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<u>TECHNICAL MEMORANDUM NO. 4</u>

DATE: October 19, 2005 | Project No.: 423-02-03-01

TO: Don Ridenhour, Project Manager | CC: WATRTAC Members

FROM: Gerry Nakano, Project Manager
Jim Connell, Project Engineer

SUBJECT: 2050 Napa Valley Water Resources Study
Napa County Incorporated Area Water Supplies

The purpose of this Technical memorandum (TM) is to describe the water supplies available to Napa County municipalities, to project the available quantity of local and imported water, to discuss opportunities and projected impacts of water recycling efforts, and to discuss the current and projected use of the groundwater basin. The municipalities involved are:

- The City of Napa (Napa),
- The City of American Canyon (American Canyon),
- The Town of Yountville (Yountville),
- The City of St. Helena (St. Helena),
- The City of Calistoga (Calistoga), and
- Napa Sanitation District (NSD - source of recycled water).

Information for this TM was derived from the following sources:

- Water Resources Study for the Napa Valley Region, James M. Montgomery, January 1991
- Water Supply Plan, City of Calistoga, West Yost & Associates, August 17, 1997
- Water Facilities Plan for the City of Calistoga, Summit Engineering, Inc., August 2000
- Urban Water Management Plan, City of St. Helena, West Yost & Associates, May 2003
- Water Supply Plan, Town of Yountville, West Yost & Associates, September 1, 1998
- Water Supply Plan Update, Town of Yountville, West Yost & Associates, June 2004
- Water System Optimization and Master Plan Report – Draft, City of Napa, West Yost & Associates, August 1997

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- The State Water Project Delivery Reliability Report, California Department of Water Resources, 2002
- Comprehensive Water Service Study, Public Workshop Draft, Local Agency Formation Commission of Napa County, 2003
- City of Napa 2020 General Plan, Adopted and with Amendments to January 1, 2002
- Napa Water Treatment and Wheeling Study, Town of Yountville and City of St. Helena, West Yost & Associates, August 2, 2000
- Napa County Local Agency Formation Commission (LAFCO) Comprehensive Water Service Study, 2003
- Rector Reservoir Yield Study, Department of Water Resources, Prepared for the California Department of Veteran Affairs, Veteran's Home of California, Yountville, December 2000.
- Conversations with local water supply representatives
- Napa County Grand Jury 2002-2003 Water Report and responses

This TM discusses the availability of local and imported surface water supplies, the current state and projected use of recycled water, and the current and projected use of groundwater.

SURFACE WATER SUPPLIES

The municipalities involved in this study receive surface water from several sources:

- The State Water Project
- Local Reservoirs
- Other Municipalities

The Napa County Flood Control and Water Conservation District (District) is a State Water Project (SWP) contractor. The District administers the SWP contract for several municipalities in Napa County, including the Cities of Napa, American Canyon, St. Helena, and Calistoga, and the Town of Yountville. Water is delivered from the SWP through the North Bay Aqueduct. This is discussed in more detail below.

The cities of Napa, St. Helena, Calistoga and the Town of Yountville each have their own local surface water reservoir that supplies a portion of the water demand.

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The terms “storage capacity”, “yield”, “firm yield” and “safe yield’ are used frequently in discussing reservoirs. For the purpose of this TM, these terms are defined below.

- Storage Capacity – The static volume of a reservoir at the spillway elevation, assuming no inflow and no outflow.
- Yield – The amount of water that can be supplied from the reservoir, taking into account dead pool, inflow, outflow, evaporation, and deliveries.
- Maximum Yield – The maximum yield is the greatest potential yield from the reservoir, based on maximum historical rainfall.
- Firm Yield and Safe Yield – The amount of water that can be guaranteed during a critically dry period.
- Reliable Yield - The amount of water that can be guaranteed during a multiple dry year period.
- Probability of Exceedence – The probability that a given reservoir yield could be exceeded in a given year. The firm, or safe yield would have a probability of exceedence of 100 percent. The reliable yield would have a probability of exceedence of 85 percent, as described in the SWP Reliability Report. The maximum yield would have a probability of exceedence of zero percent.

Planning for surface water supplies should address the variations in water availability forecasting that include average-year, wet-year, and dry-year. According to the California Department of Water Resources (DWR) State Water Project Delivery Reliability Report (SWP Report), water deliveries are based on the water year and the ability of the SWP Contractors, including the District, to receive SWP deliveries. The percent of time that each of these water availability conditions occur for SWP deliveries are shown in Table 1.

Table 1. State Water Project Occurrence Frequency for Year 2021

Water-Year Type (1)	Probability of Exceedence, percent[a] (2)	Projected SWP Delivery, percent of Table A[b] (3)
Wet-year	50	85
Average-year	60	76
Multiple Dry-years	85	40
Single Dry-year[c]	100	20

[a] Percent of time equal to or greater than as defined above.
[b] See discussion under Reliability of SWP Supplies, below.
[c] The DWR report indicated a single dry year would have the most severe reduction in supply.

The SWP Report provided the projected SWP Delivery (column 3). The probability of exceedence was determined by looking up the SWP Delivery (as Percent of SWP full Table A) on the SWP Report Figure 1, and determining the "percent of time at or above", which is termed percent exceedence for the 2050 Study. Figure 7 of this TM is Figure 1 of the SWP Report, adjusted for the Napa County full SWP entitlement of 29,025 afa. For example, the SWP Report calculates the single dry-year delivery would be 20 percent of the SWP entitlement. Cross referencing 20 percent of 29,025 afa (5,805 afa) on Figure 7 yields a "probability of exceedence" of 100 percent. Similarly, the SWP report indicates deliveries during a multiple dry year (4 or 6-year droughts) would be 40 percent of entitlement. Cross referencing 40 percent of 29,025 afa (11,610 afa) on Figure 7 yields a "probability of exceedence" of 85 percent. The same process is applied to the average year delivery of 76 percent, as reported by the DWR, and the wet year delivery of 85 percent.

The percent exceedences discussed above suggest that the water-year data are not normally distributed (i.e. the median is not equal to the average). Consequently, the average-year is not exceeded 50 percent of the time; it is exceeded 60 percent of the time. A more thorough discussion of the development of the data in Table 1 is included in the Imported Surface Water section, below.

In the City of Napa's 1997 Water Master Plan, WYA had recommended Napa use a range of 20 to 50 percent to estimate the firm-yield of the SWP (minimum percentage of Table A entitlement that would be delivered in a single-dry year). This range was recommended because, at that time, DWR was investigating projects that would help "firm up" the reliability of the SWP. Over the last several years, DWR has not been able to implement projects that would increase the reliability of the SWP in the single dry year. Therefore, DWR's published single-dry year delivery of 20 percent will be used for the 2050 Study.

Even though the occurrence frequency may be the same for the local water supply reservoirs, the water-year types do not necessarily coincide between local reservoirs and the SWP. For example, a normal (or average) rainfall year for the Lake Hennessey watershed area may occur in the same year as a dry (below average rainfall) year for the State Water Project watershed area. Reconciling the local hydrology with the SWP hydrology is an important step that should be undertaken in later studies to better understand water supply availability. To declare that a dry year, however, occurs in both the SWP and local watersheds at the same time, would provide the most conservative estimate of surface water availability, but may slightly overestimate supply shortcomings. The surface water supply summary presented in Table 11 and Table 12, assumes dry years occur at the same time for the SWP and the local reservoirs.

Local Surface Water

The major surface water features in Napa Valley are shown in Figure 1.

