Water Supplier Reliability Certification
Supporting Analysis and Calculations
June 2016

TOTAL POTABLE WATER DEMAND

The City of Napa Water Division (http://www.cityofnapa.org/water) operates and maintains the municipal water system serving a population of more than 86,000 in the City limits and adjacent areas. The system is fully metered and customers are billed by volume of use. Residential use is predominant, at about 65% of average annual demand. Commercial, institutional, and dedicated irrigation uses represent the bulk of the rest. Six-hundred (600) acre-feet (AF) are also used by the City of St. Helena under Water Supply Agreement No. 9381 between the two cities. Because it is a contractual obligation, this St. Helena usage is counted in City of Napa total potable water production. The cities of American Canyon and Calistoga also receive some water deliveries from the City of Napa; however, these are their own contractual entitlements from the State Water Project. The City simply treats their water at its Edward I. Barwick Jamieson Canyon Water Treatment Plant (WTP) and wheels it to them. These volumes are excluded from City of Napa total potable water production and they do not impact our water supply reliability.

Production meters record daily volumes entering the distribution system from our three treatment plants, Jamieson Canyon WTP, Hennessey WTP, and Milliken WTP. Operations are supported by a Supervisory Control and Data Acquisition (SCADA) system. Daily and monthly data are tabulated in Excel worksheets for simple analysis and reporting. American Canyon and Calistoga meters are read monthly, with consumption data transferred to the worksheets, enabling simple subtraction to calculate true City of Napa total potable water production.

Production volumes (AF) are shown in the tables below for calendar years 2013 and 2014. 2013 production was heavily influenced by high irrigation demands during the driest calendar year in modern history. After December 2012 there were no major precipitation events until February 2014. 2014 production was influenced by the Governor's initial declaration of a statewide Drought State of Emergency, and the subsequent voluntary conservation efforts and water waste prohibitions that emanated from it. The South Napa Earthquake in August 2014 also had a short term upward effect on demand, as more than 200 water main breaks resulted in hundreds of acre-feet of losses.

CALENDAR YEAR 2013

All volumes in Acre-Feet (AF)	Water Treatment Plant			Total Production	American Canyon + Calistoga Treat & Wheel	**City of Napa Total Production**
	Jamieson Canyon	Hennessey	Milliken			
JAN	735.98	5.83	0.00	741.81	(34.27)	707.54
FEB	713.00	0.00	0.00	713.00	(12.26)	700.74
MAR	313.00	793.93	0.00	1,106.93	(101.68)	1,005.25
APR	985.00	284.70	0.00	1,269.70	(87.70)	1,182.00
MAY	1,391.00	420.99	0.00	1,811.99	(127.91)	1,684.08
JUN	1,179.00	607.85	0.00	1,786.85	(110.90)	1,675.95
JUL	550.00	1,344.17	0.00	1,894.17	(134.55)	1,759.62
AUG	517.00	1,286.29	44.75	1,848.04	(122.99)	1,725.05
SEP	343.00	1,154.34	167.67	1,665.00	(121.81)	1,543.19
OCT	743.01	749.18	0.00	1,492.19	(129.10)	1,363.09
NOV	1,005.00	144.92	0.00	1,149.92	(50.01)	1,099.91
DEC	999.00	0.00	0.00	999.00	(79.78)	919.22
TOTAL	9,473.98	6,792.19	212.42	16,478.59	(1,112.96)	**15,365.63**

