La Mesa Water Cooperative

Water Supply Plan

December 21, 2015

Planning Committee:
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Final (2015)

- Add Mission Statement

Draft 5 – Changes from Draft 4

- In Well #3 Requirements, add reference to New Mexico Construction Industries Division
- In Well #3 Requirements, item 10, change “for as long as a month” to “periodically”

Draft 4 – Changes from Draft 3

- Updated Executive Summary to note wells 2 and 3 are on standby.
- Updated Table 1, Wells
- Minor editorial updates to reflect Marty’s comments
- Projected demand – corrected to say that we’re ok out to 2025
- Update Well #3 Requirements
    - Include county and HOAs
    - Explicitly list ferric chloride
    - Moved pH adjustment and backwash from automatic to “Operator intervention”
    - Change restart time to two days
    - Reworded pressure requirement
    - 20 year lifetime
- Added reference to NMED “Recommended Standards for Water Facilities”

Draft 3 – Changes from Draft 2

- Added Executive Summary
- Updated well data and added well figure
- Updated Demand by house to reflect projected 2016 usage
- Added Trend section
- Updated Forecasts to reflect #6 estimated decline
- Updated Requirements

Draft 2 – Changes from Draft 1

- Added Tanks and Distribution section
- Added Yearly Demand
- Updated Demand & Capacity forecast
    - Show low, mid, and high demand estimates
    - Show wells 5 & 6 in use indefinitely
- Added Annual Gallons Pumped forecast
- Added calculation of estimated acre feet and compare to water rights
- Added forecast with well #3 treatment
    - In operation by 6/2018
    - Load balance
- Updated Well 3 Treatment requirements
    - Added yearly treatment volume estimates
    - Added requirement to normally run without operator present
    - Added requirement to shut down for a month and restart in four hour (my guesses)
    - Added pressure: 120 PSI
- Minor editorial changes.

Mission Statement

To provide a safe, reliable, long-lasting water supply to Members.

Executive Summary

This is the continuation of Supply Plan documents prepared by the Coop every several years. It provides a detailed review of current demand and capacity, and a forecast out twenty five years. Current capacity is ample to meet current demand. A slightly pessimistic forecast of demand indicates that we will need a new source as soon as 2025. Of more immediate concern is the fact that by operating on two wells (#5 and #6), there is not sufficient capacity to meet demand if one of those is out of service in the summer. Wells #2 and #3 are kept on standby, and are not used. Well #2 has low capacity and has exceeded the allowable arsenic level. Well #3 has plenty of capacity, but has not been used since 2008 because water from it exceeds the current level for arsenic. The recommendation is to build an arsenic treatment plant for well #3 and put it into regular operation. This would provide the needed redundancy and excess capacity out to 2040.

Background and Current Situation

Wells

As of August 2015, the Coop has two wells in operation, and two wells available but not used because arsenic levels exceed current standards (10 parts per billion, ppb), as shown in Table 1.

	Well #2	**Well #3**	**Well #5**	**Well #6**
Capacity	15 gpm	60 gpm	102 gpm	59 gpm
Status	Inactive since 9/11/2013	Inactive since 3/1/2008	Active	Active
Began Service	1992	1998	4/1/2007	5/1/2013
Capacity Loss	3% per year	0.1% per year	0.4% per year	0.5% per year?
Arsenic Level	21 ppb (8/2013)	23 ppb (11/2014)	7 ppb (3/2015)	8 – 18 ppb (7/2015)
Well Depth		700 feet	771 feet	965 feet
Static Level (from top of casing to water surface when not pumping)		240 feet 5/30/2012	307 feet (9/9/2015)	433 feet (?/2015)
Pumping Level		260 feet	345 feet	486 feet
Water Depth (from bottom of well to water surface when not pumping)		460 feet	464 feet	575 feet
Usable Water (assume pump and motor 100 feet above bottom)		360 feet	364 feet	475 feet
Annual decline in static level		< 1 foot / year	6 feet / year	15 feet / year
Screen	Carbon steel	Carbon steel	Stainless steel	Stainless steel
PNM Power	240 V 1-phase	240 V 1-phase	240 V 1-phase	240 V 3-phase
Motor	240 V 1-phase	240 V 3-phase	480 V 3-phase	240 V 3-phase
Estimated Lifetime	zero	25-30 years from 1998	30 years from 2007	30 years from 2013
Lifetime limiting factor	Arsenic level	Casing	Water table?	Water table?

Table 1 – La Mesa Water Coop Wells

Notes on wells:

- Water levels are measured several times each year. Summer measurements are shown here.
- Well #1 was replaced by #6 in 2013.
- Well #2 arsenic level was less than 10 ppb up to 2012.
- Well #3 can provide 150 gpm with a new pump and motor.
- Well #4 was abandoned during development.
- Well #6 arsenic level seems to vary, with the level increasing the longer the well is pumped. Testing of an Isolux adsorption system began June 2015. Treating about half of the water at 18 ppb results in blended water with 8.1 ppb arsenic.
- Well #6 capacity loss is based on just two years of operation, and while the arsenic treatment system is being tested.

Figure 1 shows the configuration of wells 3, 5, and 6.