The existing major water supply reservoirs in Napa County from north to south include:

- Kimball Reservoir (serving Calistoga)
- Bell Canyon Reservoir (serving St. Helena)

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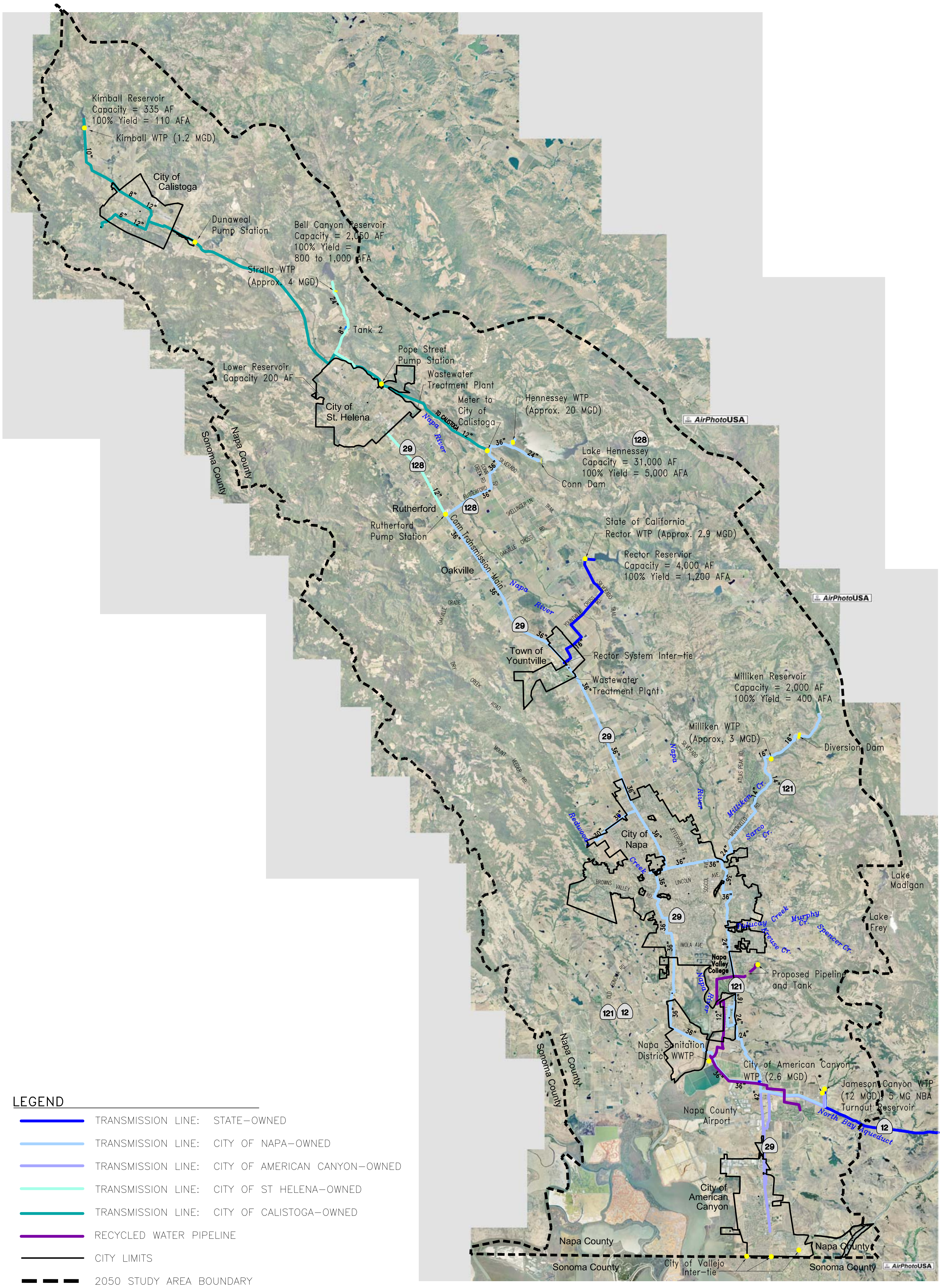

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Figure 1 FINAL

NAPA COUNTY FC&WCD

2050 NAPA VALLEY WATER RESOURCES STUDY

SURFACE WATER SUPPLIES

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- Lake Hennessey (serving Napa)
- Rector Reservoir (serving Yountville and the State of California Veteran's Home, Department of Fish and Game, and Napa State Hospital)
- Milliken Reservoir (serving Napa)

All these reservoirs are located on tributaries to the Napa River. There are also minor surface water impoundments throughout the Valley that are used for agricultural purposes.

The 1991 Water Resources Study (1991 Study) generated yield curves for the five reservoirs based on watershed modeling and forty to fifty years of rainfall data. These yield curves are shown in Figures 2 through 6 and are discussed below.

A comparison of the reservoir storage capacity to the average annual inflow from the watershed reported in the 1991 Study is presented in Table 2. The storage capacity of two of the reservoirs (Lake Hennessey and Rector) is greater than the average annual inflow. Of the three remaining reservoirs, only Kimball appears to be sized substantially smaller than the average annual inflow.

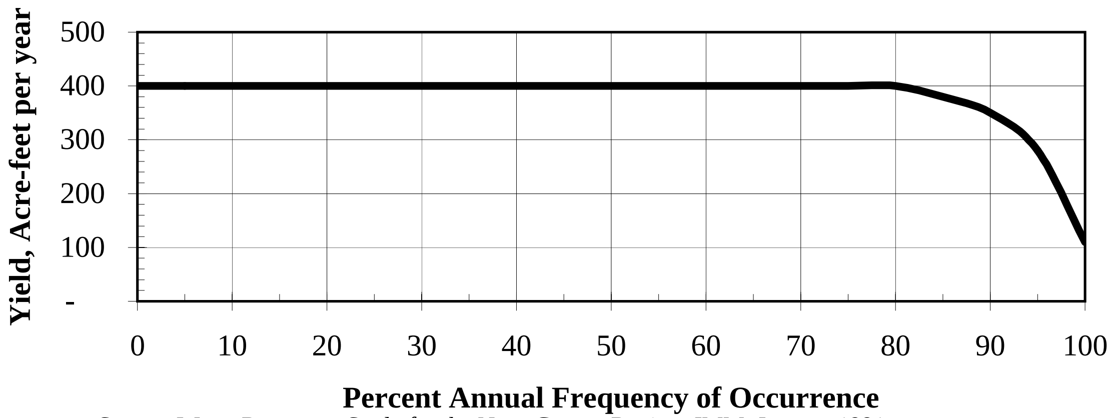
Table 2. Comparison of Reservoir Storage Capacity to Average Annual Inflow

Reservoir (1)	Total Storage Capacity, af (2)	Average Annual Inflow, af (3)
Kimball Reservoir	335	2,817
Bell Canyon Reservoir	2,050	3,133
Lake Hennessey	31,000	19,692
Rector Reservoir	4,000	3,354
Milliken Reservoir	2,000	3,656
Total	39,385	32,652

Source: 1991 Water Resource Study for Napa County Region

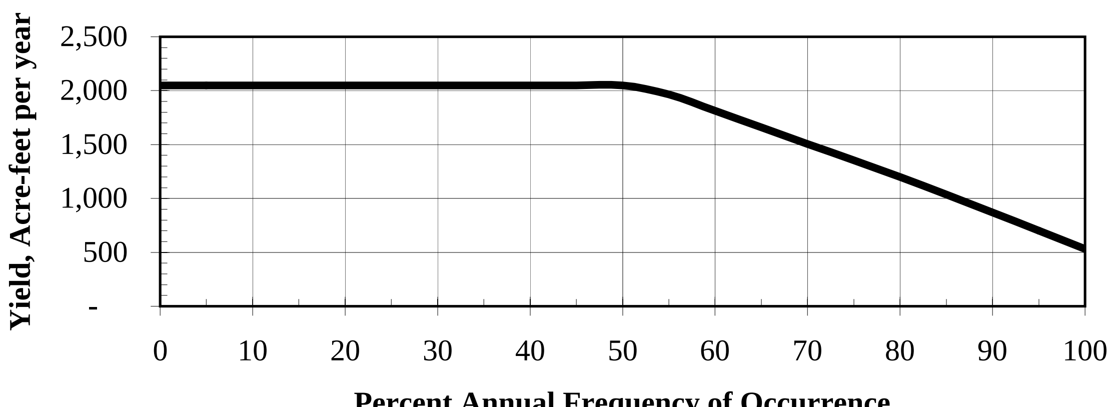
Each municipality, and the State of California, has water rights from the State Water Resources Control Board, Division of Water Rights, to divert and store water in its respective reservoirs. The current water rights are shown in Table 3.

