruptions, Hinkle Reservoir storage issues, natural disaster, deliberate acts to disrupt service and other unanticipated conditions.

5.5.1. Raw Water Supply and WTP Interruptions

The USBR owns and operates Folsom Dam, which is fed from the North and South Forks of the American River. Surface water from Folsom Lake is currently the District's sole source of water supply. Water is moved either by gravity or by pumping from the USBR's pumping station located at the base of Folsom Dam. An 84-inch pipe from the USBR's facilities splits into a 72-inch and then into a 54-inch diameter pipe that conveys water to the District's WTP. The current design capacity is 120 mgd with planned expansions to 140 mgd. Issues that could affect the surface water supply range from USBR service interruptions to fire to chemical spills to disruption of the treatment process.

5.5.2. Hinkle Reservoir Storage Issues

Treated water flows to the 62 MG Hinkle Reservoir, the final component of the District's water supply and treatment system. The lined and covered earthen reservoir acts as the clearwell for treated water for the WTP as well as a facility for system storage. Water stored in the reservoir flows by gravity to the District's wholesale customers and a portion of its retail service area. Additional water is pumped to the remainder of the retail service area and to the Ashland area of Folsom. As developed in TM 2 of the WWMP2, storage at the reservoir is currently insufficient for emergency conditions.

5.5.3. Natural Disasters

The most probable natural disasters affecting surface water supplies in the area would be an extreme earthquake or long-term drought. The service area is located in Seismic Area Zone 3 and, historically, has experienced severe droughts.

5.5.4. Terrorist Actions

The Public Health Security and Bioterrorism Preparedness and Response Act of 2002 required public water supply systems to prepare a Vulnerability Assessment (VA) to identify system vulnerabilities to acts or events which may substantially disrupt the system's ability to provide a safe and reliable supply of drinking water. The District has undertaken this evaluation and is developing a security program including emergency response plans. Nonetheless, it is possible that a terrorist attack could impact surface water supply facilities. In addition, actions of disgruntled employees or acts of vandalism could cause failures in the system.

5.5.5. Other Unanticipated Conditions

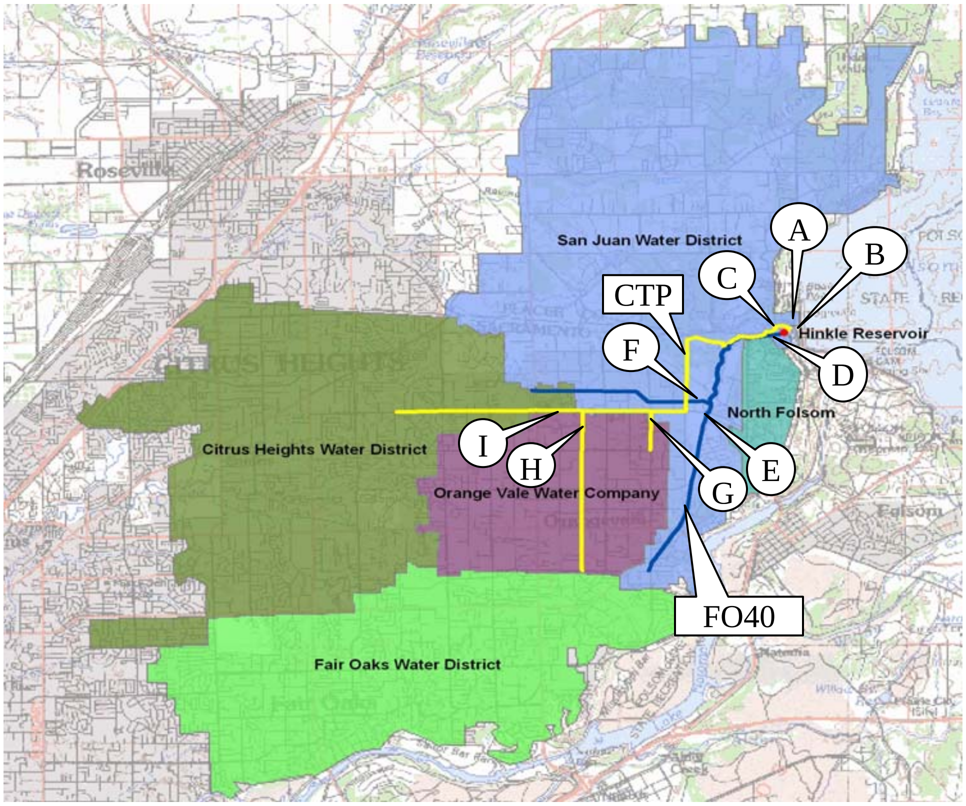
Other unanticipated conditions that could affect the water supply include a break in one of the transmission pipelines. The District currently maintains 163 miles of pipeline, which transports water to wholesale and retail customers.

5.5.6. Outage Scenarios

Several potential outage scenarios were considered for this analysis. The locations of the outages are presented on Figure 4 - 7 and are listed below.

A. Raw Water Supply or WTP
B. Hinkle Reservoir
C. CTP pipe leaving Hinkle Reservoir
D. FO40 pipe leaving Hinkle Reservoir
E. FO40 pipe to Fair Oaks
F. FO40 pipe to the District, Orange Vale, and Citrus Heights
G. CTP pipe to Orange Vale
H. CTP pipe to Orange Vale and Fair Oaks
I. CTP pipe to Citrus Heights and SSWD

Figure 4 - 7: Outage Scenarios



5.6. Summary of Water Available During Shortage Scenarios

Table 4 - 5 presents the Year 2030 demand average and the currently available surface and groundwater supplies.

Table 4 - 5: Year 2030 Average Demands and Currently Available Supplies

Family Agency	Year 2030 Average Demand (mgd) (1)	Surface Water			Groundwater (mgd)	
		Normal Year (mgd)	Drier Year (mgd)	Driest Year (mgd) (2)	Normal, Drier & Driest Year (mgd)	Emergency Outage (mgd)
Citrus Heights	21.0	21.0	21.0 – 16.4	16.4	5.3	6.8
Fair Oaks	14.7	14.7	14.7 – 12.3	12.3	6.4	8.2
Folsom	1.3	1.3	1.3 – 0.9	0.9	**0.0**	**0.0**
Orange Vale	5.0	5.0	5.0 – 3.7	3.7	2.7	3.5
District's Retail	19.6	19.6	19.6 – 12.1	12.1	**0.0**	**0.0**
Water for Conjunctive Use	**12.9**	**12.9**	**12.9 – 1.5**	**1.5**	**0.0**	**0.0**
Total Flow	**74.5**	**74.5**	**74.5 – 46.9**	**46.9**	**14.4**	**18.5**

1. Year 2030 Average demand from Table 4 – 2.
2. Surface Water allocated to each member to meet Driest Year Demand in excess of available groundwater.

As indicated in Table 4 - 5, sufficient surface water and groundwater is available in both Drier and Driest Years while maintaining the available conjunctive use water. This analysis assumes that even in the Driest Year (Conference Years) sufficient water exists to meet the District's entitlement.

Table 4 - 6 presents the water available to each of the Agencies under different emergency outage scenarios. Each agency could receive at least the indicated flow; however, most agencies, except Folsom and SSWD, would be able to supplement this water by requesting an increase in the flow in the other transmission pipeline (either the FO40 or CTP, whichever is not out of service) and transferring the water through their distribution systems. These values were determined by the max-day capacity of the transmission system, plus the groundwater available within that Agency. Values

highlighted in yellow meet the extended emergency requirement but not the 12 hour emergency requirement. Values highlighted in red meet neither criterion.

Table 4 - 6: Available Water during Various Emergency Outage Scenarios

Family Agency	12-hr Emergency Demand (mgd)	Extended Emergency Demand (mgd)	A (mgd)	B (mgd)	C (mgd)	D (mgd)	E (mgd)	F (mgd)	G (mgd)	H (mgd)	I (mgd)
Citrus Heights	44.1	10.5	6.8	20.3	27.6	30.0	50.8	30.0	50.8	50.8	27.6
Fair Oaks	29.4	7.4	8.2	17.2	21.2	24.5	24.5	37.6	37.6	21.2	37.6
Folsom	2.6	0.7	0.0	0.8	2.5	0.1	2.2	2.4	2.6	2.6	2.6
Orange Vale	10.0	2.5	3.5	6.6	3.5	13.5	13.5	13.5	8.0	9.0	13.5
SJWD Retail	35.3	9.8	0.0	10.7	34.5	0.7	29.3	33.2	35.2	35.2	35.2
Total Flow	**121**	**31**	**18.5**	**55.6**	**89.3**	**68.8**	**120.3**	**116.8**	**134.2**	**118.8**	**116.5**

Includes both available surface water and groundwater

Note:
- A Raw Water Supply or WTP
- B Hinkle Reservoir
- C CTP leaving Hinkle Reservoir
- D FO40 leaving Hinkle Reservoir
- E FO40 to Fair Oaks
- F FO40 to District, Orange Vale, and Citrus Heights
- G CTP to Orange Vale
- H CTP to Orange Vale and Fair Oaks
- I CTP to Citrus Heights and SSWD

6.0. AVAILABLE STRATEGIES TO ADDRESS SHORTAGES

6.1. Overview

This section presents strategies available to meet the reduced surface water delivery shortages identified in Section 4. Strategies discussed include demand reduction, storage, groundwater alternative, surface water, improved reliability, and interties. These strategies and their applicability to each scenario are summarized in Table 4 - 7.