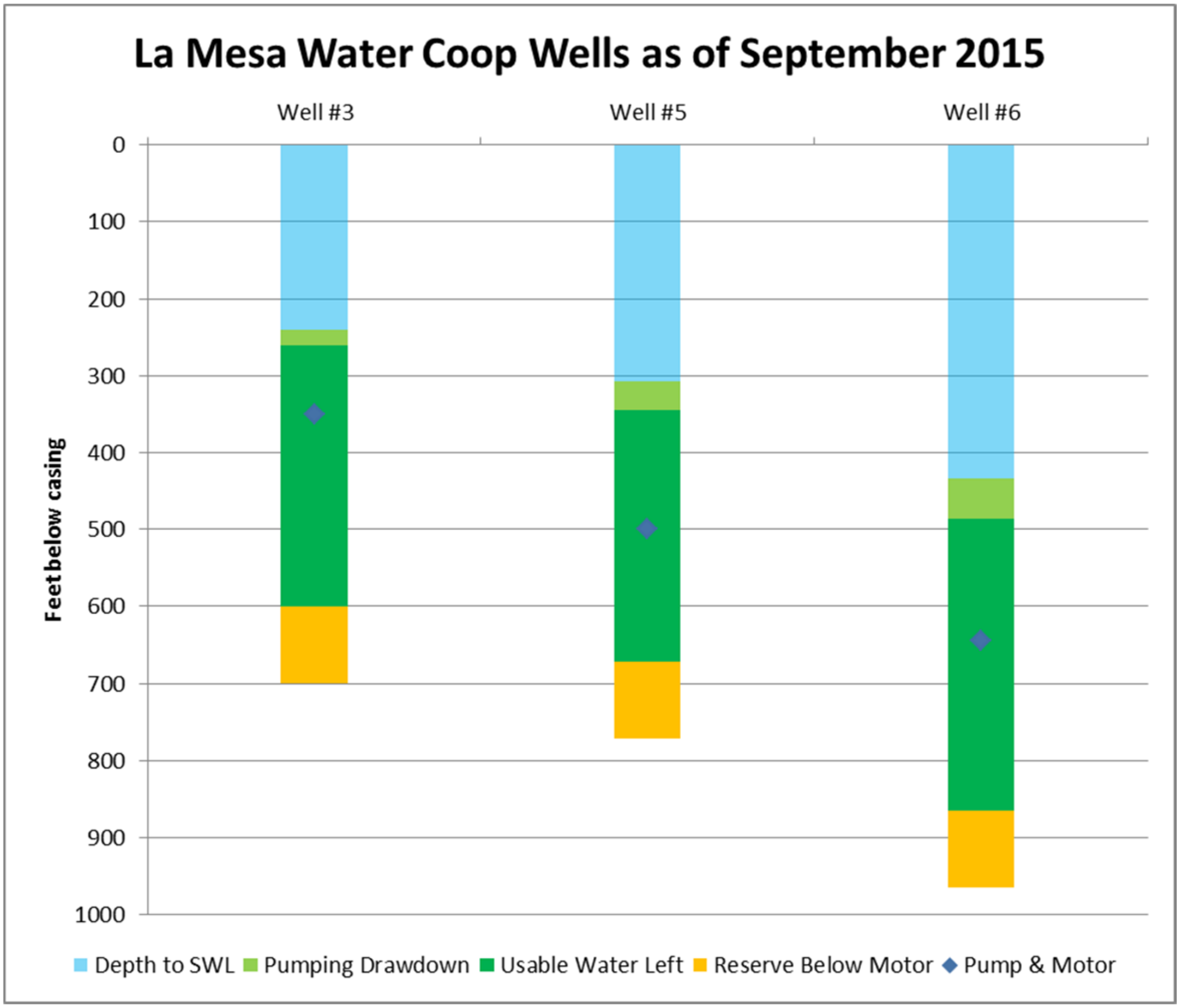


Figure 1 – La Mesa Coop Wells

A study [Johnson] done on Placitas water has our water about 10,000 years old. Given that and the depth of our wells, there is virtually no recharge from the surface and therefore there is only a very loose connection between year-to-year weather, which drives surface runoff and shallow groundwater, and our water supply. That is, the current drought has little or no influence on our water supply. Once pumped out of the ground, that water is gone, and will not be replenished in our lifetimes. The drought probably has an effect on demand, but it is not clear which direction. Are people going to water more because of less rain and snow? Or will people remove (or not replace) high water using landscaping, such as lawns and trees? The Static Water Level (SWL) is lowest in the summer, and rises each winter, indicating some form of recharge, or at least flow toward the well from a wider area. The SWL measurements of wells 1, 2, 5, and 6 all show a decline from year to year; see Table 1, above. After well #3 had been used for about ten years, the SWL showed minimal decline.

Tanks and Distribution System

The Coop has two water tanks on Camino Barranca for short term storage and fire protection. The tanks, wells, and all houses are connected to a single, simple distribution system. The wells and tanks are said to "float", in that water pumped out of each well goes first to the closest houses, and the excess eventually goes into the tanks. There are not any lines that go directly from a well to the tanks. Well pumps are controlled based on tank level.

- The tanks together store about 21,000 gallons per foot, and we keep them filled between 11.5' and 12.5'.
- If neither well is operational in the summer, we only have one to two days of stored water before the level drops to the minimum needed for fire protection (5').

Both tanks were refurbished and recoated, inside and out, in September and October 2015.

Most houses are located below the water tanks, so are gravity fed. There are 43 houses served by a pressure booster system, which consists of six pressure tanks and two booster pumps, all located in the building at the tank site.

Demand and Historical Measurements

There are several sources of data to show how much water is pumped and billed:

- Well meter readings are recorded for each well, each month (usually the 1st or 2nd day); data goes back to 9/1/1998. This is fairly accurate data, but does not show usage within a month.
- Billing data for each house for each month; data goes back to 1/31/2010.
- Surveillance data, collected through a system from Mission Communications, includes tank level, booster system pressure, and flow rate into and out of the tanks. This data is normally reported every two minutes, and is available back to 12/2013. This data is fairly noisy for a number of reasons, is moderately accurate, but allows for usage analysis by hour and day. We also have Telog surveillance data from 2001 through 2013; that data was not used in this study.

Long Term Demand

From the monthly well meter readings, Figure 2 shows the gallons pumped and the gallons sold, by month, for the past several years.

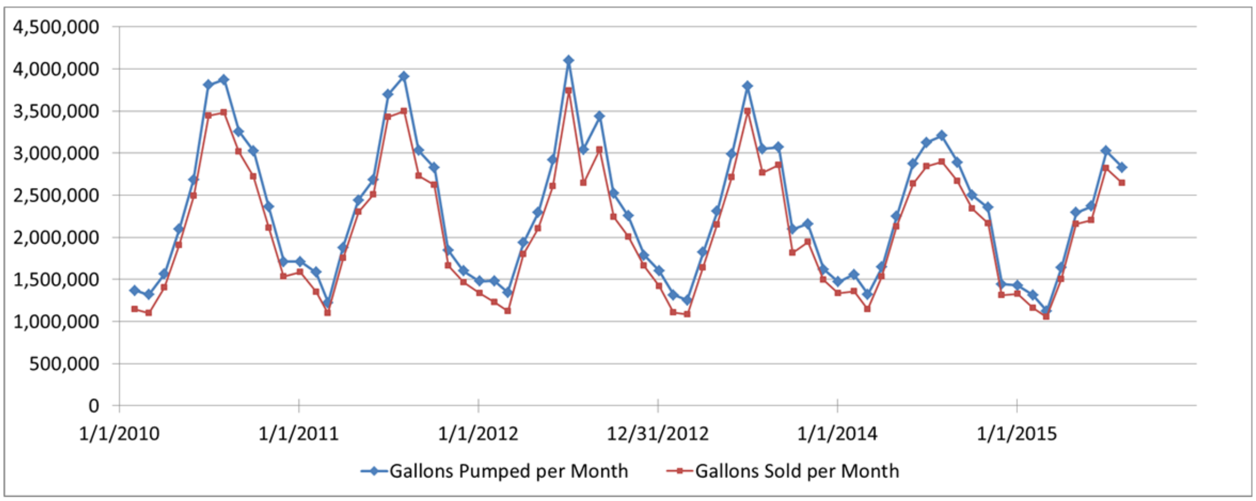


Figure 2 – Gallons Pumped and Sold

Several observations from this chart:

- There is a large seasonal variation; summer use is two to three times winter use.
- The difference between pumped and sold ("unaccounted for water" and other unbilled uses, such as hydrant flushing) is relatively constant over this time.
- From 2012 through 2015, use in the peak summer month has been declining, while winter use has stayed relatively constant. (From 2010 to 2015, the number of houses served went from 320 to 326.)

Also from the well meter readings, Figure 3 shows the "demand" and various well capacities, expressed in Gallons Per Minute (GPM). The average demand is calculated by dividing the total gallons pumped in a month by the number of days in the month, divided by 1,440 (minutes per day), multiplied by the assumed 60% duty cycle.