Figure 2. Kimball Reservoir Yield Curve



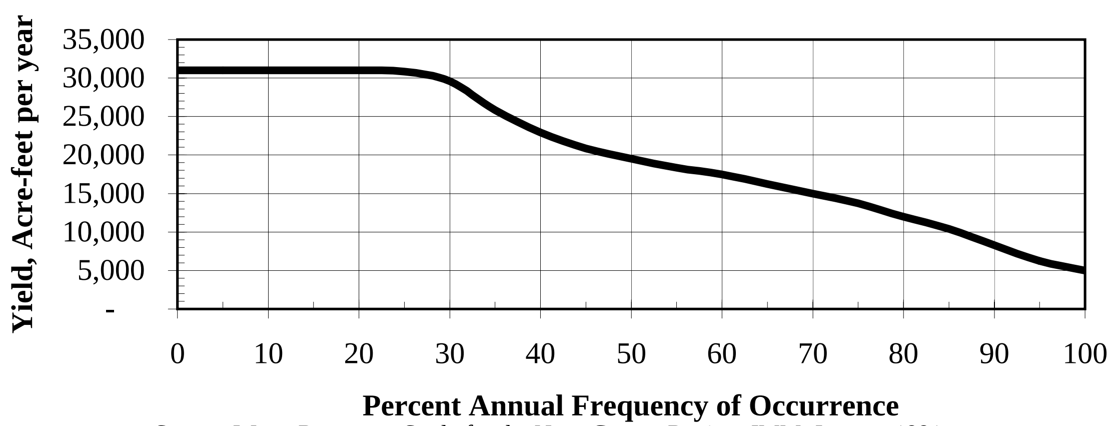
Source: Water Resources Study for the Napa County Region, JMM, January 1991

Figure 3. Bell Canyon Reservoir Yield Curve



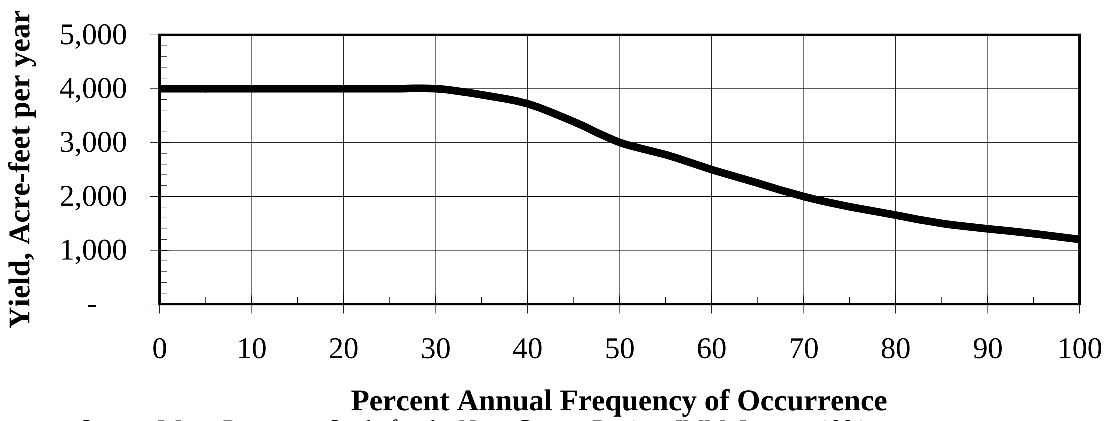
Source: Water Resources Study for the Napa County Region, JMM, January 1991

Figure 4. Hennesey Reservoir Yield Curve



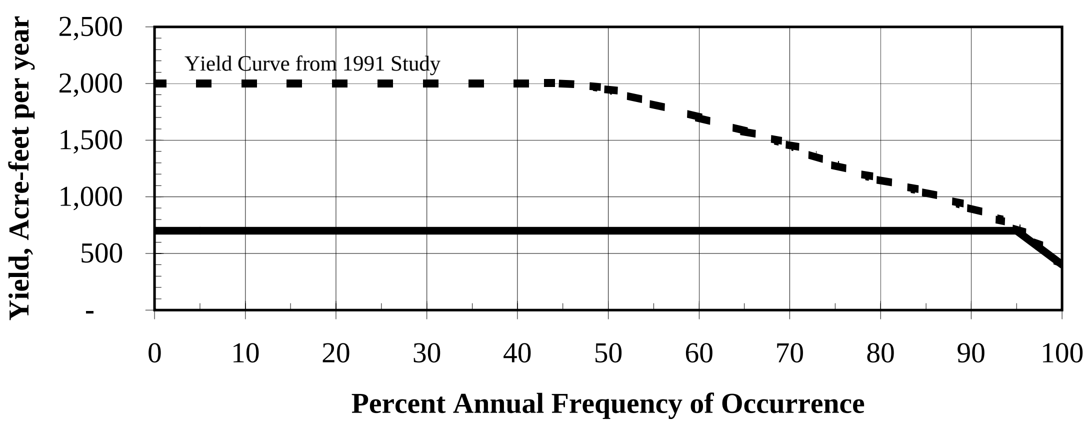
Source: Water Resources Study for the Napa County Region, JMM, January 1991

Figure 5. Rector Reservoir Yield Curve



Source: Water Resources Study for the Napa County Region, JMM, January 1991

Figure 6. Milliken Reservoir Yield Curve



Source: Water Resources Study for the Napa County Region, JMM, January 1991 modified per City of Napa, 2004.

Table 3. Summary of Diversion and Storage Water Rights

Reservoir (1)	Diversion Right, afa (2)
Kimball Reservoir	626
Bell Canyon Reservoir	3,800
Lake Hennessey	30,500
Rector Reservoir	1,937
Milliken Reservoir	2,350
Total	39,213

Source: 2003 LAFCO Comprehensive Water Service Study

The estimated yields for these five major reservoirs are shown in Table 4.

Table 4. Comparison of Reservoir Yield, acre-feet per year

Reservoir (1)	Yield in afa (Probability of Exceedence)				
	Maximum (0 percent) (2)	Wet-year (50 percent) (3)	Average-year (60 percent) (4)	Multiple Dry-years (85 percent) (5)	Single, Critically Dry-year (100 percent) (6)
Kimball Reservoir	400	400	400	380	110
Bell Canyon Reservoir	2,050	2,050	1,800	1,035	530
Lake Hennessey	31,000	19,500	17,500	10,420	5,000
Rector Reservoir[a]	4,000	3,000	2,500	1,500	1,200
Milliken Reservoir[b]	700	700	700	700	400
Total	38,150	25,650	22,900	14,035	7,240

Source: 1991 Water Resource Study for Napa County Region – updated per City of Napa 2004

(a) Total yield of Rector Reservoir, the water available for Yountville is significantly less, and is discussed below.

(b) Seismic stability concerns by the California Department of Water Resources, Division of Safety of Dams regarding Milliken Dam has significantly reduced previous yield values.

Updated storage capacity and yield studies have been performed on some of the reservoirs shown in Tables 2 through 4. These studies and a brief description of each of the reservoirs are provided below. The revised studies did not significantly alter the estimated yields shown in Table 4.

Kimball Reservoir (Calistoga)

Kimball Canyon Dam, which captures flow from Kimball Creek, was originally completed in 1939 and raised in 1948. The dam forms Kimball Reservoir, which provides water supply to Calistoga. The original total reservoir capacity to the spillway elevation was 345 acre-feet (af). Flashboards were installed that increased the capacity to 409 af, at the top of the flashboards (four feet above the spillway crest). According to the Calistoga Water Facilities Plan, soundings taken in 1991 indicated the total capacity of Kimball Reservoir to the top of the flashboards was reduced to an estimated 312 af by sedimentation following a large fire in the Kimball Creek watershed. It was estimated for the 2000 Water Facilities Plan that sedimentation losses continued at a rate of 2.6 acre-feet per year resulting in a storage capacity in 2000 of 291 af. The revised yields described in the Water Facilities Plan are shown in Table 5.

Table 5. Estimated Reservoir Storage Capacity and Yield

		Yield in afa (Probability of Exceedence)		
Reservoir (1)	Storage Capacity, af (2)	Normal-year (63 percent) (3)	Below-Normal Year (90 percent) (4)	Critically Dry-year (100 percent) (5)
Kimball Reservoir	291	392	336	103

Source: 2000 Water Facilities Plan, which references a J M Montgomery Yield Study that followed the 1991 capacity survey.

The yield curve for Kimball Reservoir, generated for the 1991 Study, is shown in Figure 2. The data shown in Table 5 were developed from reservoir soundings that were taken after the 1991 Study was issued; therefore, the 1991 Study indicated a total storage capacity of 335 af, as shown in Table 2, instead of the revised available storage capacity of approximately 291 af, as revised by JM Montgomery following the 1991 Study. As defined above, storage capacity (column 2) is the static volume of a reservoir at the spillway elevation, assuming no inflow and no outflow. Storage capacity differs from yield (columns 3 through 6) in that yield is defined as the amount of water that can be supplied from the reservoir, taking into account dead pool, inflow, outflow, evaporation, and deliveries. The revised yield, calculated by JM Montgomery and shown in Table 5, closely matches the original yield developed for the 1991 Study that is shown in Figure 2.