Table 4 - 7: Applicability of Surface Water Shortage Strategies

Strategy	Drier Years Scenarios	Driest Years Scenarios	Emergency Scenarios
Demand Reduction			
BMPs	◗	◗	○
5-Stage Water Conservation	●	●	●
Water Pricing Measures	◗	◗	○
Storage	○	○	●
Groundwater	●	●	●
Surface			
Alternative Surface Water	◗	◗	◗
Improved Reliability	●	●	●
Interties	○	○	●

● Essential Strategy ◗ Potentially Helpful Strategy ○ Not Applicable

6.2. Demand Reduction

Water conservation is an important part of demand reduction strategies being implemented in the District's service area. The Family of Agencies has aggressively implemented water conservation BMPs and has achieved substantial savings. In addition, the District has developed a 5-Stage Water Conservation program for its retail customers that include a "staircase" of exceedingly stringent water conservation measures for implementation during drought and emergencies. The intent of the program is to provide a coordinated basis for requesting water use cutbacks by the District's retail customers. The program, which is summarized in Table 4 - 8, defines five water supply stages:

- Stage One, Normal Water Supply. The District's supply or distribution system is able to meet all water demands of its customers in the immediate future.
- Stage Two, Water Warning. There is a probability that the District's supply or distribution system will not be able to meet all the water demands of its customers. All customers will be required to reduce consumption by 5 to 10 percent.
- Stage Three, Water Shortage. The District's supply or distribution system will not be able to meet all the water demands of its customers. All customers will be required to reduce consumption by 11 to 25 percent.
- Stage Four, Water Crisis. The District's supply or distribution system is not able to meet all the water demands of its customers under Stage 3 Water Shortage requirements. All customers will be required to reduce consumption by 26 to 50 percent.
- Stage Five, Water Emergency. The District is experiencing a major failure of a water supply, shortage, or distribution facility. All customers will be required to restrict consumption to 50 percent or less.

Table 4 - 8: Summary of District's 5-Stage Water Conservation Program

Stage	Description	Water Consumption Reduction	Landscape Irrigation	Other Actions
No: 1: Normal Water Supply	7-step program of actions to achieve water-use efficiencies.	----------	----------	----------
No: 2: Water Warning	Stage 1 actions plus additional measures.	5 – 10%	Between midnight and 10 a.m.	----------
No. 3: Water Shortage	Stage 1 and Stage 2 actions plus additional measures.	11 – 25%	Two days per week	----------
No. 4: Water Crisis	Stage 1, 2, and 3 actions plus additional measures.	26 – 50%	One day per week	No potable water to refill pools or water features. Recycled water for car washing and other uses.
No. 5: Water Emergency	Stages 1 through 4 plus additional measures.	At least 50%	Prohibited	No potable water for construction purposes. No new connections to District system.

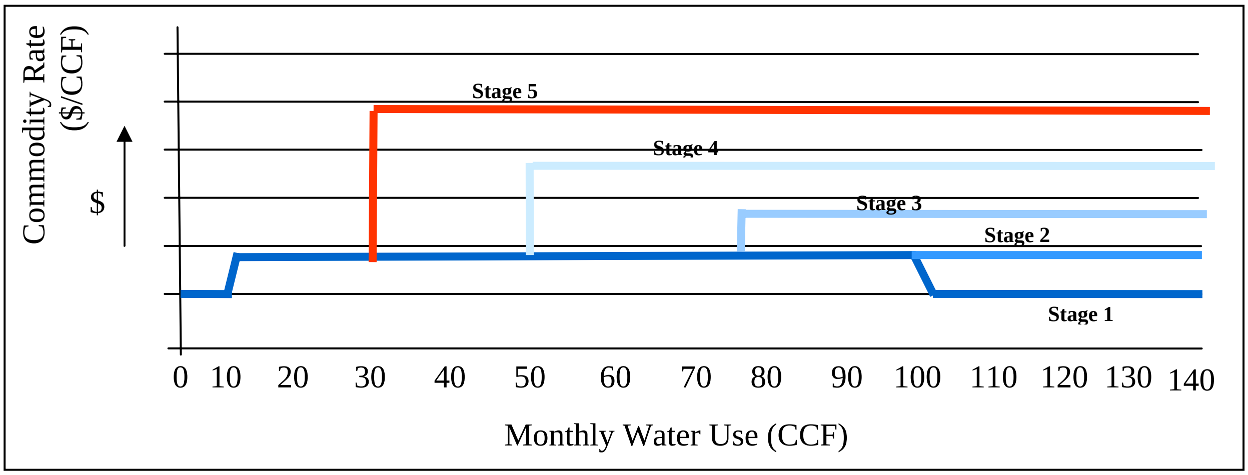
Water Pricing Measures

The District's water pricing policy reflects the 5-stage water conservation program objectives. The objectives were developed through a February 2000 Retail Rate Study and included heavy involvement from the Customer Rate Resource Committee. The objectives are:

- Include a tiered rate structure for residential users during times of shortage
- Tie tiered rates to correspond to Stage 1 through Stage 5 of the Water Conservation Plan

The 5 stages of pricing are on Figure 4 - 8. To date, the District has adopted only the Stage 1 rates.

Figure 4 - 8: District's 5-Stage Pricing



As discussed in TM No. 1, per capita demand has decreased significantly over the last 30 years indicating the success of the Family of Agencies' conservation efforts including BMPs and pricing policies. Due to this success, further demand reduction levels would require a plan to force reduction when necessary. The strategies discussed above will be used to obtain the necessary levels and are reflected in the levels represented in the reliability goals discussed in Section 2 of this TM. The following sections discuss the strategies available to meet the remaining demand.

6.3. Storage

As developed in TM No. 2, the District's only storage is available at the Hinkle Reservoir, located at the WTP. Since demands during the Drier and Driest year occur over a long period of time, storage is ineffective in providing any benefit in meeting these demands. However, storage can play a critical role in meeting demands during a short term emergency. As indicated in Section 2 of this TM, the emergency supply would need to be able to meet the maximum day demand for 12 hours (60.7 MG).

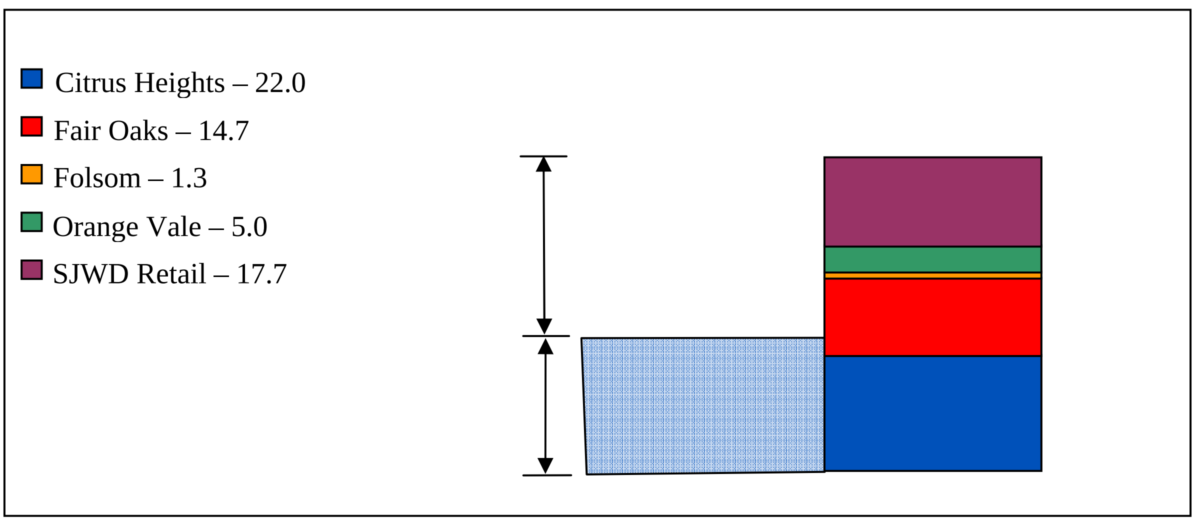
6.3.1. Hinkle Reservoir

Hinkle Reservoir is a 62 MG, lined and covered earthen and concrete structure, which acts as the clearwell for treated water for the WTP as well as a facility for system storage. Water stored in the reservoir flows by gravity to the District's wholesale customers and a portion of its retail service area. Additional water is pumped to the remainder of the retail service area and to the Ashland area of Folsom. As developed in TM 2, the reservoir has approximately 42.3 MG as available usable storage.