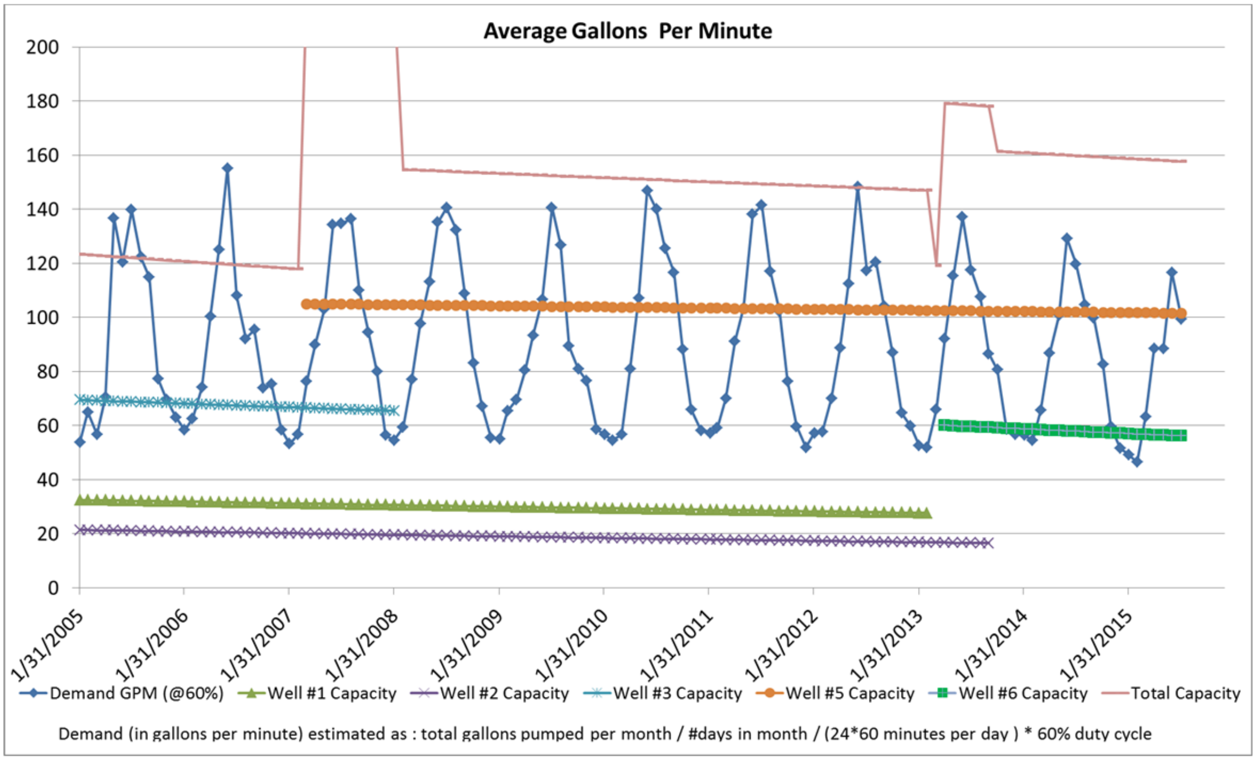


Figure 3 – Demand and Well GPM

Several observations from this chart:

- The 60% assumed duty cycle provides significant buffer for short term fluctuations.
- Since 2007, total capacity has comfortably exceeded demand, except for June 2012.
- Both wells 5 and 6 are required to provide sufficient capacity in the summer (May through August). Well 5 alone provides sufficient capacity for the other eight months. Well 6 by itself provides sufficient capacity only for three months (December, January, February).
- Note the spike in capacity when wells 1, 2, 3, and 5 were all running in 2007.

Since the Coop does not have long term storage, such as a reservoir, that would allow us to spread the summer and winter demand, we must plan capacity to meet the peak summer demand. The gallons pumped per house per day during the peak month each year is shown in Table 2 and Figure 4.

DATE	Gallons Per House Per Day		
6/28/2001	537		
6/29/2002	405		
7/31/2003	448		
6/28/2004	394		
7/31/2005	406		
7/1/2006	434		
9/4/2007	372		
8/1/2008	381		
8/3/2009	376		
7/1/2010	394		
8/3/2011	381		
7/3/2012	399		
7/2/2013	364		
7/1/2014	342		
7/1/2015	307		
With 2001		**Without 2001**	
Average	396	Average	386
Std Dev	52	Std Dev	35
"1 in 10 year"[1]	462	"1 in 10 year"	431
Min	307	Min	307
Max	537	Max	448

Table 2 – Peak Demand Months

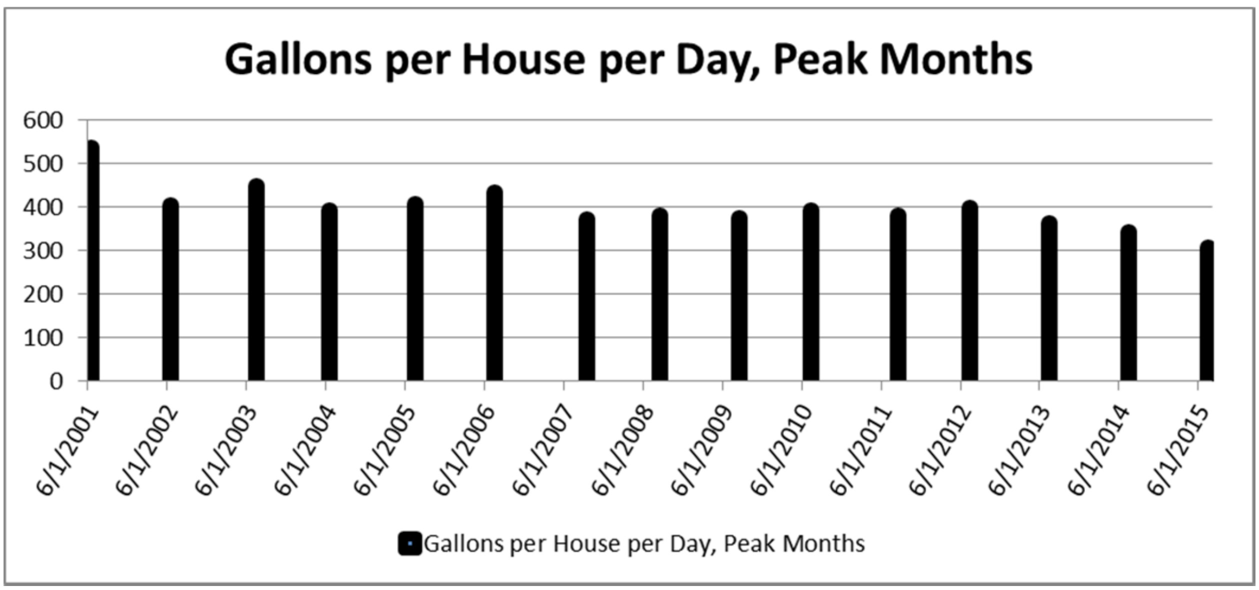


Figure 4 – Peak Months, Gallons per House per Day

[1] The "One in ten year" concept appears in the 2007 Water Use Analysis, and for several years after that. It is based on the assumptions that the yearly fluctuations are random, and follow a "normal" distribution, so that 90% of the observations will be less than the average plus 1.28 standard deviations. With 15 years of data, it is easy to pick out the high year ("one in fifteen"), without using the average and standard deviation.

Observations on this data and chart:

- The dates reflect when the well meters were read, so usage is actually for the preceding month.
- For unknown reasons, 2001 was exceptionally high.
- Excluding the 2001 measurement, the peak for each year has been around 400 gallons per house per day.
- The downward trend, beginning in 2012 for the past four years is more apparent.

Demand Distribution by House

To assist the 2014 and 2015 Rate Committees, historical billing data was used to produce a forecast of demand by month by house. One way of summarizing that is shown in Figure 5. This shows, for each month, the number of gallons expected to be used for different percentiles. For example, in January, 10% of our members are expected to use less than 1,200 gallons. And in June, 90% will use 15,000 gallons or less, but one or two houses are expected to use slightly over 30,000 gallons in August and September.