CALENDAR YEAR 2014

All volumes in Acre-Feet (AF)	Water Treatment Plant			Total Production	American Canyon + Calistoga Treat & Wheel	**City of Napa Total Production**
	Jamieson Canyon	Hennessey	Milliken			
JAN	1,103.00	43.67	0.00	1,146.67	(55.74)	1,090.93
FEB	392.97	335.66	0.00	728.63	(36.92)	691.71
MAR	655.00	217.63	0.00	872.63	(73.60)	799.03
APR	917.29	33.10	0.00	950.39	(46.72)	903.67
MAY	1,291.69	0.00	104.70	1,396.39	(63.31)	1,333.08
JUN	1,472.45	31.99	172.65	1,677.09	(113.86)	1,563.23
JUL	1,364.12	217.30	203.34	1,784.76	(167.09)	1,617.67
AUG	1,242.00	392.46	84.31	1,718.77	(122.49)	1,596.28
SEP	785.64	620.27	0.00	1,405.90	(44.28)	1,361.62
OCT	1,079.33	225.58	0.00	1,304.91	(46.83)	1,258.08
NOV	540.43	361.94	0.00	902.37	(24.46)	877.91
DEC	459.72	321.95	0.00	781.67	(66.72)	714.95
TOTAL	11,303.64	2,801.55	564.99	14,670.18	(862.02)	**13,808.16**

Average annual City of Napa total potable water production was **14,586.90 AF** for these two years. This is the total annual demand applied to the water supply reliability scenarios detailed below for Water Years 2017, 2018, and 2019.

TOTAL POTABLE WATER SUPPLY

The City of Napa meets its demands by supplying water from three surface water sources:

- State Water Project (SWP)
- Lake Hennessey
- Milliken Reservoir

State Water Project (SWP)

The City of Napa subcontracts with the Napa County Flood Control and Water Conservation District (NCFCWCD) for imported surface water from the SWP. Operated by the California Department of Water Resources (DWR), the SWP diverts water from the Sacramento-San Joaquin Delta via the North Bay Aqueduct (NBA) to two 5 million gallon raw water storage tanks located at the City's Jamieson Canyon WTP. While some of the SWP water represents entitlements for the cities of Calistoga and American Canyon, the majority is for the City of Napa. Under the DWR-NCFCWCD contract, the City's SWP supplies come in the following forms:

Table A – This is the basic contractual annual entitlement, currently **21,900 AF**. Actual deliveries are determined by DWR depending on each year's hydrologic conditions. A full 100% allocation of this amount would only be available during very wet years. Contractors are officially notified of changes to their Table A allocation via DWR's State Water Project Analysis Office. Actual Table A deliveries in any given year are now bolstered by the 2013 "Area of Origin" settlement which entitles the City to a 'North of Delta' allocation, typically 5% to 25% higher than the standard Table A allocation. In 2016 for example, the City of Napa's approved allocation is 75% of its Table A entitlement, with contractors south of the Delta receiving just 60%. The 2013 settlement also provides for an Advanced Table A program, essentially a water credit account that can be accessed in extreme situations.

Carryover – This is SWP water from a previous year's Table A entitlement that was allocated and approved for delivery, but was not used by the end of the year. Carryover water is stored in San Luis Reservoir, subject to space being available, for use in the following year. The City of Napa typically maintains a running balance of carryover water and uses that water strategically in the following year.

Article 21 – This is an interruptible surplus SWP supply available when the Delta is in 'excess' flow conditions, typically during winter months. It does not impact Table A or carryover supplies. The City uses an annual delivery schedule that maximizes use of Article 21 water.

This Water Supply Reliability "Stress Test" estimates supplies available for the next three Water Years (WY 2017, WY 2018, WY 2019) assuming precipitation mirrors WY 2013, WY 2014, and WY 2015, and demands are the average of calendar years 2013 and 2014. For City of Napa SWP supplies, the following assumptions ensure that the scenario is conservative:

- Starting conditions on October 1, 2016 reflect the current availability of carryover, the 75% Table A allocation for Calendar Year 2016, and low WY 2016 demand based on production through May 2016 and the lingering impact of drought regulations.
- DWR provides the same Table A allocations for Calendar Years 2017, 2018, and 2019 as they did for 2013 (**35%**), 2014 (**5%**), and 2015 (**25%**). No additional 'North of Delta' allocation is assumed beyond what was granted in those three years.
- Water Year Table A Available Supply is a prorated amount across the two affected calendar years. For example, WY 2017 is based on 3 months (25% of year) at 75% allocation plus 9 months (75% of year) at 35% allocation. Allocation percentage is multiplied by the City of Napa's contractual entitlement of 21,900 AF to calculate available supply.
- No Article 21 water is used.
- Advanced Table A program is not accessed.