Also as developed in TM 2, storage at the reservoir is currently insufficient for emergency conditions. Emergency storage available is only 25.8 MG when the WTP is operating at 140 mgd, the anticipated plant capacity after improvements are completed. However, 60.7 MG of storage (or 63.5 MG if SSWD is supplied water for 2 hours after the start of the emergency) is required to meet the 12 hour emergency demand if no other strategy is employed.

Figure 4 - 9 shows the storage issues at Hinkle Reservoir.

Figure 4 - 9: Hinkle Reservoir Storage Issue



6.3.2. New Storage

An additional 38MG will be required to meet 12-hr emergency demand for all agencies. This storage could be provided in a single location or in multiple locations. Multiple locations would provide additional redundancy; however, it would likely increase the costs and may increase the difficulty of project implementation due to the need to obtain multiple properties.

Further evaluation of the optimal method to provide the required storage is recommended. This evaluation should include a public outreach component.

6.4. Groundwater

No additional groundwater is necessary to meet demands during the drier and driest years assuming that the groundwater availability as reported by the Agencies is maintained. However, insufficient water is available to meet emergency conditions. Table 4 - 9 indicates the amount of additional groundwater that would be required, assuming no contribution from storage.

Positive values represent the additional amount of water required. Negative values represent the excess amount of water available with existing groundwater and surface water supplies.

As shown in Table 4 - 9, there are scenarios where some agencies have more groundwater available than required to meet their demands. Therefore, in order to fully utilize the available groundwater during shortages, groundwater will need to able to be distributed to areas other than those from which it is pumped. This will require a pumping system, perhaps using temporary portable pumps with hook-ups to the existing pipelines.

Table 4 - 9: Additional Groundwater Required to Meet Emergency Outage Scenarios

Family Agency	A (mgd)	B (mgd)	C (mgd)	D (mgd)	E (mgd)	F (mgd)	G (mgd)	H (mgd)	I (mgd)
Citrus Heights	37.3 / 3.7	23.8 / -9.8	16.5 / -17.1	14.1 / -19.5	-6.7 / -40.3	14.1 / -19.5	-6.7 / -40.3	-6.7 / -40.3	16.5 / -17.1
Fair Oaks	21.2 / -0.8	12.2 / -9.8	8.2 / -13.8	4.9 / -17.1	4.9 / -17.1	-8.2 / -30.2	-8.2 / -30.2	8.2 / -13.8	-8.2 / -30.2
Folsom	2.6 / 0.7	1.8 / -0.1	0.1 / -1.8	2.5 / 0.6	0.4 / -1.5	0.2 / -1.7	0.0 / -1.9	0.0 / -1.9	0.0 / -1.9
Orange Vale	6.5 / -1.0	3.4 / -4.1	6.5 / -1.0	-3.5 / -11.0	-3.5 / -11.0	-3.5 / -11.0	2.0 / -5.5	1.0 / -6.5	-3.5 / -11.0
SJWD Retail	35.3 / 9.8	24.6 / -0.9	0.8 / -24.7	34.6 / 9.1	6.0 / -19.5	2.1 / -23.4	0.1 / -25.4	0.1 / -25.4	0.1 / -25.4
Total Flow	**103 / 12**	**66 / -25**	**32 / -58**	**53 / -38**	**1.1 / -89**	**4.6 / -86**	**-13 / -103**	**2.6 / -88**	**4.9 / -86**

Note: Values above are as follows:

12-hr Emergency / Extended Emergency

Positive values represent the additional amount of water required. Negative values represent the excess amount of water available with existing groundwater and surface water supplies.

Note:
- A Raw Water Supply or WTP
- B Hinkle Reservoir
- C CTP leaving Hinkle Reservoir
- D FO40 leaving Hinkle Reservoir
- E FO40 to Fair Oaks
- F FO40 to District, Orange Vale, and Citrus Heights
- G CTP to Orange Vale
- H CTP to Orange Vale and Fair Oaks
- I CTP to Citrus Heights and SSWD

6.5. Alternative Surface Water

Alternative surface water has the potential to help meet drier, driest, and emergency demands. However, new surface water supplies are difficult to develop and take long periods of time to implement. The Sacramento River diversion should be considered as a potential supply in the future.

6.6. Improved Reliability/Redundancy

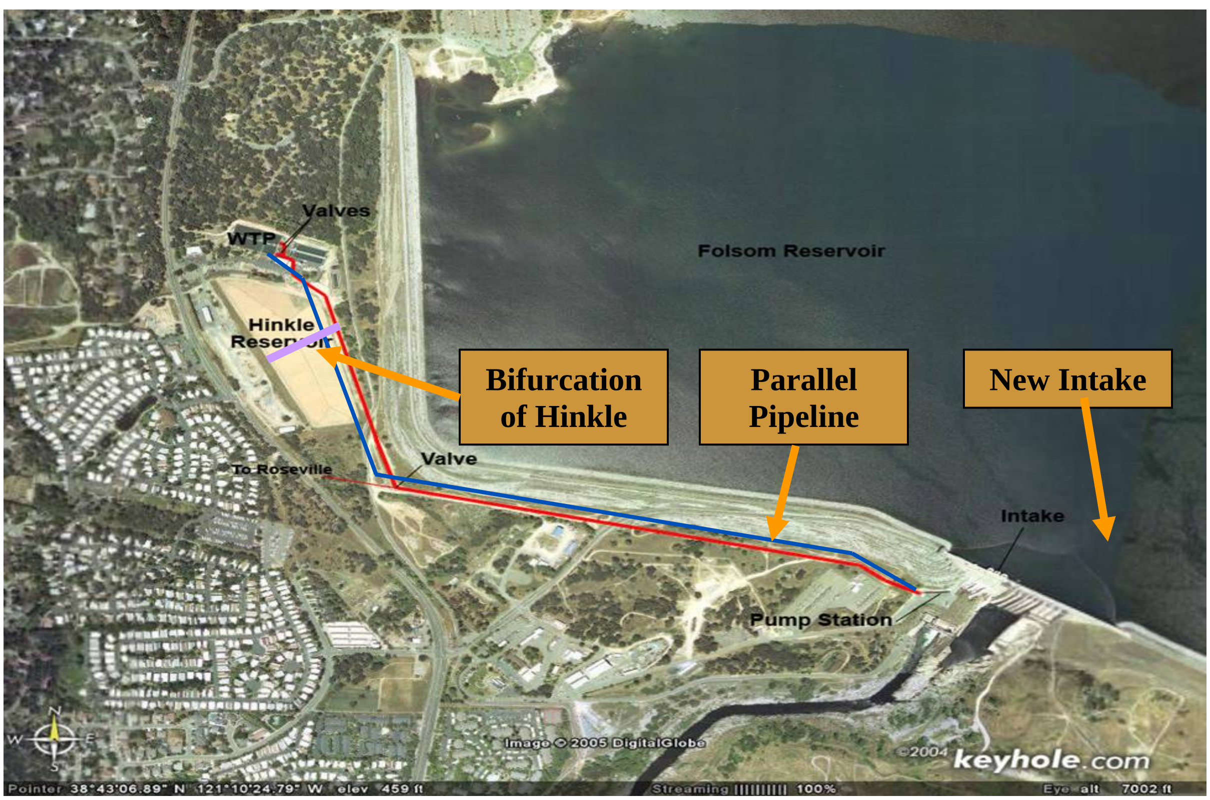
Section 5.5 outlines several potential emergency conditions. Key to addressing these emergency conditions is improving reliability and redundancy. Improvements should be considered on the supply side (intake and WTP) and on the transmission side (pipelines).

6.6.1. Supply Side Improvements

Improvements that are being evaluated by others at the WTP include a second intake, a parallel raw water pipeline, and bifurcation of the Hinkle Reservoir. Figure 4 - 10 presents the enhancements that are being considered.

The second intake could be located in the vicinity of the existing intake. However, alternative locations should also be investigated. One approach to an alternative location would be co-use of a site with another utility. The El Dorado Irrigation District has proposed the construction of a new intake in Folsom Lake. This new intake could present co-use opportunities that should be investigated further.

Figure 4 - 10: Reliability Enhancements



6.6.2. Transmission System Improvements

The reliability of the transmission system can be improved through piping improvements and interties with other utilities. Piping improvements may entail selective repair or replacement and is being evaluated separately.

Interties with neighboring utilities will also improve reliability. Proposed and potential intertie locations are presented in Figure 4 - 11.