The data in Table 2 and the yield curve in Figure 2 suggest Kimball Reservoir is undersized for the watershed.

Water from Kimball Reservoir is treated at Calistoga's Kimball Water Treatment Plant, which has a nominal treatment capacity of 833 gpm, or 1.2 million gallons per day (mgd).

Bell Canyon Reservoir (St. Helena)

Bell Canyon Dam, which captures Bell Creek, was originally constructed in 1959. The dam forms Bell Canyon Reservoir, which provides water supply to St. Helena. Although Bell Canyon Reservoir was originally built to store 1,800 af of water, the Napa County Local Agency Formation Commission (LAFCO) reports the existing maximum capacity of Bell Canyon Reservoir is 2,350 af. Other reports have indicated a reservoir storage capacity from 2,050 af (1991 Study) to 2,500 af (2003 Urban Water Management Plan).

The yield curve for Bell Canyon Reservoir, generated for the 1991 Study, is shown in Figure 3. The 1991 Study indicated a maximum annual yield of 2,050 af, based on a total storage capacity of 2,050 af.

Water from Bell Canyon Reservoir is treated at St. Helena's Louis Stralla Water Treatment Plant, which has a nominal treatment capacity of 2,430 gpm, or 3.5 mgd.

Lake Hennessey (City of Napa)

Conn Dam, which captures flow in Conn Creek, was originally constructed in 1946. The dam forms Lake Hennessey, which provides water supply to Napa. According to the 2003 LAFCO Comprehensive Water Service Study, Lake Hennessey has a storage capacity of approximately 31,000 af.

The yield curve for Lake Hennessey, generated for the 1991 Study, is shown in Figure 4. The 1991 Study indicated a maximum annual yield of 31,000 af. As this yield confirms, the volume of Lake Hennessey is quite large in comparison to the yield from the tributary watershed.

Water from Lake Hennessey is treated at the City of Napa's Hennessey Water Treatment Plant, which has a nominal treatment capacity of 13,888 gpm, or 20 mgd.

Rector Reservoir (State of California)

Rector Dam, which captures water from Rector Creek, was originally constructed in 1946 and raised in 1985. The dam forms Rector Reservoir, which provides water supply to Yountville and the State of California Yountville Veteran's Home, Napa State Hospital and Department of Fish and Game. According to the 2003 LAFCO Comprehensive Water Service Study, Rector Reservoir has a capacity of approximately 4,600 af.

The yield curve for Rector Reservoir, generated for the 1991 Study, is shown in Figure 5. The 1991 Study indicated a maximum annual yield of 4,000 af.

In 2000, the DWR conducted a study of the Rector Reservoir storage capacity and range of possible yields. The study calculated the reservoir capacity to be 4,535 af. The safe yield was estimated to be 1,670 acre feet annually (afa), assuming 1992 actual deliveries, and 1,190 afa considering the flow releases anticipated to meet "the instream flows proposed by DFG and the needs projected by all parties are met." This value compares well to the 1991 Study safe yield of 1,200 afa, shown on Figure 5.

Yountville has recently signed an agreement with the State of California Yountville Veteran's Home to obtain water from Rector Reservoir. The estimated delivery to Yountville is presented in Table 6.

Table 6. Estimated Rector Reservoir Deliveries to Yountville, afa

Parameter (1)	Average-year (60 percent) (2)	Multiple Dry-years (85 percent) (3)	Single, Critically Dry-year (100 percent) (4)
Delivery to Yountville	500	500	125

Source: Yountville Water Supply Plan Update, 2004

Water from Rector Reservoir is treated at the State of California's Rector Water Treatment Plant, which has a nominal treatment capacity of 2,000 gpm, or 2.9 mgd.

Milliken Reservoir (City of Napa)

Milliken Dam, which captures flow in Milliken Creek, was originally constructed in 1923. The dam forms Milliken Reservoir, which provides water supply to Napa. According to the 2003 LAFCO Comprehensive Water Service Study, Milliken Reservoir has a capacity of approximately 1,980 af.

The yield curve for Milliken Reservoir, generated for the 1991 Study, is shown in Figure 6. The 1991 Study indicated a maximum yield of 2,000 af.

Recent California Department of Water Resources, Division of Safety of Dams concerns over the seismic stability of Milliken Dam have caused Napa to significantly lower the water level in Milliken Reservoir. Substantial modifications will be required to allow operation at the original reservoir design levels. Currently, Napa operates Milliken Reservoir to deliver 700 afa in all but single dry years.

Water from Milliken Reservoir is treated at Napa's Milliken Water Treatment Plant, which has a nominal treatment capacity of 2,777 gpm, or 4 mgd.

Drought Assumptions

The impact of single-year and multiple-year drought conditions on estimated reservoir yield was evaluated. The initial storage in a local reservoir at the start of a drought period is based on the assumption that each reservoir would start the previous year full and would be drawn down by the 1998-2002 average use described in previous TMs.

The estimated amount of surface water storage in each reservoir following a Normal Year supply and demand condition is shown in Table 7.

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Table 7. Calculation of Normal Year Final Storage[a]

Parameter	Reservoir			
	Kimball	Bell Canyon	Milliken	Lake Hennessey
Initial Storage	400	2,050	1,100	31,000
Annual Demand	200	1,035	700	5,000
Final Storage	200	1,015	400	26,000
Percent of Initial Storage Remaining	50%	50%	36%	84%

(a) Based on zero consumption of storage.

This amount of storage was then used to calculate the amount of drawdown that would occur in multi-year droughts and single year droughts. For a multi-year (6-year) drought condition, it was assumed the reservoir drawdown would be 50 percent of the remaining storage following a Normal Year. For Kimball Reservoir, Bell Canyon Reservoir, and Milliken Reservoir the storage was withdrawn at a uniform rate of 8.33 percent over the six year drought period. For Lake Hennessey, an initial drawdown of 25 percent in the first year was followed by five years of 5 percent drawdown to simulate the impacts of starting a multi-year drought with a single year drought. The estimated reservoir yields, including drawdown of reservoir storage, are shown in Table 8 for each of the four locally controlled reservoirs.

Table 8. Multi-Year Drought Estimated Reservoir Yields[a]

Parameter	Reservoir			
	Kimball	Bell Canyon	Milliken	Lake Hennessey
Initial Storage	200	1,015	400	26,000
Annual Storage Depletion	17	85	33	1,300[b]
Annual Yield	380	1,035	1,040	10,420
Total Annual Water Supply	397	1,120	1,073	11,720

(a) Based on a 6-year drought and 50 percent consumption of the storage following a normal year as depicted in Table 7.
(b) Hennessey yield based on one year of 25 percent draw down and five years of 5 percent drawdown.

For a single-year drought, it was assumed each reservoir would be drawn down by 25 percent of the storage remaining following a Normal Year. The estimated reservoir yields, including drawdown of reservoir storage, for a single-year drought are shown in Table 9 for each of the four locally controlled reservoirs.

Table 9. Single-Year Drought Estimated Reservoir Yields[a]

	Reservoir			
Parameter	Kimball	Bell Canyon	Milliken	Lake Hennessey
Initial Storage	200	1,015	400	26,000
Total Storage Depletion	50	254	100	6,500
Annual Yield	110	530	400	5,000
Total Annual Water Supply	160	784	500	11,500

[a] Based on a 1-year drought and 25 percent consumption of the storage following a normal year as depicted in Table 7.

Imported Surface Water

Four Napa Valley municipalities receive imported surface water from the State Water Project. Some of the municipalities also receive imported surface water from other sources. State Water Project deliveries and the other sources of imported water supplies are discussed below.

State Water Project

The District is a contractor of the State Water Project (SWP) and imports surface water supplies for use in the Napa Valley. Water is diverted from the Sacramento/San Joaquin Delta at the Barker Slough Pumping Plant and conveyed through the North Bay Aqueduct (NBA) approximately 21 miles to the Cordelia Forebay to serve customers in Napa and Solano Counties. District water is pumped from the Cordelia Forebay and conveyed an additional six miles to the SWP Napa Turnout Reservoir at Jamieson Canyon. The majority of the water delivered through the NBA is then treated at Napa's Jamieson Canyon Water Treatment Plant and distributed to Napa water users and the participating municipalities (Yountville and Calistoga). The remainder of this water is treated at American Canyon's water treatment plant or delivered as raw water to American Canyon irrigation customers.