STATE WATER PROJECT SUPPLY SCENARIO

All volumes in Acre-Feet (AF)	**Table A**	**Carryover**	**Total SWP**
WY 2016 Available Supply	*13,688*	*3,800*	*17,488*
Estimated WY 2016 Usage	*8,000*	*0*	*8,000*
WY 2017 Available Supply	**9,855**	**9,488**	**19,343**
Estimated WY 2017 Usage	7,000	2,000	9,000
WY 2018 Available Supply	**2,738**	**10,343**	**13,080**
Estimated WY 2018 Usage	2,738	5,262	8,000
WY 2019 Available Supply	**4,380**	**5,080**	**9,460**
Estimated WY 2019 Usage	4,380	2,620	7,000
Remaining Carryover		*2,460*	

Under this conservative scenario, the City of Napa gradually shifts some production away from the SWP and onto its local reservoirs, with SWP usage decreasing from 9,000 AF in WY 2017 to 7,000 AF in WY 2019. This enables the City to retain 2,460 AF in SWP carryover entering WY 2020 without significantly drawing down its reservoirs, as shown below.

Lake Hennessey

Lake Hennessey is the major local water source for the City of Napa system. Located approximately 13 miles north of the City, Lake Hennessey was formed in 1946 with the construction of Conn Dam, allowing storage of water from Conn Creek, an upvalley tributary of the Napa River. The City's right to appropriate Lake Hennessey water for municipal use is secured through a license with the State Water Resources Control Board (SWRCB), Division of Water Rights. The lake's tributary watershed area is about 35,000 acres and its storage capacity is **31,000 AF**, the static volume of the reservoir at its spillway elevation of 315 feet.

Raw water from the lake is pumped up to the Hennessey WTP, which has a treatment capacity of 20 million gallons per day (MGD). Based on the *2050 Napa Valley Water Resources Study*, Lake Hennessey's firm yield was determined to be 5,000 AF per year.