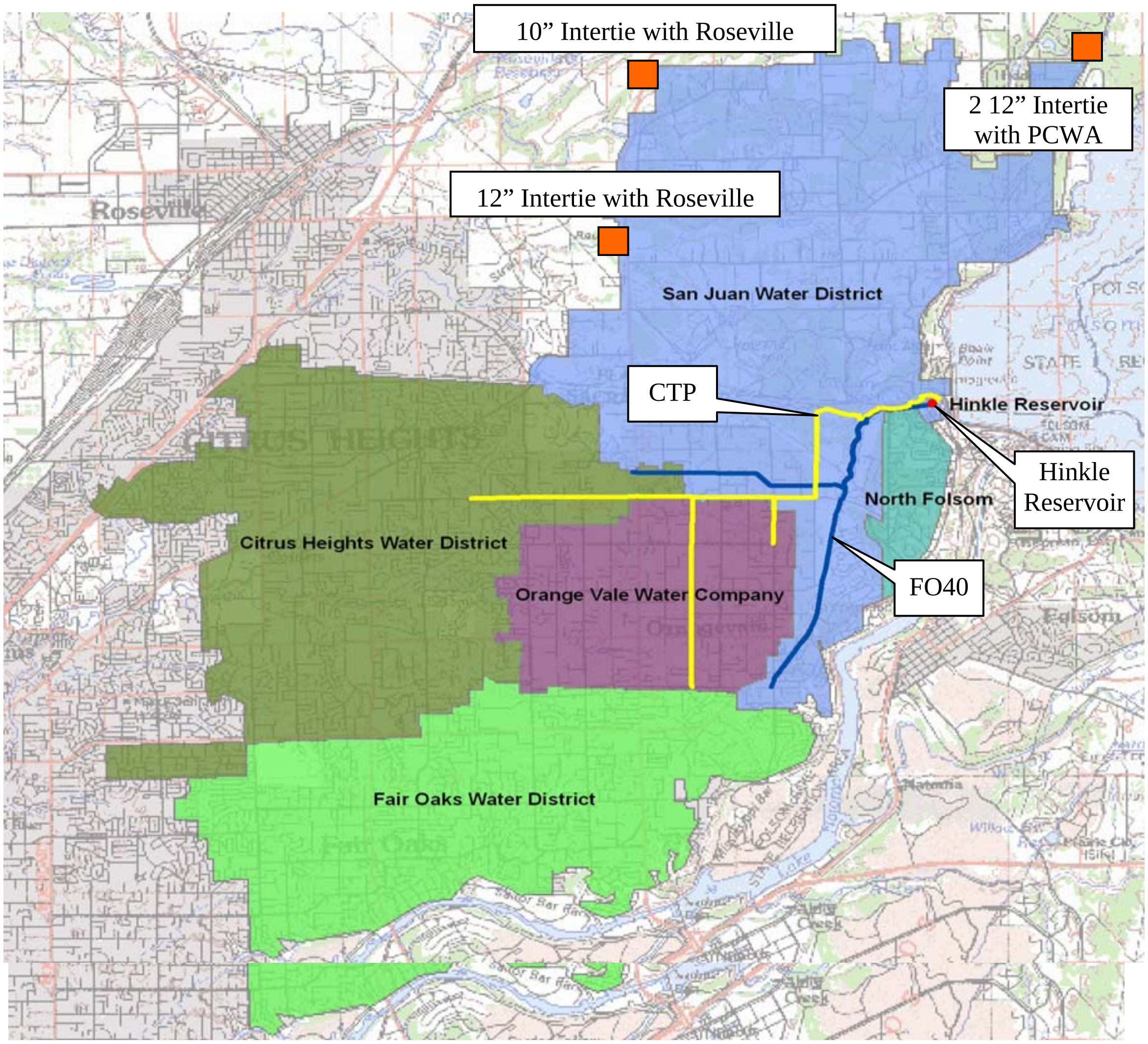
Table 4 - 10 presents the potential water available from the interties.

Table 4 - 10: Potential Water Available from Interties

Neighboring Utilities	Water Available (mgd)
Roseville	2.4
PCWA	2.5
Total Flow	**4.9**

Additional interties should be investigated to determine appropriate locations and the volume of water that could be made available. The potential for additional interties with all surrounding utilities and between the Family of Agencies should be investigated further.

Figure 4 - 11: Inter-ties with Neighboring Agencies



7.0. CONCLUSIONS AND RECOMMENDATIONS

7.1. Overview

This section presents conclusions and recommendations linked to the reliability goals established by the General Managers of the Family of Agencies. (See Executive Summary and Section 2 for a listing of the reliability goals.)

7.2. Conclusions

7.2.1. Drier and Driest Years

No additional groundwater or storage is required to meet demands during Drier and Driest Years.

7.2.2. 12-Hour Emergency

To meet the goal of providing water sufficient to supply the max day demand for 12 hours, 38 million gallons of storage or 103 mgd of groundwater is required. However, the storage is only usable if the location is downstream of the outage point. The additional groundwater is only usable with pump back provisions and if the outages are upstream of the connection.

7.2.3. Extended Emergency

Additional storage would be ineffective in meeting an extended emergency outage. To meet extended emergency demands, 12 mgd of additional groundwater would be required. However, the groundwater is only usable with some pump back provisions and if the outages are upstream of the connection.

7.2.4. Additional Activities

In addition to the conclusions associated with meeting demands under each scenario, this study identified the following activities that are required to realize the benefits provided by the recommended improvements or that will result in enhancements to the system.

1. The amount of groundwater currently available should be maintained by periodically testing the wells to confirm capacity, routine maintenance, and well redevelopment, if necessary.

2. The Family Members should install the proposed wells at the indicated capacity.

3. The number, size, and location of additional storage facilities should be evaluated further.

4. The improvements at the WTP being evaluated by others should be implemented.

5. The potential for additional interties with all surrounding utilities and between the Family of Agencies should be investigated further.

7.3. Recommendations

Extended emergency needs can only be met with groundwater if the emergency entails a loss of the surface water supply. The minimum additional groundwater required would be 12 mgd. This capacity of additional groundwater is equivalent to 6.0 mgd over the 12 hour emergency outage. As a result the storage required under this outage scenario could be reduced to 32 MG (38 - 6.0).

It is recommended that a minimum of 12 mgd of additional groundwater and 32 MG of storage be added to the system. An evaluation of interconnects and pump back provisions should be conducted to evaluate the optimal methods to fully utilize this additional capacity.

The additional activities listed in the conclusions should be implemented.

APPENDIX

A1. Orange Vale Wells

A2. Citrus Heights Wells

A3. Fair Oaks Wells

APPENDIX A: Existing and Proposed Wells

A1. Orange Vale Wells

Orange Vale Wells

Well Name	Energy Source	Existing or Proposed	Year Built	Well Capacity (gpm)	Well Capacity (mgd)	Derated 80% (mgd)	Derated 75% (mgd)
Well #1	Diesel	Existing	1977	1,200	1.7	1.4	1.1
Well #2	Electric	Existing	1991	800	1.1	0.9	0.7
Well #3	UNDER CONSIDERATION			1040	1.5	1.2	0.9
			TOTAL	**3,040**	**4.3**	**3.5**	**2.7**

A2. Citrus Heights Wells

Citrus Heights Wells

Well Name	Energy Source	Existing or Proposed	Year Built	Well Capacity (gpm)	Well Capacity (mgd)	Derated 80% (mgd)	Derated 75% (mgd)
Sunrise (10)	SMUD	Existing	1991	900	1.3	1.0	0.8
Palm Ave (1A)	SMUD	Existing	1991	1,400	2.0	1.6	1.2
Sylvan (8)	SMUD, diesel	Existing	1991	1,600	2.3	1.8	1.4
Mitchell Farms (12)	SMUD	Proposed	2006	900	1.3	1.0	0.8
Skycrest School	SMUD	Proposed	2007	1,200	1.7	1.4	1.3
			TOTAL	**6,000**	**8.6**	**6.8**	**5.3**

A3. Fair Oaks Wells

Fair Oaks Wells

Well Name	Energy Source	Existing or Proposed	Year Built	Well Capacity (gpm)	Well Capacity (mgd)	Derated 80% (mgd)	Derated 75% (mgd)
Chicago	SMUD	Existing	1947	581	0.8	0.6	0.5
New York	SMUD	Existing	1972	830	1.2	1.0	0.8
Casabella	SMUD	Existing	1953	850	1.2	1.0	0.8
Park	SMUD	Existing	1990	1,090	1.6	1.3	1.0
Northridge	SMUD	Existing	1992	940	1.4	1.1	0.8
Town	SMUD	Proposed	2006	1,500	2.2	1.8	1.4
Heather	SMUD	Proposed	2006	1,200	1.7	1.4	1.1
			TOTAL	**6,991**	**10.1**	**8.2**	**6.4**

BLACK & VEATCH
TECHNICAL MEMORANDUM NO. 5

	SJWD–Wholesale Master Plan Phase 2 Opinion of Cost and Implementation Schedule For Recommended Improvements	B&V Project 139074.0200 B&V File G.2 December 18, 2006 **FINAL**

To: Keith Durkin

Prepared By: David Carlson
Nhicolas Ly

Reviewed By: Jim English
Melissa Blanton

EXECUTIVE SUMMARY

Purpose

San Juan Water District (District, SJWD) is developing the Wholesale Master Plan Phase 2 (WMPP2) as a follow up to the Water Forum and Regional Water Master Plan. Overall goals for WMPP2 are to assess the District's storage and transmission as related to the Family of Agencies (Citrus Heights Water District, Fair Oaks Water District, the Ashland area of the City of Folsom, Orange Vale Water Company, and SJWD Retail) and to develop a water supply plan for the Family of Agencies within the context of regional planning efforts. The major objectives of WMPP2 are to: (1) determine demands/level of service, (2) plan for normal operations, (3) plan for reduced water operations, and (4) determine costs for any additional required facilities. Project deliverables include a series of technical memoranda (TMs) and a Final Report.