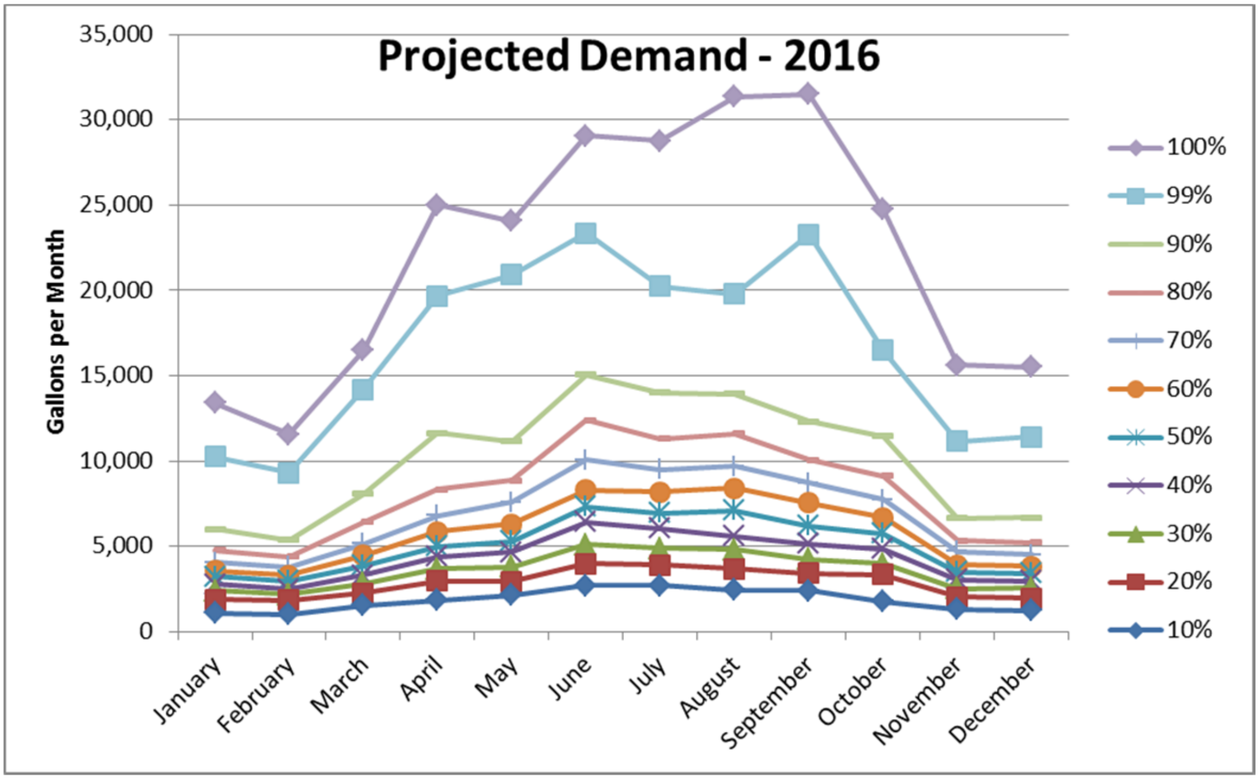


Figure 5 – Gallons per House per Month, by Percentile

Observation on this chart:

- The overall pattern of summer demand being about twice winter is consistent when looked at by house.
- In the summer, fewer than 10% of the houses account for disproportionate share of demand – up to twice what 90% of houses use.

A more conventional histogram, showing the frequency of different levels of water use, is shown in Figure 6.

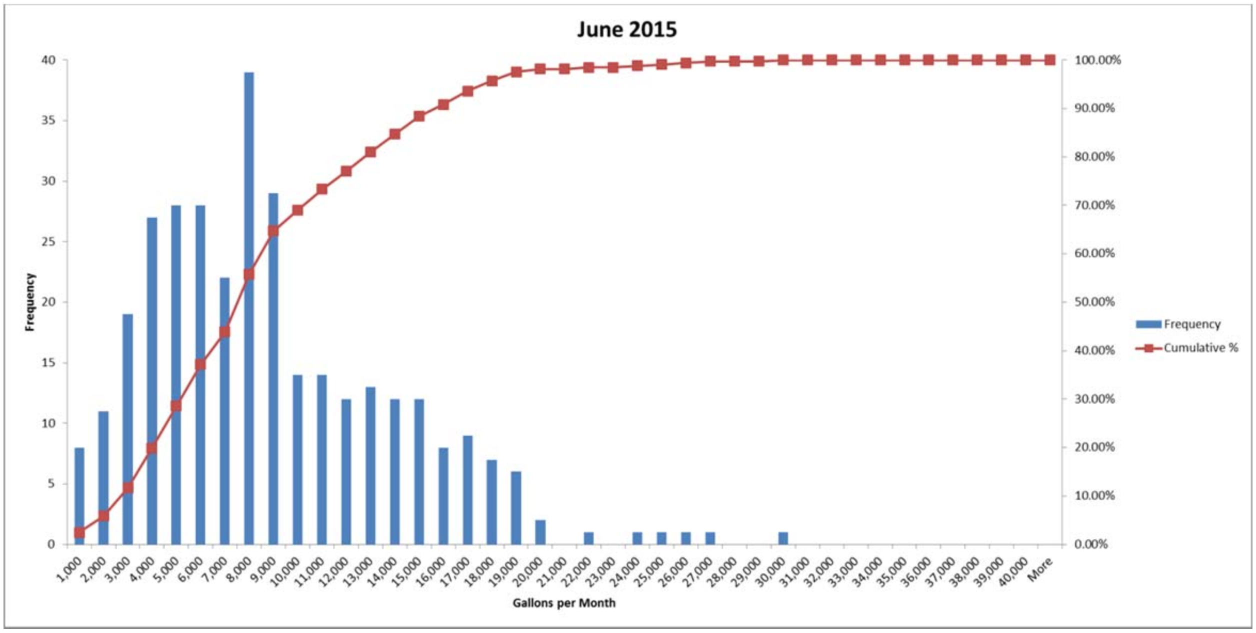


Figure 6 – Histogram of Water Demand

Observations from this chart:

- Most (95%) of the houses use less than 18,000 gallons in a peak month, and 70% of the houses used less than 10,000 gallons.
- There are eight houses that used over 20,000 gallons in June.

Short Term Demand

To get an understanding of how demand varies within a month, such as by day, and even by hour, the surveillance data collected by the Mission Communications system was analyzed. Generally, the tank level is reported every two minutes. However, as of August 2015, actual well pump states (on or off) and flow rates are not collected, and so have to be inferred by changes in tank level.

The specific numbers in the following charts should be treated as approximations. This study is based on a number of factors, such as tank dimensions, pump start and stop times, measurement accuracy, etc. The curves and patterns are probably accurate.

Figure 7 shows an estimate of overall demand by time of day, for a high demand summer week, June 21 through June 27, 2015.

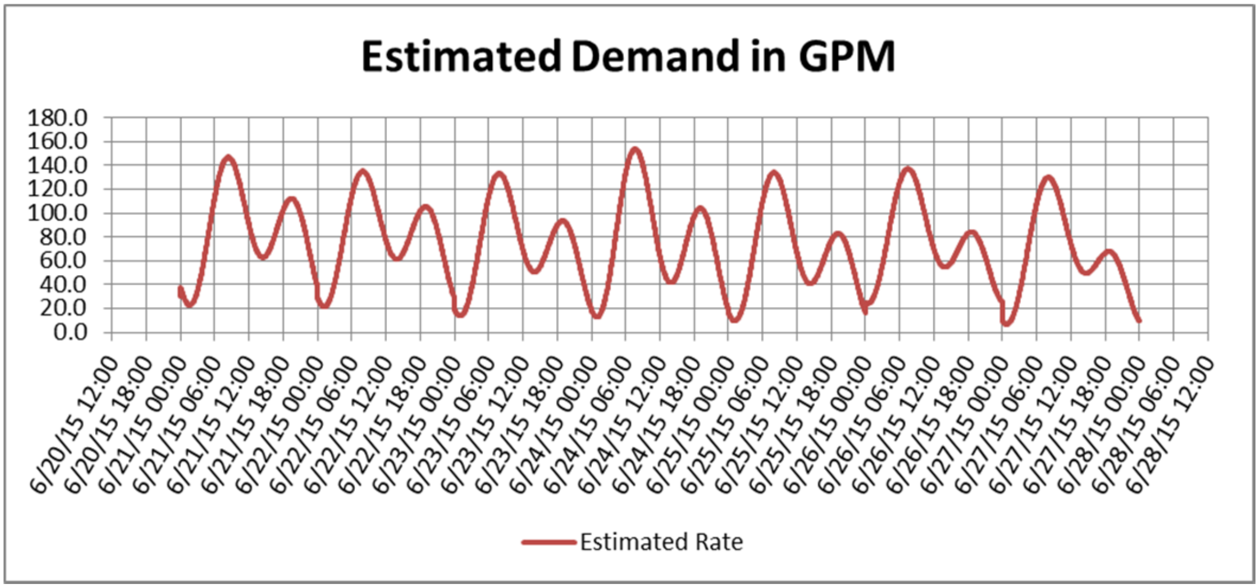


Figure 7 – Estimated Demand (GPM) by Time of Day, June 21 – 27, 2015

Observations on this chart:

- There is a very distinct pattern of two peaks each day, with the high between 6 and 10 AM, and a lower peak between 6 and 9 PM.
- Peak use in a day is five to seven times the low use, around midnight.
- Not clear if there is any significance for capacity planning.