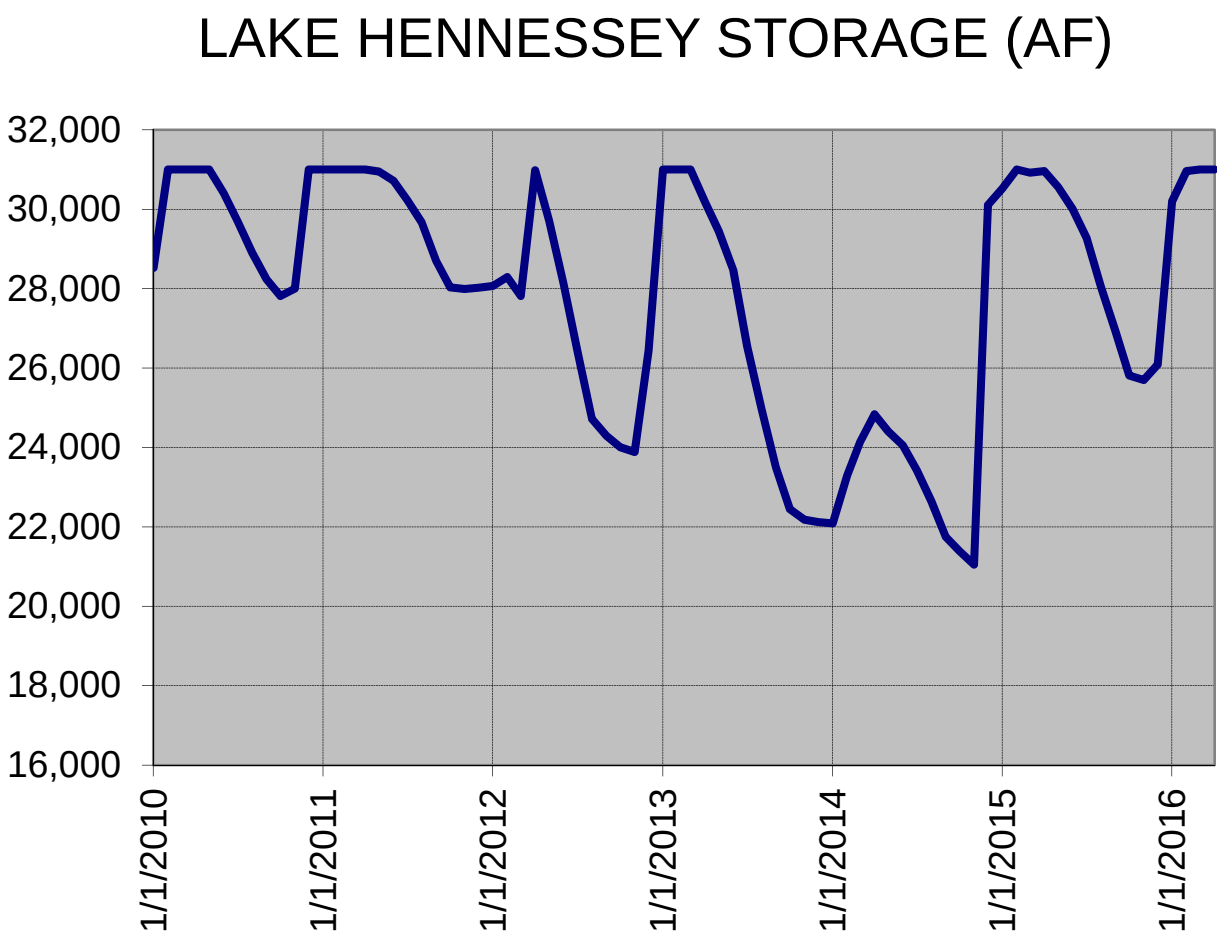
Lake elevation readings and rainfall totals are tracked routinely in Excel worksheets. Data are also available publicly on the Napa OneRain web site. The following rainfall totals were recorded at Lake Hennessey for the key water years used in this supply reliability analysis:

WY 2013 = 26.54 inches (nearly 20 inches fell in November-December 2012)

WY 2014 = 16.84 inches

WY 2015 = 25.07 inches

On October 1, 2012, Lake Hennessey began WY 2013 at 306.10 feet of elevation, holding 24,240 AF (78% of capacity). Over the next three years of drought, the lake exhibited the following storage patterns:



Sufficient inflow had the lake fill and spill, reaching its storage capacity of 31,000 AF, in all recent water years except for WY 2014. Starting conditions on October 1, 2016 are projected to be better than they were in 2012, with the lake elevation at least 309 feet, holding 26,231 AF (84.6% of capacity). The "Stress Test" scenario below is very conservative in that it assumes winter recharge amounts for WY 2017, WY 2018, and WY 2019 equal the exact amounts portrayed in the chart above for WY 2013, WY 2014, and WY 2015, ignoring the excess that spilled and might have contributed to storage in a more depleted lake situation. Evaporation/Other losses are derived from actual WY 2013 through WY 2015 analyses. Another stressor is that WY 2018 and WY 2019 assume greater WTP production usage than occurred in WY 2014 and WY 2015.