The amount of water available to each contractor is included in Table A of the SWP contract. The total Table A entitlement for the District is 29,025 acre-feet per year, including the KCWA purchase, as indicated in Table 10.

Originally, the District contracted for the ultimate delivery of up to 25,000 af of water from the SWP and a pre-determined ramp-up schedule. Therefore, this entitlement has been increasing incrementally each year until 2021, when the full Table A entitlement will be in effect. In 2000, an additional 4,025 af of SWP water was acquired, and permanently transferred from the Kern County Water Agency (KCWA) to the District. Therefore, with the addition of this entitlement from Kern County, in 2021, the District's total allocation will increase to 29,025 af. The water supply contract is due to expire in 2035. The current (2004) and ultimate SWP water entitlement, by municipality, is shown in Table 10.

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The SWP contract states that the maximum-month delivery cannot exceed 11 percent of the total annual entitlement. For the District, this delivery rate is 11 percent of the pre-KCWA purchase, or a maximum-month delivery of 2,750 af (approximately 46 cfs).

Concerns regarding the hydraulic delivery capability of the NBA have recently been expressed and studied. In a memorandum dated February 2, 2004, David Okita, General Manager of the Solano County Water Agency, summarized the results of recent capacity studies. In the memorandum, the contractual capacity of the NBA from Barker Slough to Cordelia Forebay is indicated as 175 cfs (includes contractors in addition to the District). The theoretical capacity of the pump station at Barker Slough is 154 cfs, to be increased to 175 cfs with the installation of an additional pump. The actual capacity was measured by DWR at 140 cfs. This reduction in capacity was reportedly due to bio-growth. The bio-growth was removed through pigging and the capacity of the system increased to approximately 154 cfs, although the accuracy of the second capacity test has been questioned. Several months after DWR removed the bio-growth, the capacity of the system was again measured at the pre-pigging amount of 140 cfs. Further studies are being undertaken to assess the improvements necessary to increase the capacity to the contractual amount and further increase the capacity to a future desired amount of 248 cfs. These studies were expected to be completed prior to the issuance of this TM, but have not been received.

Table 10. SWP Entitlements, acre-feet per year

Municipality (1)	Year 2004 Table A Entitlement (2)	Remaining Table A Entitlement (3)	KCWA Purchase (4)	Total SWP Contractual Entitlement (5)
American Canyon	4,100	600[a]	500	5,200[c]
Napa	12,600	6,200	1,000	19,800
Yountville	500	0	600	1,100
St. Helena	0	0	1,000	1,000[d]
Calistoga	625[b]	375[b]	925	1,925
Total District Entitlement	17,825	7,175	4,025	29,025

Source: 2003 LAFCO Comprehensive Water Service Study

(a) Includes the sale of 500 afa to Calistoga in 1998.
(b) Includes 500 afa purchased from American Canyon in 1998, to be added in 25 afa increments beginning in 2000.
(c) American Canyon has an additional 500 afa of “Permit” water (non-SWP water) that is conveyed through the NBA.
(d) St. Helena did not acquire any conveyance capacity in the NBA through the acquisition of this SWP entitlement.

The impact of the reduced conveyance capacity in the NBA is that the District may not be able to receive its full contractual capacity of 46 cfs through the Barker Slough to Cordelia portion of the NBA system. The NBA system from Cordelia to the Napa turn-out is reportedly capable of delivering the contracted amount of 46 cfs, although that capacity is also being studied.

If 40 cfs were delivered continuously for the entire year, the total volume of water delivered would be approximately 29,000 af. During low demand months, however, the District may not be able to receive and treat the available SWP supply. Without significant local raw water storage capacity, the District's ability to receive its full entitlement is limited. If non-local storage or dry-year water supply options were available, these sources of supply could be used to supplement SWP cut-backs in dry and critically dry years. The relationship between available supply and demand, and the effect of local and non-local storage, will be discussed in more detail in future TMs.

The capacity of the NBA is discussed in more detail under the Reliability of SWP Supplies paragraph, below.

Interruptible Supply (Article 21) Water

In addition to Table A, Article 21 of the SWP contract allows for the purchase of surplus water beyond the Table A quantities. Article 21 assumes the contractor can take delivery of the surplus water during the wet season without interfering with the ability of the SWP to deliver the Table A water to other contractors, and that all environmental and other water requirements have been met. Article 21 also requires the contractor to receive the full month's scheduled delivery prior to receiving Article 21 water.

The District provides a delivery schedule to the DWR that maximizes the use of Article 21 water, following consumption of carryover water.

Carryover Water

Carryover water is water from a previous year's entitlement that was available for use, but was in excess of demands, and was therefore stored for use in the subsequent years. District carryover water is stored in San Luis Reservoir. If San Luis Reservoir spills, the carryover water is considered the first water to be lost. The District frequently uses carryover water during the early months of the year.

Turn-back Pools (Article 56)

Each year, the DWR decides whether to operate a dry-year purchase program to distribute water from those agencies that may not be using their full entitlement, to those agencies that request additional water supplies. According to Article 56 of the State Water Project Contracts, the State will "establish an annual entitlement water pool (the Pool) for contractors wishing to sell or buy project water…" The amount of water available for purchase from the Pool is dependent on the contractor's willingness to sell entitlement that is excess to their needs for that given year, and could drop to zero in any given year.

The District has purchased water through the program in the past and is expected to continue to do so in the future. Due to the unpredictable nature of the program, however, the program should not be considered a reliable long-term source of supply.

The amount and source of imported surface water the District has received in recent years is shown in Table 11.

Table 11. Recent Imported Surface Water Deliveries, af

Source (1)	2001 (2)	2002 (3)	2003 (4)
Original SWP Table A Entitlement	3,808	1,577	4,197
Kern County Water Purchase	0	0	0
Interruptible, Article 21 Water	532	996	0
Carryover Water	1,723	4,226	3,399
Turnback Pools, Article 56	82	76	760
Total	6,145	6,875	8,356

Source: Napa County Flood Control and Water Conservation District

The water from the SWP is treated at Napa's Jamieson Canyon WTP, which has a rated capacity of 12 mgd (although it can treat up to 15 mgd during peak demand periods), and American Canyon's WTP, which has a current capacity of 5.6 mgd. Both treatment plants may undergo capacity expansions – design is currently under way at Napa's Jamieson Canyon WTP to expand this facility to 24 mgd, and American Canyon is planning a subsequent 3 mgd expansion to 8.6 mgd. Once these expansions are complete, the total treatment capacity at the Napa turnout will be 32.6 mgd, or approximately 50 cfs.

The projected 2050 maximum-day demands, NBA WTP capacity, SWP facility conveyance capacity, and maximum NBA pipeline capacity allocated to each municipality are shown in Table 12.

Table 12. NBA Capacity Allocation

Municipality (1)	Projected 2050 Maximum-Day Demand, cfs[(a)] (2)	NBA WTP Capacity, cfs (3)	SWP Facility Conveyance Capacity[(b)], cfs (4)	Contractual NBA Conveyance, Capacity[(c)], cfs (5)
American Canyon	27.4	13.3[(d)]	9.6	8.6
Napa	84.3	37.0[(e)]	36.6	34.7
Yountville	3.1	0	2.0	0.9
St. Helena	8.1	0	1.8	0.0
Calistoga	5.9	0	3.6	1.8
Total	128.8[(f)]	50.3	53.6	46.0[(g)]

(a) Annual 2050 demands from TM 3 multiplied by max-day peaking factor of 2.0.
(b) 11 percent of full Table A entitlements, found in Table 6, including KCWA purchase.
(c) 11 percent of original SWP entitlement, not including KCWA purchase.
(d) Equivalent to future capacity of 8.6 mgd.
(e) Equivalent to future capacity of 24 mgd.
(f) Local surface water treatment plants serve a portion of this demand (approximately 43 cfs).
(g) Physical NBA capacity may be as low as 40 cfs, as discussed in more detail above.