Using this data, Figure 8 shows the total estimated gallons used per day for June 2015.

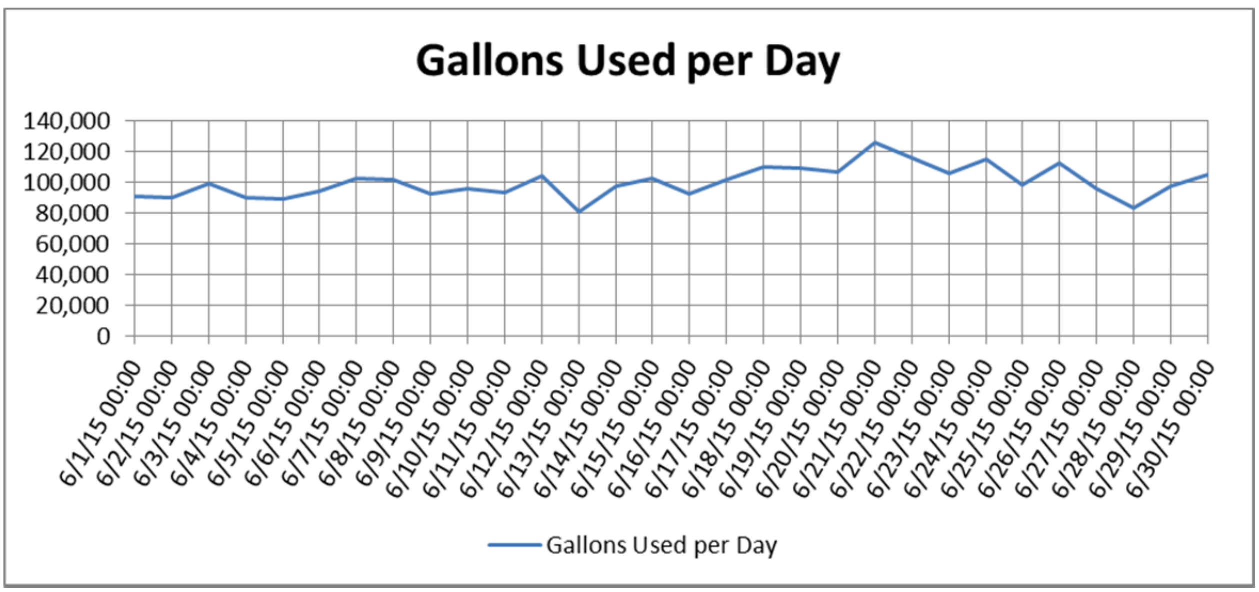


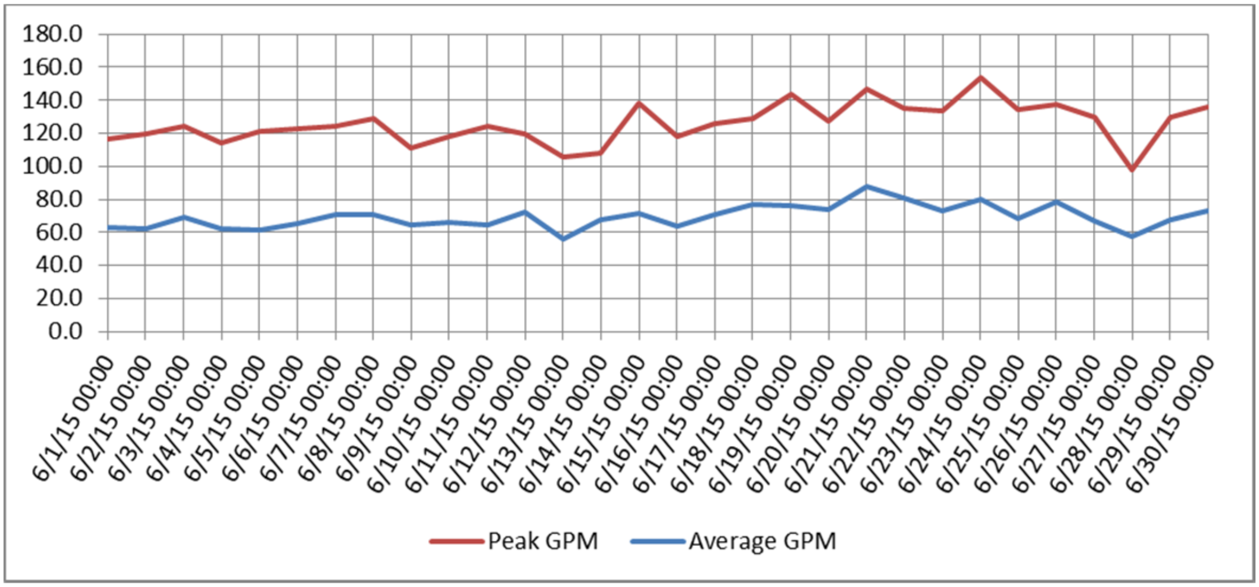
Figure 8 – Gallons Used per Day, June 2015

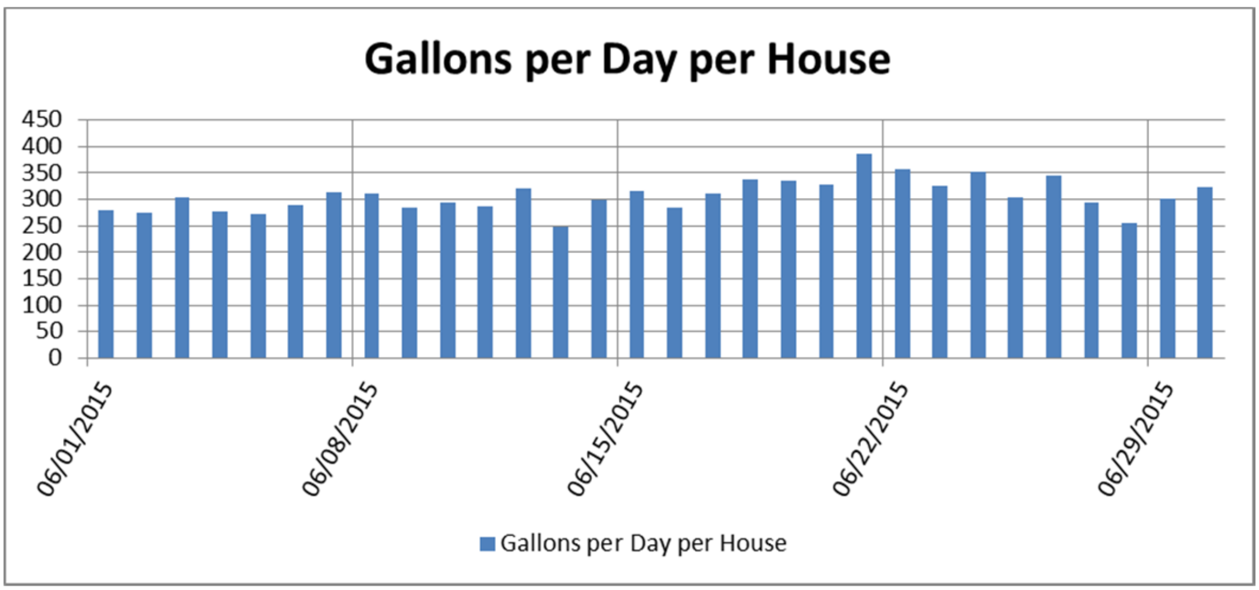
Observations from this chart:

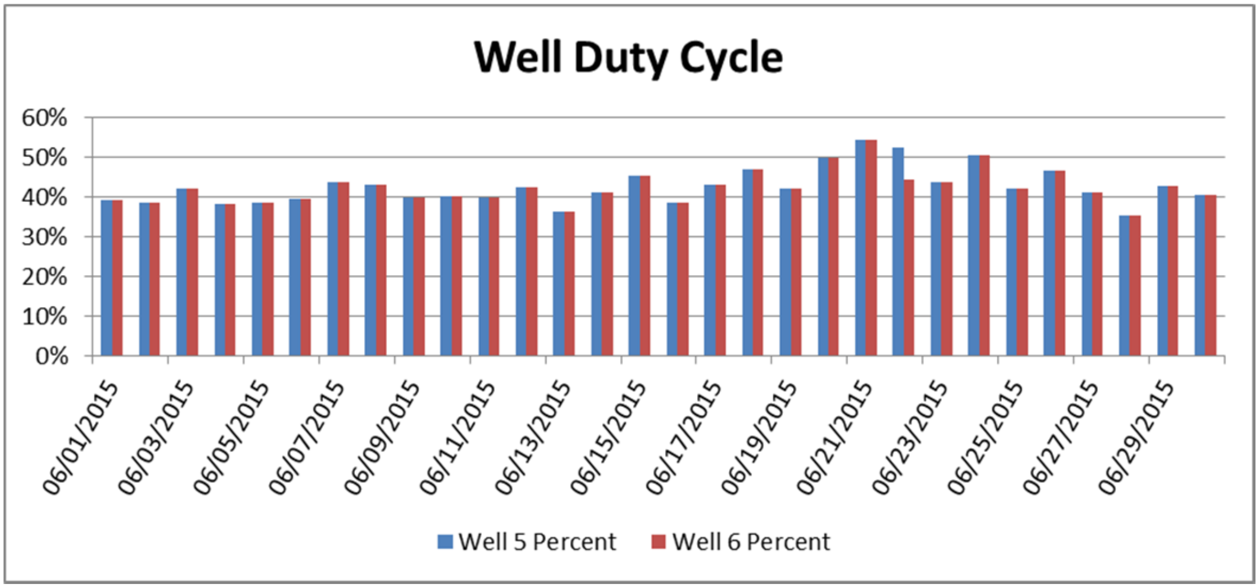
- There is not an obvious pattern across days, such a peak every Monday.
- For June 2015, an average of 100,000 gallons were used per day, with a high of over 120,000 and a low of slightly over 80,000.
- Since the tanks provide water for several days, capacity planning should be for the peak average over a few days, and not necessarily a one day peak, and not the overall average of the peak month. For

example, although the June 2015 average with 100,000 gallons per day, June 21-24 were all above 100,000 gallons each day.

Other charts from this data are shown below:







Yearly Demand

Also taken from the monthly well meter readings, Table 3 and Figure 9 show the total gallons pumped and the average number of gallons pumped per house per day.

Year	Total Gallons Pumped	Average Gallons Pumped per House per Day
2001	20,733,373	252
2002	22,397,507	256
2003	24,230,300	264
2004	25,558,800	249
2005	28,642,700	260
2006	28,349,700	249
2007	29,593,300	256
2008	29,667,814	253
2009	27,702,695	237
2010	28,775,800	244
2011	28,197,640	242
2012	28,712,631	245
2013	26,935,830	227
2014	26,593,261	225
Average	27,746,706	246
Standard Deviation	1,640,518	12

Table 3 – Total Gallons Pumped, and Yearly Average Gallons per House per day

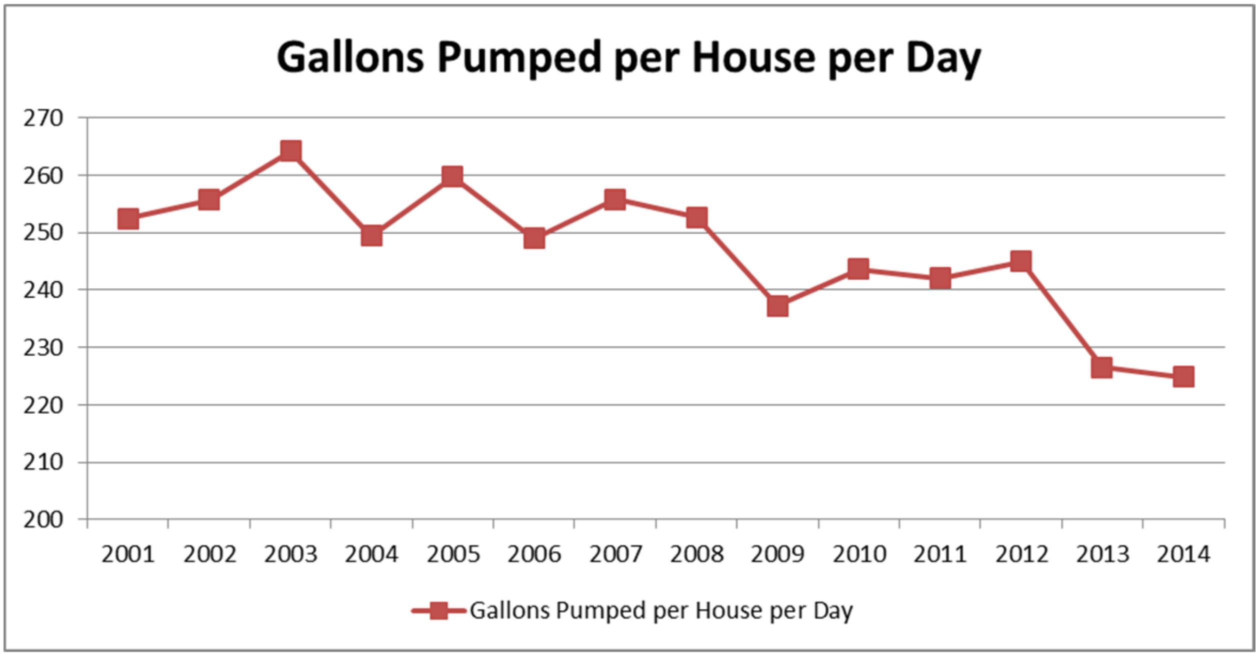


Figure 9 – Yearly Average Gallons per House per Day

Observations from this data:

- Over the past twelve years, overall demand has been declining, with some year-to-year fluctuations.
- Guesstimating an average of two people per house, this would give us an average Gallons per Capita per Day (GPCD) of 126, compared to Santa Fe with 95 (2014), the lowest of western cities. Albuquerque GPCD was 135 in 2013. It is not clear how non-residential water users are reflected in GPCD measurements.

Trends

From several of the previous charts, there appears to be a general declining trend from 2012 through 2015. Figure 10 shows data from the monthly well meter readings.