This TM, Opinion of Cost and Implementation Schedule for Recommended Improvements, develops facilities to implement the improvements identified in TM No. 4 – Plan for Meeting Reduced Surface Water Delivery. An opinion of probable project cost and information on cost allocations are also presented.

Scope

TM No. 4, Plan for Meeting Reduced Surface Water Delivery, evaluated improvements required to meet projected demands under both normal and emergency operation. The evaluation concluded that the system is adequate to meet demands during normal conditions, but may be unable to meet demands under emergency conditions. As a result, it was recommended that 12 million gallons per day (mgd) of well capacity and 32 million gallon (MG) of storage should be added. In this TM, an analysis was performed to determine the number of storage tanks and wells that would be required to meet these requirements. The need for pumping of the storage volume was also assessed. After determining the required facilities, opinions of probable project cost were developed for the facilities. Factors to consider in the allocation of the costs among the Family of Agencies were also developed.

Conclusions and Recommendations

Storage. The required 32 MG of storage will be provided by three separate tanks. The use of three tanks results in increased reliability through redundancy, tank sizes that will allow for easier incorporation into developed areas, and greater choice in the type of tank that can be used. To utilize standard tank sizes, three 11-MG tanks would be required.

Pumping. During an emergency outage, the storage tanks would be able to provide service for customers at lower elevations; however, pump stations would be required to service customers at higher elevations. The pumping stations would also allow for frequent turn over of the tank volume to avoid water quality issues. Since the criteria for the storage volume were based on meeting the maximum day demand for 12 hours, the total volume of the storage must be pumped into the system during this 12 hour period. This criterion requires that each pump station have a capacity of 22 mgd.

Wells. Based on the capacity of the existing wells, it appears that the capacity of each new well would be approximately one mgd. As a result, 12 new wells would be required. These wells would be located as close as feasible to the existing transmission mains and tied to these mains to allow the water to be available throughout the regional system.

Opinions of Cost. The opinions of probable cost are summarized in Table ES – 1.

Table ES – 1: Summary of Opinions of Probable Project Cost

Description	**Quantity**	**Units**	**Unit Cost**	**Rounded Cost**
Tanks (11 MG size)	3	ea	$9,600,000	$ 28,800,000
Pump Station	3	ea	$6,000,000	$ 18,000,000
Groundwater wells	12	ea	$2,000,000	$ 24,000,000
Property Acquisition[1]	12	acre	$ 300,000	$ 3,600,000
Subtotal Net Construction				$ 74,400,000
Estimating Contingency	30%			$ 22,300,000
Engineering, Legal, and Administration	25%			$ 24,200,000
Total Project Cost[2]				**$120,900,000**

NOTE: [1]Property cost estimated based on land currently on the market.
[2]Cost based on ENR CCI Cost Index of 7910.81.

Cost Allocation Considerations. The Family of Agencies is presently holding discussions on cost allocation policies. Considerations may include allocations based on demand under the emergency outages and each Agency's current supply.

Schedule. Table ES – 2 presents the implementation schedule necessary to meet the emergency criteria that has been established.

Table ES – 2: Schedule of Recommended Improvements

Year	**Tanks**		**Pump Stations**		**Wells**	
	Number	Capacity	Number	Capacity	Number	Capacity
Current Need	3	33 MG	3	66 mgd	10	10 mgd
2013					1	1 mgd
2021					1	1 mgd
Total	3	33 MG	3	66 mgd	12	12 mgd

1.0. INTRODUCTION

1.1. Overview

This section presents the project background and description. Also provided are a brief narrative on the organization of this TM and a list of abbreviations and acronyms used herein.

1.2. Background

The District provides wholesale treated water supplies to Fair Oaks Water District (Fair Oaks), Citrus Heights Water District (Citrus Heights), Orange Vale Water Company (Orange Vale), the City of Folsom (Folsom) north of the American River (the Ashland area), and the SJWD retail service area. Collectively, these entities are referred to as the Family of Agencies. The District's wholesale service area and its transmission pipelines, the Cooperative Transmission Pipeline (CTP) and the Fair Oaks 40 (FO40), are shown on Figure 1 - 1. The District also treats and conveys surface water, when capacity is available, to Sacramento Suburban Water District (SSWD).

The District is signatory to the Sacramento Area Water Forum Agreement (WFA), an agreement among a diverse group of business and agricultural leaders, environmentalists, citizen groups, water managers, and local governments in Sacramento, Placer, and El Dorado counties. The WFA has two co-equal objectives: (1) provide a reliable and safe water supply for the region's economic health and planned development through to the year 2030 and (2) preserve the fishery, wildlife, recreational, and aesthetic values of the Lower American River.

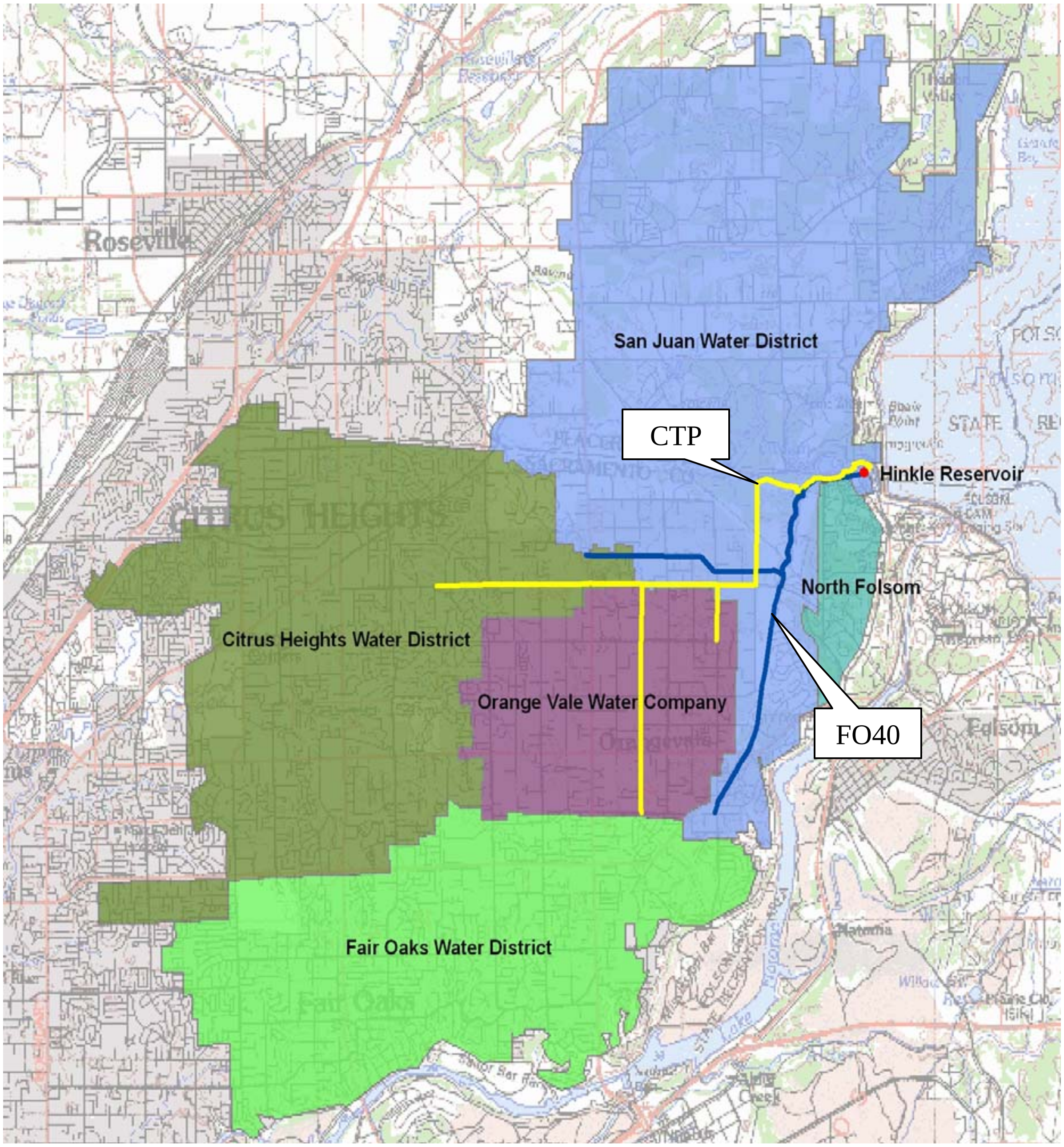
1.3. Project Description

The overall goals of WMPP2 are to assess the District's storage and transmission as related to the Family of Agencies and to develop a water supply plan within the context of the regional planning efforts described above. The major objectives of WMPP2 are to:

- Determine demands/level of service
- Plan for normal operations
- Plan for reduced water operations
- Determine opinions of probable project cost

These objectives are being explored through development of a series of evaluations to be presented in TMs and incorporated into a Final Report. Workshops and reviews will enable extensive review and input by the Family of Agencies.