The main points to consider in a review of Table 12 are:

1. The hydraulic capacity of the NBA is less than originally contracted (comparing column 5 with footnote g and discussion above).
2. The contractual capacity in the NBA is less than the full Table A entitlement (comparing column 5 with column 4).
3. The treatment capacity is approximately equal to the full Table A entitlement, assuming a 10 percent loss during the treatment process (comparing column 4 with column 3.
4. The local WTP capacity (43 cfs) plus the NBA water treatment capacity (50 cfs - totaling 93 cfs) is substantially less than the projected maximum-day demand of 129 cfs.

Although additional hydraulic capacity in the NBA was not available for purchase during the KCWA transfer, the transfer did include transportation in the SWP facilities to KCWA. This capacity may be used to transfer water to and from a Kern County groundwater storage system, such as the Semitropic Water Storage District, if desired.

In addition to the capacity limitations shown in Table 12, other, non-SWP water is conveyed through the NBA facilities to Solano County agencies ("Settlement Water", not discussed in this TM) and Solano and Napa County agencies ("Permit Water", discussed briefly below). The priority of these two other deliveries (Settlement water and Permit water) is less than the SWP water. For example, Settlement water can be delivered to Vacaville only after the SWP and Permit water have been delivered.

<u>Reliability of SWP supplies</u>

To assist municipalities in their compliance with SB 221 and SB 610, two projections were completed by DWR for the Year 2021 SWP deliveries using the CALSIM II model. The first projection (2021A) assumes the water demands of each Contractor (i.e. the District) change with the rainfall year. During a wet year, demands would be lower and local storage would be full, or spilling. Therefore, the contractor would not be able to receive the volume of SWP water that is available. The second projection (2021B) assumes the water demands of each Contractor do not change with the weather and that the contractors can receive the entire SWP entitlement (i.e. each contractor has an infinite ability to receive available SWP water).

The two projections are shown in Figure 7. The major difference between the two projections occurs during wet years when local reservoirs are more likely to be full, and water demands lessened. The projections match closely for four of the five conditions under consideration in this study (i.e. 50 percent, 60 percent, 85 percent, and 100 percent exceedence). During wet years, the SWP is able to deliver 100 percent of the full Table A entitlement more frequently under projection 2021B than under 2021A. Following discussions with District personnel, projection 2021A was used in this study because of its more realistic use of weather data. The potential deliveries under the five conditions are shown in Table 13.

As shown in Figure 7, the delivery for a single, critically dry year is 20 percent of the entitlement. In the City of Napa's 1997 Water Master Plan, WYA had recommended Napa use a range of 20 to 50 percent to estimate the firm-yield of the SWP (minimum percentage of Table A entitlement that would be delivered in a single-dry year). This range was recommended because, at that time, DWR was investigating projects that would help "firm up" the reliability of the SWP. Over the last several years, DWR has not been able to implement projects that would increase the reliability of the SWP in the single dry year. Therefore, DWR's published single-dry year delivery of 20 percent will be used for the 2050 Study.

An extensive study of the interaction of all the District surface water supplies could indicate that a multiple dry-year scenario where the District receives 40 percent of its allocation for three or more years could affect water supplies more severely than a single dry year. Calculating the projected demands and comparing to the potential yield based on 85 percent exceedence and 100 percent exceedence indicates a single dry year has a more severe impact on storage than multiple dry years. Therefore, for the purposes of this study, the single dry year has been taken to be the most critical.

Table 13. Comparison of SWP Deliveries, acre-feet per year

	Delivery in afa (Probability of Exceedence)				
Reservoir (1)	Full Table A[(a)] (0 percent) (2)	Wet-year[(a)] (50 percent) (3)	Average-year[(a)] (60 percent) (4)	Multiple Dry-years[(a)] (85 percent) (5)	Single, Critically Dry-year[(a)] (100 percent) (6)
American Canyon	5,200	4,315	3,950	2,080	1,040
Napa	19,800	16,435	15,050	7,920	3,960
Yountville	1,100	915	835	440	220
St. Helena[(b)]	1,000	830	760	400	200
Calistoga	1,925	1,600	1,465	770	385
Total	29,025	24,095	22,060	11,610	5,765

Source: 2002 SWP Delivery Reliability Report

(a) Refer to Table 1 for percent deliveries under supply conditions.
(b) This volume cannot be delivered until St. Helena acquires contractual capacity in the NBA system.

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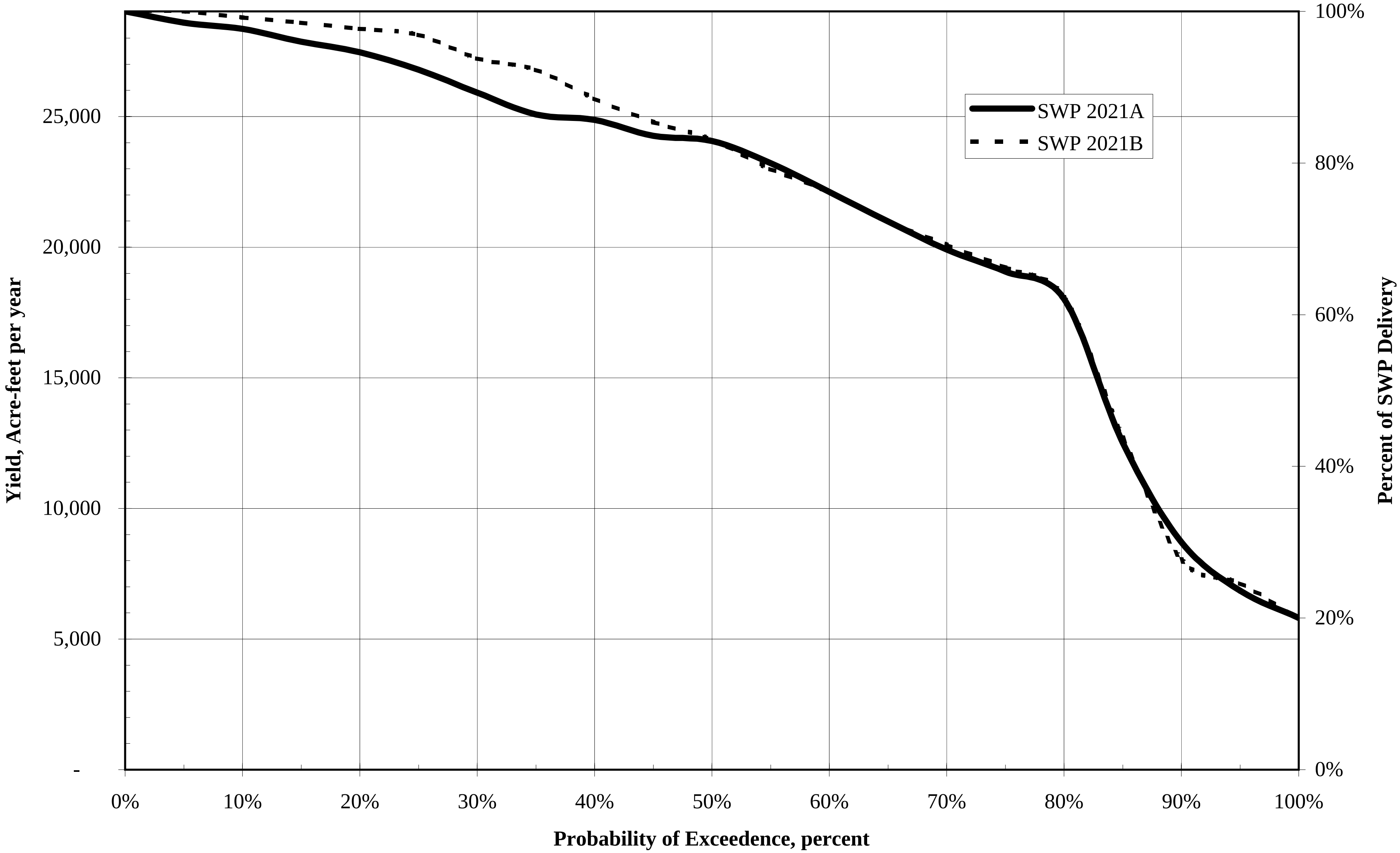
Figure 7. SWP Yield Curve



Source: SWP Delivery Reliability Report, DWR, 2002

Other Sources of Imported Surface Water

In addition to the SWP, American Canyon has an agreement with the City of Vallejo (Vallejo) in Solano County for additional imported surface water.