LAKE HENNESSEY SUPPLY SCENARIO

Lake Hennessey	**Lake Elevation**	**Storage (AF)**	**% of Capacity**
WY 2016 End	*309 feet*	*26,231*	*85%*
WY 2017 Net Recharge Potential		*7,114*	
WY 2017 Available Supply	**315 feet**	**31,000**	**100%**
Estimated WY 2017 Usage for WTP Production		5,200	
Estimated WY 2017 Evaporation/Other Loss		2,409	
WY 2017 End	304.9 feet	23,391	75%
WY 2018 Net Recharge Potential		2,748	
WY 2018 Available Supply	**308.9 feet**	**26,139**	**84%**
Estimated WY 2018 Usage for WTP Production		6,200	
Estimated WY 2018 Evaporation/Other Loss		1,824	
WY 2018 End	296.4 feet	18,115	58%
WY 2019 Net Recharge Potential		9,953	
WY 2019 Available Supply	**311.4 feet**	**28,068**	**91%**
Estimated WY 2019 Usage for WTP Production		7,200	
Estimated WY 2019 Evaporation/Other Loss		1,613	
WY 2019 End		*19,255*	*62%*

Even under these conservative assumptions, Lake Hennessey would begin WY 2020 at 62% of capacity, holding 19,255 AF prior to the winter recharge.

Milliken Reservoir

The City of Napa began offering water service in 1923 following purchase of the privately-owned Municipal Water Works. This purchase coincided with the construction of Milliken Dam, which stores water from Milliken Creek, a tributary of the Napa River. Located approximately 5 miles northeast of the City, Milliken Reservoir is currently a secondary source of supply used only in the high-demand summer months when turbidity levels in the reservoir can be effectively treated at the 4.0 MGD Milliken WTP, a direct filtration plant. As with Lake Hennessey, the City's rights to Milliken Reservoir are secured through a license with the SWRCB.

The Milliken watershed covers an area of roughly 6,000 acres. The storage capacity of Milliken Reservoir is limited to **1,390 AF** due to seismic stability concerns by the State Division of Safety of Dams (DSOD) that necessitated the boring of five holes which lowered the spillway elevation to 907 feet (was previously 923 feet). Its firm yield is 400 AF per year.

Lake elevation readings and rainfall totals are tracked routinely in Excel worksheets. Data are also available publicly on the Napa OneRain web site. The following rainfall totals were recorded at Milliken for the key water years used in this supply reliability analysis:

WY 2013 = 29.54 inches (more than 20 inches fell in November-December 2012)

WY 2014 = 24.58 inches

WY 2015 = 27.20 inches

Located in a narrow canyon, Milliken Reservoir consistently fills quickly to 907 feet elevation each winter, storing its full capacity of 1,390 AF, even during the recent drought years WY 2013, WY 2014, and WY2015. With its seismic and treatment plant process limitations however, the reservoir's **maximum yield is defined at 700 AF** per year, as first documented in the *2050 Napa Valley Water Resources Study*. With an assumed 386.90 AF produced at Milliken WTP each of the next three water years, the "Stress Test" remains quite simple for this source:

MILLIKEN RESERVOIR SUPPLY SCENARIO

Milliken Reservoir	**Lake Elevation**	**Storage (AF)**	**Maximum Yield (AF)**
WY 2017 Status	907 feet	1,390	
WY 2017 Available Supply			**700**
WY 2018 Status	907 feet	1,390	
WY 2018 Available Supply			**700**
WY 2019 Status	907 feet	1,390	
WY 2019 Available Supply			**700**

Combining the scenarios for the three sources shows that total supplies available for WY 2019 are estimated at 38,228 AF, dwarfing the assumed annual demand of 14,586.90 AF. No supply shortfall would occur at the end of WY 2019.

TOTAL SUPPLY SCENARIO

All volumes in Acre-Feet (AF)	**State Water Project**	**Lake Hennessey**	**Milliken Reservoir**	**TOTAL**
WY 2017 Available Supply	19,343	31,000	700	**51,043**
WY 2018 Available Supply	13,080	26,139	700	**39,919**
WY 2019 Available Supply	9,460	28,068	700	**38,228**