Figure 1 - 1: District Wholesale Service Area



1.4. Organization of This TM

This introductory section (Section 1) provides background information and presents the rationale for WMPP2. Section 2 presents the definition of the recommended improvements, and Section 3 presents the opinions of probable project costs. Section 4 presents an implementation schedule for the new facilities and Section 5 provides considerations for the cost allocation among the Family of Agencies. Finally, Section 6 presents conclusions and recommendations.

1.5. Abbreviations and Acronyms

A list of abbreviations used in this TM is presented below.

Citrus Heights	Citrus Heights Water District
CTP	Cooperative Transmission Pipeline
District	San Juan Water District
Fair Oaks	Fair Oaks Water District
FO40	Fair Oaks 40 Pipeline
Folsom	City of Folsom
mgd	million gallons per day
MG	millions gallons
O&M	operations and maintenance
Orange Vale	Orange Vale Water Company
SJWD	San Juan Water District
SSWD	Sacramento Suburban Water District
TMs	technical memoranda
WFA	Sacramento Area Water Forum Agreement
WMPP2	Wholesale Master Plan Phase 2

2.0. IMPLEMENTATION OF RECOMMENDED IMPROVEMENTS

2.1. Overview

This section summarizes the results of TM No. 4, which established the additional capacity necessary to meet demand through Year 2030, and translates this additional capacity into the required facility improvements. TM No. 4 found that the existing facilities could meet the capacity requirements under normal demands; however, additional facilities would be required to meet both the 12-hour and extended emergency outages. These additional facilities fall into three categories: storage, pumping stations, and wells. The facilities are summarized in Table 2 – 1 and described briefly below.

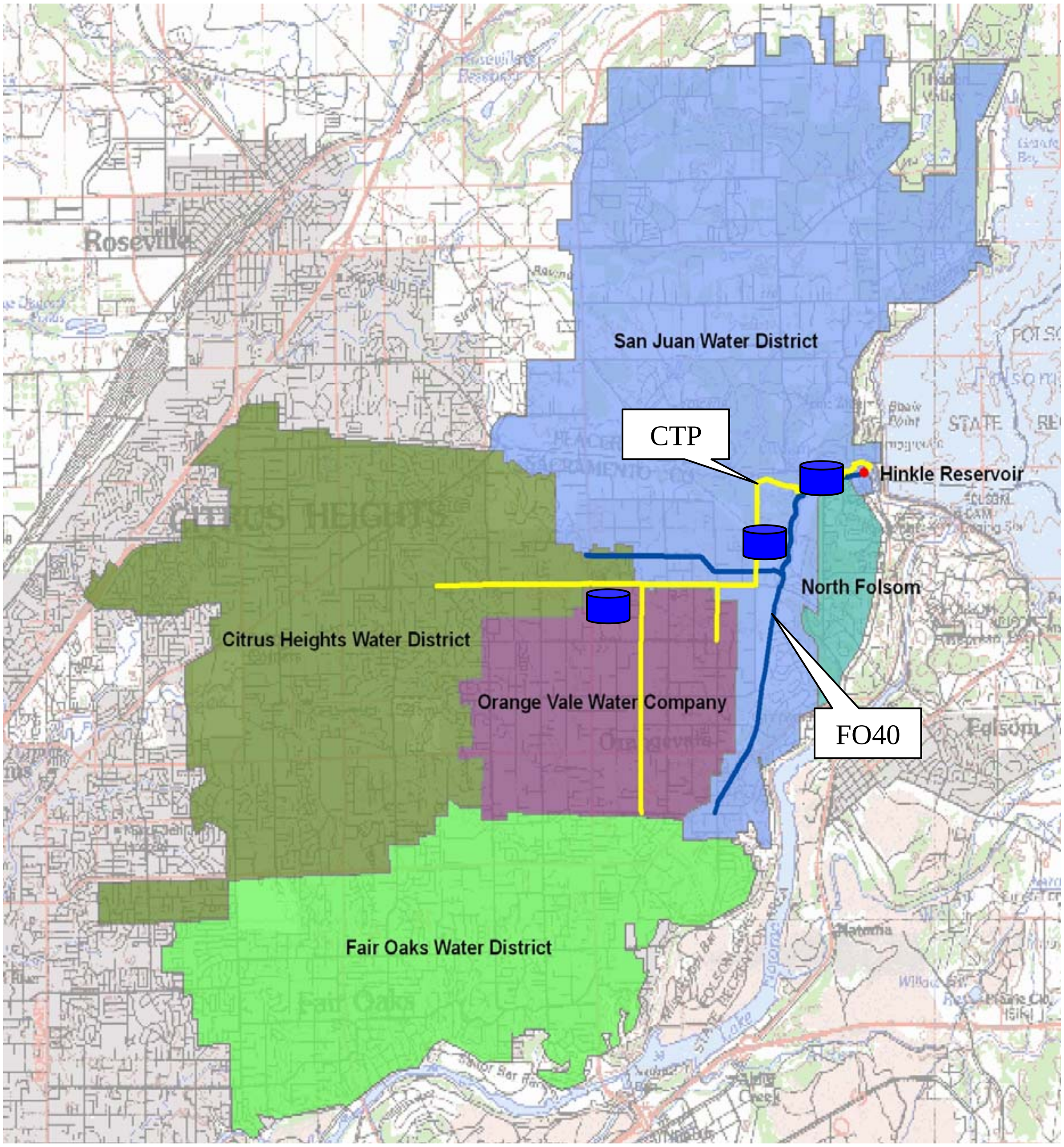
2.2. Storage

TM No. 4 identified the need for 32 MG of storage to meet the 12 hour emergency demand criteria. To develop costs for these improvements, the number of tanks, the tank dimensions, and the tank type need to be evaluated. The number of tanks was selected to balance the redundancy provided by multiple tanks, and the subsequent increased reliability, with the increased costs associated with multiple tank sites. Consideration of these factors resulted in the selection of three tanks to provide the total needed volume of 32 MG. To keep all tanks the same size and utilize standard tank dimensions, three 11 MG tanks were assumed.

The three tanks would be distributed along the transmission pipelines to improve reliability by limiting the area out of service due to a single pipeline failure. However, locating the tanks in these developed areas requires that consideration be given to tank dimensions that would be acceptable to the community. For the purposes of this evaluation, the tanks were limited to a height of 25 feet resulting in a tank diameter of 314 feet. Figure 2 – 1 shows a general concept for the distribution of the tanks. The conceptual locations were chosen based on cursory review of open lots and proximity to the transmission pipelines. Further study is needed to select specific sites.

The final criterion considered was the type of tank construction. Water storage tanks for this service are typically either steel, prestressed concrete, or cast-in-place concrete. While cast-in-place offers the greatest flexibility in terms of tank configuration, it is also the most costly type. Steel tanks can frequently provide the lowest initial cost, but have higher operation & maintenance (O&M) costs. Prestressed concrete tanks have relatively low initial cost and O & M costs. These tanks also provide greater flexibility in terms of site utilization such as partial burial to minimize the visual impact. Due to these factors, prestressed tanks were selected for the basis of the cost opinion.

Figure 2 - 1: General Location of Tanks



2.3. Pump Stations

The water stored in the proposed tanks must be available to all of the Family of Agencies in the emergency scenario. Due to the elevations within the Agencies' distribution systems and the potential elevations of the tanks, a portion of the demand may be met by releasing water by gravity from the tanks. However, the remaining volume would need to be pumped to supply adequate pressure. A pumping system is also necessary to provide continual turn over of the tank volume to avoid water quality problems. To address these issues, three pump stations, one for each tank, would be required. The maximum capacity of each pump station would be 22 mgd to allow pumping of the entire volume to the Family of Agencies in 12 hours as required by the emergency criteria which was established by the Family of Agencies.

Each pump station would be located adjacent to one of the storage tanks. Multiple pumps would be provided to meet the variations in flow. The pumps would be housed in block structures compatible with the surrounding development.