In 2000, American Canyon transferred 500 af of its entitlement to Calistoga and arranged to purchase 500 af of Vallejo's "Permit" water (appropriative water right), which is pumped from Lindsey Slough and delivered through the NBA. American Canyon staff have indicated that this water supply is more reliable than the SWP water supply and is expected to have a firm capacity in multi-dry and single dry years of 90 percent of the total annual volume. American Canyon's total raw surface water supply through the NBA is thus 5,700 af (SWP water of 5,200 af plus 500 af "Permit" water).

American Canyon also has an agreement with Vallejo to purchase up to 628.6 acre-feet per year of potable water at a maximum-day capacity of one mgd. Additional maximum-day potable water capacity can be purchased in 0.1 mgd (62.86 afa) increments to a maximum of 5.1 mgd (3,206 afa). The raw water supply for this potable water could come from American Canyon supplies, or from Vallejo's supplies. Each year, American Canyon decides whether to allocate the previous year's potable water purchase to American Canyon's supplies or to Vallejo's supplies. A discount of $75 per acre-foot is applied to the cost of the potable water if American Canyon's raw water supply is used. Because the reliability of the Vallejo supplies were not investigated as part of this evaluation, the reliability of the potable water supply has been estimated to be the same as the SWP reliability.

Surface Water Summary

A summary of the surface water sources discussed above is presented in Table 14 and Table 15. The reliability of the Vallejo potable water supply to American Canyon is dependent on the source of raw water and the reliability of the Vallejo supplies. Currently the Vallejo raw water supplies are considered very reliable, so the capacity of the 630 af maximum is assumed to be firm. The reliability of the Permit water supply is not known at this time, but is understood to be a more reliable supply than SWP water, although Permit water has a lower priority in the NBA conveyance capacity than the SWP water does, as discussed above. Since the exact reliability is not known, the Permit water was assumed to have the same cutback as SWP water.

The reliable capacity of the local and imported water systems, which is the ability of the water system to supply water during a multiple-year drought condition, is shown in Table 14.

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Table 14. Reliable Capacity of Surface Water Supplies During Multiple Dry-Years, afa

Municipality (1)	Local Surface Water[a] (2)	Imported Surface Water[a] (3)	Total (4)
American Canyon	0	2,781[b]	2,781
Napa	11,120[e]	7,920	19,040
Yountville	500[c]	440	940
St. Helena	1,035	400[d]	1,435
Calistoga	380	770	1,150
Total	13,035	12,311	25,346

[a] Includes both SWP (Table 13) and other sources of imported water. Corresponds to an 85 percent exceedence for a multiple dry-year for SWP deliveries.
[b] Table 13 SWP delivery plus 90 percent of Vallejo Permit water and approximately 40 percent of the 628 afa potable Vallejo water supply.
[c] Based on August 2004 Yountville Water Supply Study update.
[d] This volume cannot be delivered until St. Helena acquires contractual conveyance capacity in the NBA system and is therefore not considered in the later TM comparison of supplies and demands.
[e] Supply available from both Lake Hennessey and Milliken Reservoirs.

The reliable capacity during a multiple-year drought is estimated to be slightly less than 26,000 af. The firm capacity of the local and imported water systems, which is the ability of all surface water sources to supply water during the critical dry year is approximately 12,700 afa as shown in Table 15.

Table 15. Firm Capacity of Surface Water Supplies (During Single Dry Year), afa

Municipality (1)	Local Surface Water (2)	Imported Surface Water[a] (3)	Total (4)
American Canyon	0	1,616[b]	1,616
Napa	5,400[e]	3,960	9,360
Yountville	125[c]	220	345
St. Helena	530	200[d]	730
Calistoga	110	385	495
Total	6,165	6,381	12,546

[a] Includes both SWP (Table 13) and other sources of imported water. Corresponds to a 100 percent exceedence for single dry-year SWP deliveries.
[b] Table 13 SWP delivery plus 90 percent of Vallejo Permit water and approximately 20 percent of the 628 afa potable Vallejo water supply.
[c] Based on August 2004 Yountville Water Supply Plan Update.
[d] This volume cannot be delivered until St. Helena acquires contractual capacity in the NBA system.
[e] Supply available from both Lake Hennessey and Milliken Reservoir.

Substituting recycled water to meet non-potable water demands can extend the effectiveness of surface water use. A brief discussion of the state of recycled water use is included below.

RECYCLED WATER SUPPLIES

Many of the municipalities initiated recycled water systems to avoid discharge to the Napa River during the restricted period of May 1 to October 31. Using recycled water reduces the size of effluent storage required to hold treated wastewater until the Napa River flows increase to the level where discharge to the river are permitted by the RWQCB.

Current and anticipated recycled water use is summarized in Table 16.

Much of the recycled water is used to irrigate areas that would not otherwise be irrigated (i.e. spray fields). This use constitutes a disposal of wastewater, as opposed to offsetting potable water use, and does not create additional supply. A small portion of the current recycled water use is used to offset potable water, raw surface water, or groundwater use by irrigating areas that would be irrigated regardless of the water source. These types of uses create additional supply by allowing the surface water and groundwater supplies to serve potable demands, instead of serving non-potable demands.

Table 16. Current and Planned Recycled Water Use, afa

Municipality (1)	Current Use (2)	Planned Future Production (3)	Total Projected Wastewater Flows (4)
American Canyon	107	858	2,800[b]
Napa/NSD	2,222	3,600 to 9,800[a]	3,600 to 9,800[a]
Yountville	200	200	675[c]
St. Helena	0	—[f]	1,232[d]
Calistoga	265	265	3,670[e]

[a] Based on information contained in NSD's Draft Recycled Water Master Plan, February 2005, by Larry Walker and Associates. The most likely alternatives deliver recycled water volumes ranging from 3,600 to 4,700 afa.
[b] Total of Main Basin (0.625 mgd) and North Basin (1.875 mgd) Discharge Permits per 2003 Recycled Water Facilities Plan.
[c] Based on 2001 average influent flow rate of 0.42 mgd (including Veterans' Home) projected using same growth rate as water projections.
[d] Based on 2003 Facility Plan for the Water Recycling Project, year 2025 average precipitation.
[e] Based on 1998 WWTP Master Plan, year 2040.
[f] Potential recycled water production quantity is currently being estimated.

The planned future treatment capacity, itemized in Column 3, does not necessarily replace potable water use. The fraction of the future production capacity delivered to offset potable water use depends on the recycled water storage, the delivery capacity, and the recycled water distribution system.

The total projected wastewater flows (Column 4) is a theoretical value that represents the projected volume of wastewater that would be available to offset potable water and groundwater use for non-potable demands, provided customers and infrastructure exist to store and deliver the total volume.

Each agency's current and projected recycled water use is described below.

American Canyon

American Canyon has recently completed construction of a new wastewater treatment plant that can treat approximately 2.6 mgd to tertiary recycled water standards. Phase I water deliveries began in late spring 2004 with deliveries to Green Island Vineyards and Hess Collection Wineries. Phase II is anticipated to be complete by the end of 2006 and will include City facilities, parks, agricultural users, and large landscaped areas in the City's distribution system.

According to the Recycled Water Facilities Plan by HydroScience Engineers, Inc., dated December 2003, engineering, administration, and legal work is scheduled to begin in 2004 with construction completed in 2009. The Plan did not detail which customers would be served at each annual milestone, but the project is intended to serve 80 customers at the completion of construction. The potential recycled water customers are using either potable water, or raw NBA water for irrigation. According to the American Canyon 2003 Recycled Water Facilities Plan, the use of recycled water will replace the use of potable and raw water, and is anticipated to save an estimated 1,000 af of potable water and 500 af of raw NBA water. More recent estimates by City staff suggest a 858 afa potable and raw water offset is more likely. The value 858 afa was used in this study.

Even though some potable water use is offset by the recycled water system, the primary purpose of the recycled water system is to dispose of wastewater, not to offset potable water use. As a result, no recycled water storage, other than a one million gallon operational storage tank, is anticipated. By not having significant recycled water storage, the recycled water must be used as it is produced. The water demand of those areas where the recycled water would be offsetting potable water or raw water is not sufficient in May or October to consume the anticipated volume of recycled water treated. Therefore, excess recycled water would be delivered to spray fields that would not normally receive potable or raw surface water. During the higher demand months of June through September, the production of recycled water would not meet the demand of those areas where recycled water would be offsetting potable or raw water use. Therefore, potable water or raw NBA water would be required to supplement the recycled water production.