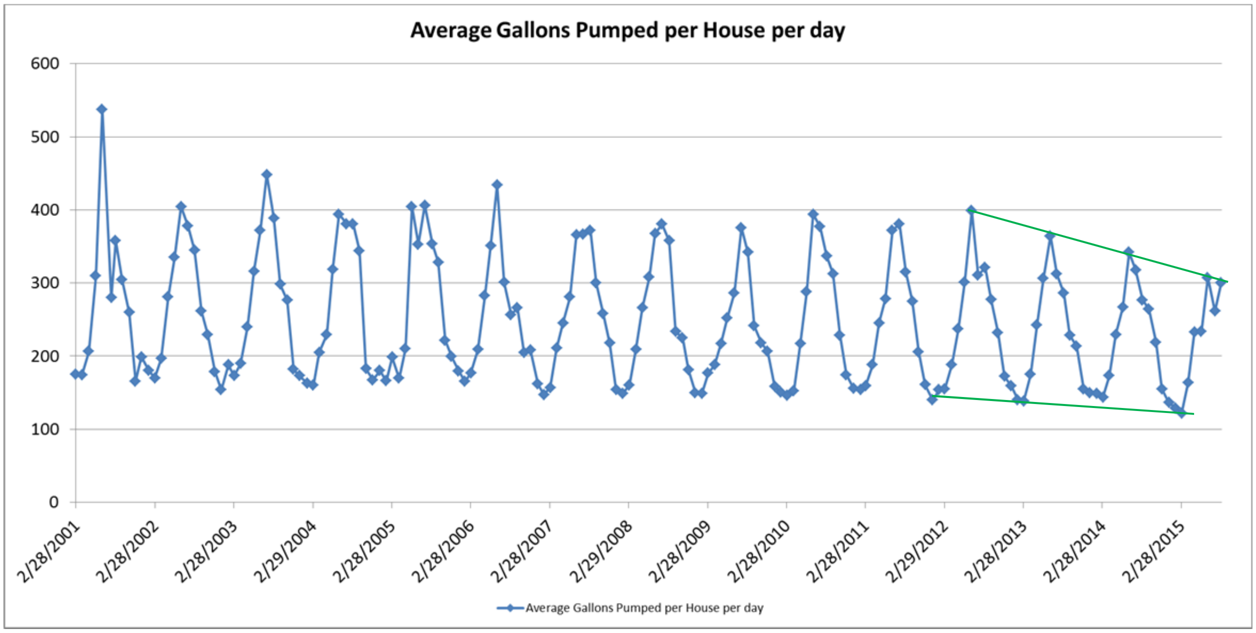


Figure 10 – Average Gallons Pumped per House per Day

A more detailed analysis of this trend, using monthly well data, and individual house billing data shows:

- Decline was across most (but not all) months; most noticeable in peak month (June).
- Decline was across most user groups (low, medium, high, top 1%).
- Decline was in both pumped and billed gallons; the difference ("unaccounted water") has not significantly changed.
- Decline was in total gallons per month and in gallons per house per day. (The number of house increased from 322 to 326 in this time.)
- No apparent change in "wasted" water / leaks.

There is not an obvious explanation for the decline.

- Probably not rate related, since rates recently changed in 2012 and 2015.
- Probably not weather related, since drought has persisted. Changes in usage do not seem to correlate with temperature or precipitation, but we're only looking at four years.
- There has been general publicity about drought, water shortages and water saving strategies (especially Albuquerque and Santa Fe).
- People removing or not replacing grass and high water use landscaping could account for this.

There are several implications and recommendations:

- Water Supply Planning: Assume that decline does not persist (pretty conservative – see Forecast, below)
  - Base peak capacity on high month over past ten years
  - Base yearly capacity on high year over past ten years
- Budgeting: Assume that usage continues to decline, at least for next year
  - Set rates to get primary revenue from base rather than usage charges

Forecast

"It's tough to make predictions, especially about the future." - Yogi Berra

Assumptions, Requirements, and Constraints

1. The Coop should always maintain sufficient capacity to meet estimated demand.
2. Estimated demand is based on historical usage, without any significant changes. For example, we are assuming that we will not have to supply a new orchard or vineyard.
3. The Coop should be able to meet normal demand with the highest capacity well (#5 in 2015) out of service for as long as a month.
4. The Coop should meet the letter and spirit of water quality regulations. For example, the arsenic rule says that a system is in violation when the running average of four consecutive quarterly samples is above the limit (10 ppb). The Coop plans to not have a quarterly sample exceed the limit.
5. Well duty cycle will normally not exceed 60%.
6. One new house will be added per year until full build-out. See Table 4.

	La Mesa	**Sundance Mesa**	**Total**
Houses	148	178	326
Undeveloped Lots	17	24	41
Total	165	202	367

Table 4 – Numbers of Houses and Lots as of August 2015

Note: This includes three La Mesa lots that are not currently Coop members, and excludes three La Mesa houses on private wells that are not Coop members.

7. The number of houses using private wells (three) will not change. One house that has a private a well and is a member of the coop is included in estimates.
8. Additional lots created by someone subdividing a lot will be roughly balanced by existing empty lots that are never built on.

Projected Capacity Requirements

The two key parameters required to estimate long term capacity requirements are the number of houses (see Table 4), and the average gallons per day per house. Possible planning values for the later number are shown in Table 5.

Source	**Gallons per Day per House**	
Average peak month, 2002 through 2015	386	
“One in Ten Year”, 2002 through 2015	431	
Peak, in past 15 years, excluding 2001	448	
Peak in past ten years	434	“High estimate”
Number used in 2011 and 2012 Water Supply Plans	380	“Mid Estimate”
Average peak month, 2011 through 2015	359	“Low Estimate”
Yearly average, 2001 through 2014	247	

Table 5 – Gallons per House per Day Planning Values

Applying the above assumptions, and the well characteristics shown in Table 1 result in the projections shown in Table 6 and Figure 11. Three estimates (Low, Middle, High) for the demand in the peak month are included.

Year	Houses	Well #5 GPM	Well #6 GPM	Water Available GPM	Peak Demand GPM (Low)	Peak Demand GPM (Mid)	Peak Demand GPM (High)	Gallons per Year Estimate
2015	326	102	58	160	117	117	117	29,391,000
2016	327	102	57	159	136	144	164	29,481,000
2017	328	101	56	157	136	144	165	29,571,000
2018	329	101	55	156	137	145	165	29,661,000
2019	330	100	55	155	137	145	166	29,751,000
2020	331	100	54	154	138	146	166	29,841,000
2021	332	100	53	153	138	146	167	29,931,000
2022	333	99	52	151	138	146	167	30,022,000
2023	334	99	51	150	139	147	168	30,112,000
2024	335	98	51	149	139	147	168	30,202,000
2025	336	98	50	148	140	148	169	30,292,000
2026	337	98	49	147	140	148	169	30,382,000
2027	338	97	48	146	140	149	170	30,472,000
2028	339	97	48	144	141	149	170	30,563,000
2029	340	96	47	143	141	150	171	30,653,000
2030	341	96	46	142	142	150	171	30,743,000
2031	342	96	46	141	142	150	172	30,833,000
2032	343	95	45	140	143	151	172	30,923,000
2033	344	95	44	139	143	151	173	31,013,000
2034	345	95	44	138	143	152	173	31,103,000
2035	346	94	43	137	144	152	174	31,194,000
2036	347	94	42	136	144	153	174	31,284,000
2037	348	93	42	135	145	153	175	31,374,000
2038	349	93	41	134	145	153	175	31,464,000
2039	350	93	40	133	145	154	176	31,554,000
2040	351	92	40	132	146	154	176	31,644,000
2041	352	92	39	131	146	155	177	31,735,000
2042	353	92	39	130	147	155	177	31,825,000
2043	354	91	38	129	147	156	178	31,915,000
2044	355	91	37	128	148	156	178	32,005,000