2.4. Wells

Storage will meet short term outages, but well capacity is necessary to meet extended emergency demands. As determined in TM No. 4, 12 mgd of well capacity would need to be added to the system.

Based on the data for the existing wells, it was assumed that the new wells would yield 1 mgd and would be 16 inches in diameter with a depth of 450 feet. As a result, a total of 12 wells would be required.

3.0. OPINIONS OF PROBABLE PROJECT COSTS

3.1. Overview

This section documents the cost methodology and opinions of probable project costs.

3.2. Opinions of Probable Project Costs

The opinions of probable cost were developed at a conceptual level and were not based on detailed plans and specifications. The costs are based on the use of standard prestressed concrete tanks. Each storage tank would have a pump station associated with it as previously discussed. Each pump station would entail multiple pumps housed in a block structure compatible with surrounding development.

Since the sites for the tanks have not been determined, these opinions of cost do not include the following:

- any environmental impacts and mitigation considerations
- property acquisitions
- excavation of rock
- hazardous soil removal

A summary of the opinions of probable project cost is presented in Table 3 – 3. As indicated in the table, the total project cost is $105.3 million.

Table 3 – 3: Summary of Opinions of Probable Project Cost

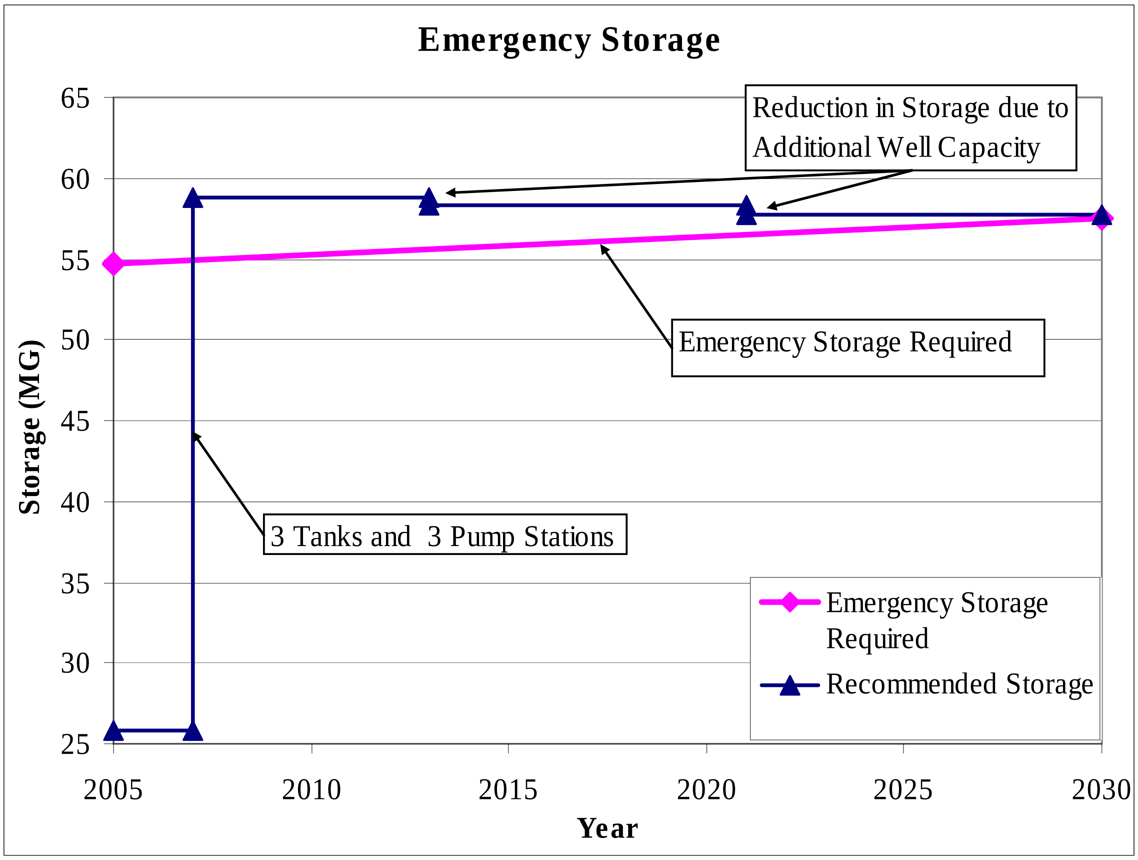
Description	Quantity	Units	Unit Cost	Rounded Cost
Tanks (11 MG size)	3	ea	$9,600,000	$ 28,800,000
Pump Station	3	ea	$6,000,000	$ 18,000,000
Groundwater wells	12	ea	$2,000,000	$ 24,000,000
Property Acquisitions[1]	12	acre	$ 300,000	$ 3,600,000
Subtotal Net Construction				$ 74,400,000
Estimating Contingency	30%			$ 22,300,000
Engineering, Legal, and Administration	25%			$ 24,200,000
Total Project Cost[2]				**$120,900,000**

NOTE: [1]Property cost estimated based on land currently on the market.
[2]Cost based on ENR CCI Cost Index of 7910.81.

4.0. IMPLEMENTATION SCHEDULE

Figure 4 – 1 presents the storage required to meet the criteria established for the 12 hour emergency as detailed in TM No. 4. Also shown is the existing storage of 25.8 MG.

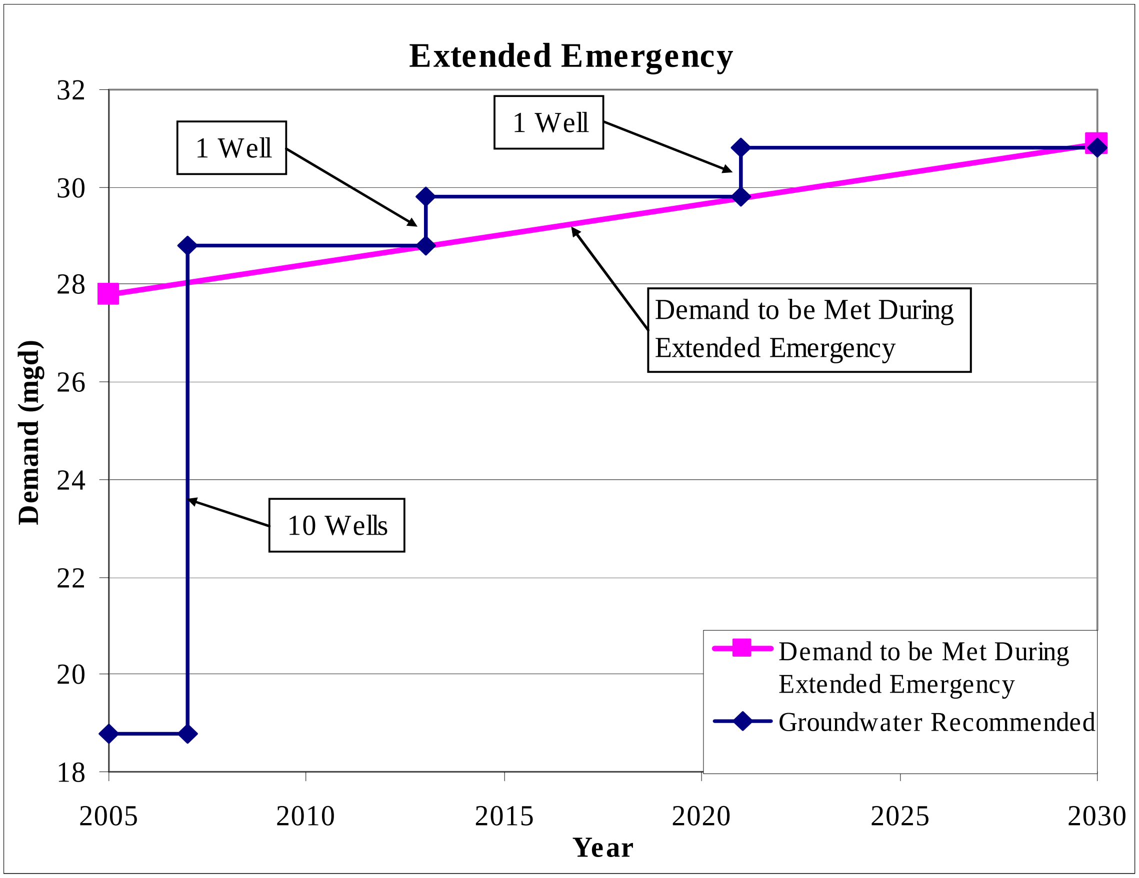
Figure 4 - 1: 12-Hour Emergency Required and Recommended Storage



As indicated in this figure, all three storage tanks and associated pumping stations would be required to meet the current 12 hour emergency criteria.

Figure 4 – 2 presents the well capacity required to meet the criteria established for the extended emergency as detailed in TM No. 4. Also shown is the current well capacity of 18.8 mgd.