By adding sufficient recycled water storage, excess treated wastewater could be delivered to storage during low demand periods in sufficient quantities to serve the peak demands of the irrigation areas currently using potable water or raw surface water. Storage of recycled water in sufficient quantities to serve peak non-potable demands would allow a greater volume of recycled water to offset potable water and raw water use. The offset water could then be used to serve demands that require potable water.

Potentially, with sufficient recycled water storage and distribution systems, the entire treated wastewater volume could be delivered to offset non-potable water demands currently met by potable water, raw surface water, or groundwater. The volume of storage and the capacity of the distribution system necessary for zero discharge were not discussed in the Recycled Water Facilities Plan.

Napa Sanitation District

Wastewater from Napa and surrounding unincorporated areas is treated and recycled at the Soscol Wastewater Treatment Plant (Soscol WWTP), owned and operated by the Napa Sanitation District (NSD). NSD is currently developing a Strategic Plan for Recycled Water Use. Although the plan will not be complete until later in 2005, preliminary data are available. Because the plan is not final, all preliminary data should be considered tentative.

In 2001, NSD treated approximately 9,343 af of wastewater and delivered approximately 2,222 af of recycled water for landscaping and/or agricultural irrigation to the following seven locations:

- Jamieson Canyon Ranch
- Somky Ranch
- Napa County Airport/Fagundos Ranch
- Giles Vineyard
- Chardonnay Golf Course
- Kohnan, Inc.
- Napa Corporate Office Park

In 2002, approximately 2,100 af were delivered to the same seven locations. Of that amount, approximately 800 af were replacing potable water landscape irrigation. The remaining water was applied to land that would not otherwise have been irrigated, as treated wastewater disposal.

NSD has recently completed a 24-inch diameter pipeline connecting to the Napa Municipal Golf Course at Kennedy Park. According to the preliminary data, the golf course is anticipated to consume approximately 60 million gallons per year (184 af) or more. Short-term future expansion of NSD’s recycled water distribution system includes delivering water to Napa State Hospital, with an expected recycled water demand of approximately 54 million gallons per year (165 af).

The Soscol WWTP has a capacity of 8.8 mgd to provide tertiary treated water. Wastewater is treated to tertiary standards from May 1 to October 1, when discharge to the Napa River is prohibited. One alternative under evaluation for the strategic plan is to eliminate discharge to the Napa River and deliver all treated wastewater to recycled water customers. Although the analysis is not complete, preliminary results suggest eliminating discharge would be prohibitively expensive without outside financial assistance.

It has not been determined what percentage of the future recycled water use would be offsetting potable water or groundwater use, but it appears that up to 3,000 af could be available for use, and are discussed further in a subsequent TM being prepared for this study. Approximately 166 afa of this amount (serving non-potable demands of Kennedy Memorial Park and the Napa Municipal Golf Course) have already been accounted for through a reduction in the potable water demand projections for the City of Napa.

Yountville

Yountville produces recycled water treated to advanced secondary standards at the Yountville Veterans Home Wastewater Treatment Plant, owned and operated by Yountville. Recycled water is delivered to four customers for vineyard and/or landscape irrigation:

- Chimney Rock (vineyard)
- Vintner's Golf Club
- Clos du Val (vineyard)
- Stag's Leap (vineyard)

The vineyards listed above also recycle their own treated wastewater for landscape irrigation. In 2002-2003, Yountville produced and delivered approximately 200 af of recycled water. All this water is used to irrigate areas that would be irrigated independent of the availability of recycled water. Thus the delivery of recycled water is reducing the amount of groundwater extracted.

Yountville has two small treated water flow-equalization ponds, but no long-term recycled water storage. Recycled water is delivered when discharge to the Napa River is prohibited. Yountville has no plans to expand its recycled water system at the present time.

St. Helena

The City of St. Helena is currently developing preliminary planning documents to evaluate a comprehensive recycled water system that could include upgrading the existing wastewater treatment plant, constructing recycled water storage, and installing transmission and distribution pipelines. While plans are still very preliminary at this time, St. Helena may be able to reduce its annual potable and non-potable water demands through the implementation of this program. If implemented, the recycled water program would be constructed over the next ten to fifteen years.

Calistoga

Calistoga provides tertiary treated recycled water to 14 entities, irrigating a total of 131 acres. Recycled water customers include a golf course, school irrigation, City park landscape irrigation, and commercial facility landscape irrigation at motels, an apartment complex, and a water bottling plant. Although the water meets tertiary standards, a high level of boron reduces the irrigation usefulness of the recycled water to irrigating turf grass and pasture. There is very little, if any, boron in the potable water system. It is believed the boron originates from the geothermal wells that local spas use and discharge into the City sewer system. The City is currently working with the local spas to decrease the amount of geothermal well water discharged into the sewer system.

At this time, approximately half of the recycled water delivered to users is replacing potable water use, the other half is delivered to fields which otherwise would not be irrigated. The total estimated water demand of the 14 recycled water recipients that is replaced with this reuse program is 265 acre-feet per year. This value is accounted for in the Calistoga potable water demand projections summarized in TM 2.

The City would like to increase the amount of recycled water delivered, but there are no current plans to expand the recycled water delivery system.

GROUNDWATER SUPPLIES

Some of the Napa Valley municipalities are using, or are planning to use, the main groundwater basin to supplement existing water supplies. A brief summary of each municipality's historical and immediate future groundwater use situation is described below.

Napa

Napa currently does not have any groundwater production capacity, nor does the City have any immediate plans to install water supply wells. The 1997 Water System Optimization and Master Plan recommended the City develop a groundwater conjunctive use project that recharges local groundwater in the Milliken and Conn Creek areas, using excess surface water available from these two sources in wet and normal years, and then extracting this previously stored groundwater in the years of supply deficiency. To date, Napa has not implemented these suggestions.

American Canyon

American Canyon does not currently have any groundwater production capacity nor does the City have any immediate plans to install water supply wells.

Yountville

Although Yountville does not currently have any groundwater production capacity, the Town is planning to construct a well to provide supplemental water supplies in years when SWP water and Rector Reservoir water supplies are cut back. The estimated extraction quantity during a single dry year water supply condition is approximately 300 af.

St. Helena

According to the 2003 Urban Water Management Plan, St. Helena currently has two active groundwater wells: Stonebridge Well No. 1 was placed into service in 1992 and Stonebridge Well No. 2 was placed into service in 1996. Both of these wells are near the Napa River, south of Pope Street in the northeastern part of St. Helena. Current production capacities for Well No.1 and Well No. 2 are 245 gallons per minute (gpm) and 350 gpm, respectively. These groundwater supplies are treated to remove iron and manganese and are chlorinated prior to entering St. Helena's distribution system. St. Helena generally only operates one well at a time and has an extensive groundwater monitoring program to monitor groundwater levels in the local area. St. Helena's current policy is to utilize local groundwater supplies to meet about 20 percent of the annual water demand. This groundwater usage percentage can be increased to 30 percent under Phase II of St. Helena's Water Shortage Contingency Plan. St. Helena's historic groundwater production has averaged approximately 340 afa.

St. Helena also owns three wells located in the vicinity of the wastewater treatment plant. The well located closest to the wastewater treatment plant is used to supply the non-potable water needs at the wastewater treatment plant. The other two wells had been used many years ago for irrigation purposes; however, these two wells are not currently used.

During the 1977 drought, several private wells (including the Pope Park, Spring Street, Bartolucci, and Van Asperen wells) were temporarily connected to the City's distribution system to provide emergency supplies during this critical water shortage period.

Calistoga

Calistoga removed its Feige Canyon water supply wells from production in 1998 due to declining production and water quality concerns. The August 2000 Water Facilities Plan discussed opportunities for Calistoga to install groundwater production capacity, but the City does not have any immediate plans to install groundwater production capacity.

Groundwater Supply Summary

A summary of the existing and immediate future groundwater capacity for the Napa Valley municipalities is presented in Table 17.

Table 17 Estimated and Projected Groundwater Production Capacity, afa

Municipality (1)	Current (2)	2020 (3)	2050 (4)
Napa	—	—	—
American Canyon	—	—	—
Yountville	—	300	300
St. Helena	340[a]	340	340
Calistoga	—	—	—
Total	340	640	640

[a] Average annual yield of Stonebridge Wells from 1991 through 2000.

Additional supplemental groundwater production and/or emergency supply capability for use in the incorporated areas may be recommended in future TMs as a result of this Study and subsequent analysis.

GSN/JPC:ajb