Figure 4 - 2: Extended Emergency Recommended Improvements



As indicated on the figure, 10 additional wells are required to meet the current extended emergency criteria. Two more wells would be needed to meet ultimate requirements. This schedule assumes adding one well in 2013 and the other well in 2021.

Table 4 – 1 presents a summary of the implementation of facilities required to meet the emergency criteria that have been established.

Table 4 - 1: Schedule of Improvements

Year	Tanks		Pump Stations		Wells	
	Number	Capacity	Number	Capacity	Number	Capacity
Current Need	3	33 MG	3	66 mgd	10	10 mgd
2013					1	1 mgd
2021					1	1 mgd
Total	3	33 MG	3	66 mgd	12	12 mgd

5.0. COST ALLOCATION CONSIDERATIONS

5.1. Overview

This section presents cost allocation considerations for the recommended improvements.

5.2. Cost Allocation Considerations

The Family of Agencies is currently considering cost allocation policies. A preferred policy has not been established at the time of this TM.

As the policy is developed, the following factors may be considered:

- Percentage of the demand associated with each Agency during the emergency condition
    - Maximum day during the 12 hour emergency
    - 50 percent of average day during the extended emergency
- Need during the emergency equal to the projected demand minus the Agency owned supply

6.0. CONCLUSIONS AND RECOMMENDATIONS

6.1. Overview

This section presents conclusions and recommendations associated with the recommended improvements.

6.2. Conclusions

6.2.1. Storage

To provide the required 32 MG of storage, this volume was divided among three separate tanks. The use of three tanks would result in increased reliability through redundancy, tank sizes that will allow for community acceptance in developed areas, and greater flexibility in selecting the type of tank that can be used. To utilize standard tank sizes, three 11-MG tanks would be required.

6.2.2. Pumping

During an emergency outage, the storage tanks would be able to provide service for customers at lower elevations; however, pump stations would be required to service customers at higher elevations. The pumping stations would also allow for frequent turn over of the tank volume to avoid water quality issues. Since the criteria for the storage volume were based on meeting the maximum day demand for 12 hours, the total volume of the storage must be pumped into the system during this 12 hour period. This criterion requires each pump station have a capacity of 22 mgd.

6.2.3. Wells

Based on the capacity of the existing wells, it appears that the capacity of each new well would be approximately 1 mgd. As a result, 12 new wells would be required. These wells would be located as close as feasible to the existing transmission mains and tied to these mains to allow the water to be available throughout the regional system.

6.2.4. Opinion of Cost

The opinions of probable cost are summarized in Table 6 – 1.

Table 6 – 1: Summary of Opinions of Probable Project Cost

Description	Quantity	Units	Unit Cost	Rounded Cost
Tanks (11 MG size)	3	ea	$9,600,000	$ 28,800,000
Pump Station	3	ea	$6,000,000	$ 18,000,000
Groundwater wells	12	ea	$2,000,000	$ 24,000,000
Property Acquisition[1]	12	acre	$ 300,000	$ 3,600,000
Subtotal Net Construction				$ 74,400,000
Estimating Contingency	30%			$ 22,300,000
Engineering, Legal, and Administration	25%			$ 24,200,000
Total Project Cost[2]				**$120,900,000**

NOTE: [1]Property cost estimated based on land currently on the market.
[2]Cost based on ENR CCI Cost Index of 7910.81.

6.2.5. Cost Allocation Considerations

The Family of Agencies is presently holding discussions on cost allocation policies. Considerations may include allocations based on demand under the emergency outages and each Agency's current supply.

6.3. Recommendations

Table 6 – 2 presents the implementation schedule recommended to meet the emergency criteria that have been established.

Table 6 – 2: Schedule of Recommended Improvements

Year	Tanks		Pump Stations		Wells	
	Number	Capacity	Number	Capacity	Number	Capacity
2007	3	33 MG	3	66 mgd	10	10 mgd
2013					1	1 mgd
2021					1	1 mgd
Total	3	33 MG	3	66 mgd	12	12 mgd

Appendix A: Opinions of Probable Cost for Storage Tank

Description	Quantity	Unit Cost	Unit	Cost
Prestressed Concrete Tanks (11 MG)				
General Requirements		14%		$ 1,183,000
Contractors OH&P		18%		$ 1,289,000
Site Work				
Clear & Grub	2.2	$ 3,400	Acre	$ 7,000
Site Grading	2.2	$ 5,000	Acre	$ 11,000
Revegetation & Landscape	0.5	$ 8,500	Acre	$ 4,000
Access Road/ Parking	2000	$ 18	S.Y.	$ 36,000
Electric Service	1	$ 306,750	Lot	$ 307,000
Foundations				
Excavation	30000	$ 12	C.Y.	$ 345,000
Excavation Disposal	0	$ 1	C.Y.	$ 0
Reinforced Concrete	0	$ 0		$ 0
Overflow Basin	0	$ 0		$ 0
Tank (314' Dia x 22' High)	1	$6,135,000	EA	$ 6,135,000
Instrumentation & Controls	1	$ 50,000	Lot	$ 50,000
Conduit & Wiring	1	$ 10,000	Lot	$ 10,000
Piping Site & Tanks	1	$ 150,000	Lot	$ 150,000
Painting & Coating		$ 0		$ 0
Const. Access/Temp Esmt.	1	$ 0	Lot	$ 0
Site Fencing & Gates	2000	$ 50	Ft	$ 100,000
Traffic Control	1	$ 5,000	Lot	$ 5,000
Subtotal Net Construction				$ 9,632,000
Subtotal Net Construction (Rounded)				$ 9,600,000
Estimating Contingency		30%	%	$ 2,900,000
Engineering and Administration		25%	%	$ 3,100,000
TOTAL PROJECT COST				**$ 15,600,000**

Appendix B: Opinions of Probable Cost for Pump Station

Description	Quantity	Unit Cost	Unit	Cost
Pump Station				
General Requirements		14%	%	$ 741,000
Contractors OH&P		18%		$ 807,000
Site Work				
Clear & Grub	0.5	$ 3,400	Acre	$ 2,000
Site Grading	1	$ 5,000	Acre	$ 5,000
Revegetation & Landscape	0.5	$ 8,500	Acre	$ 4,000
Access Road/Parking	1000	$ 18	SY	$ 18,000
Transformer Yard	102	$ 18	SY	$ 2,000
Storm Drain	1	$ 5,000	Lot	$ 5,000
Electric Service	1	$ 139,150	Lot	$ 139,000
Foundations				
Excavation	3000	$ 100	CY	$ 300,000
Excavation Disposal	2400	$ 1	CY	$ 2,400
Reinforced Concrete	1000	$ 580	CY	$ 580,000
Building				
Masonry 40' x 50'	2000	$ 220	SF	$ 440,000
Acoustical Panels	2400	$ 5	SF	$ 13,000
Equipment				
Pumps (Vertical Turbine)	5	$ 128,625	EA	$ 643,000
Diesel Generator	1	$ 190,000	EA	$ 190,000
Surge Tank	1	$ 55,000	EA	$ 55,000
Piping & Tie ins	1	$ 105,000	Lot	$ 105,000
Valves	1	$ 32,000	Lot	$ 32,000
Meters	1	$ 18,000	EA	$ 18,000
Electrical				
VFD for Pumps	5	$ 125,000	EA	$ 625,000
Electrical Lines and Poles	3000	$ 100	FT	$ 300,000
Transformers & MCC	1	$ 375,000	Lot	$ 375,000
Conduit & Wiring	3000	$ 100	FT	$ 300,000
Outdoor Lighting	1	$ 4,500	Lot	$ 5,000
Instrumentation & Controls	1	$ 100,000	Lot	$ 100,000
Plumbing & HVAC	1	$ 20,000	Lot	$ 20,000
Const. Access/Temp Esmt.	1	$ 200,000	Lot	$ 200,000
Traffic Control	1	$ 5,000	Lot	$ 5,000
Subtotal Net Construction				$ 6,031,000
Subtotal Net Construction (Rounded)				$ 6,000,000
Estimating Contingency		30%	%	$ 1,800,000
Engineering, Legal, and Administration		25%	%	$ 2,000,000
TOTAL PROJECT COST				**$ 9,800,000**

Appendix C: Opinions of Probable Cost for Wells

Description		**Anticipated Cost**
Wells		
General Requirements		$ 96,000
Contractors OH&P	18%	$ 272,000
Sitework		$ 96,000
Well Drilling		$ 350,000
Well Enclosure Building		$ 80,000
Electrical Generator & Building		$ 328,000
Mechanical		$ 224,000
Onsite Hypochlorite Disinfection System		$ 112,000
Electrical and I&C		$ 224,000
Piping and Tie ins including valves		$ 200,000
Subtotal		$ 1,982,000
Subtotal Net Construction (Rounded)		$ 2,000,000
Estimating Contingency	30%	$ 600,000
Engineering, Legal, and Administration	25%	$ 700,000
Total Cost		**$ 3,300,000**