Table 6 – Projected Demand and Capacity

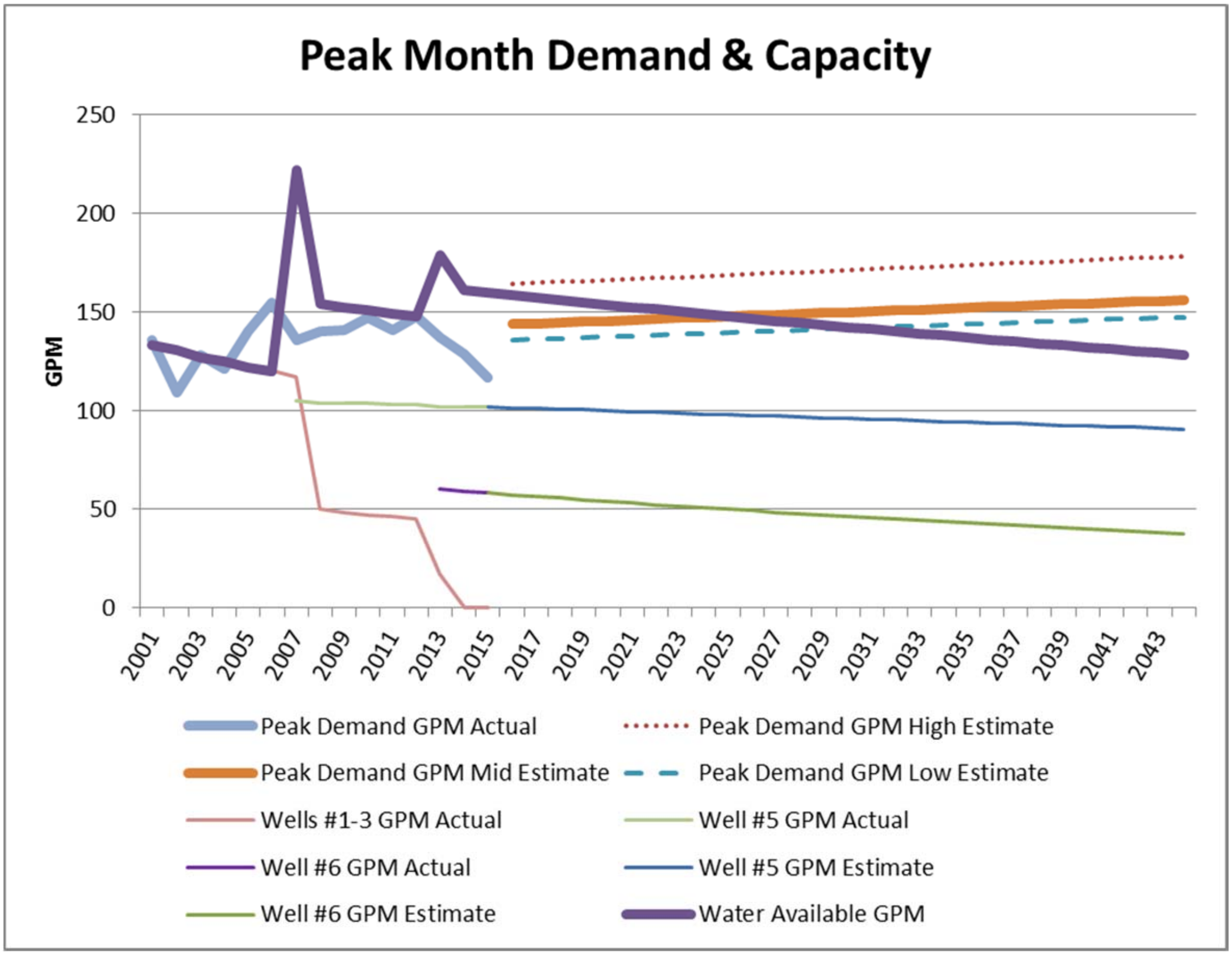


Figure 11 – Projected Demand and Capacity

Observations on this table and chart:

- In the peak month, capacity exceeds the middle demand estimate out to 2025. A new source will need to be in operation around then to operate under the 60% duty cycle.
- The margin between capacity and the middle demand estimate in 2016 is only about 10%, and steadily declines.
- During the peak month, there is little redundancy or reserve capacity if either well goes out of service for more than a day or two.
- There is substantial “hidden” reserve to the extent that actual use in 2015 is below the assumed gallons per house per day. As shown in Table 2, that was 307 in June 2015 (equivalent to 117 GPM).
- If demand were to return to the high estimate, demand already exceeds capacity.

Annual Water Usage

Using the average annual gallons per day per house demand shown in Table 4, the total gallons pumped each year are shown in Figure 12.

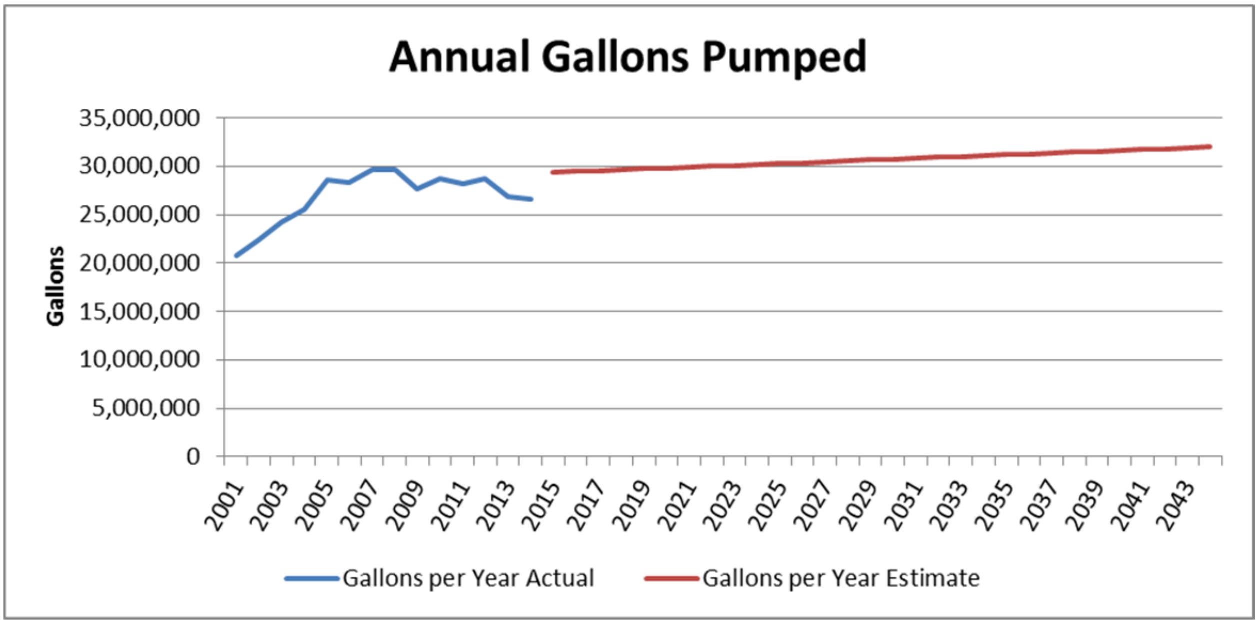


Figure 12 – Gallons Pumped per Year

Observations from this chart:

- The forecast, based on the average over the past 14 years, is probably high, since it does not reflect the general lowering trend.
- Because not many new houses are expected, total gallons per year will probably stay in the 27 million to 32 million range.

Water Rights

The estimate of 32,005,000 gallons to be pumped in 2044 (355 houses, 247 gallons per day per house) is 98.2 acre feet, substantially less than the rights to 118 acre feet owned by the Coop.

Alternatives

The immediate need is to increase reserve capacity to meet demand if well 5 is out of service for more than a few days during the summer. This issue has been extensively considered ever since the tighter arsenic rule was announced and well #3 could not be used.

Mix Water

When the situation is first explained, many people immediately ask if the high arsenic well 3 water can be mixed with low arsenic water. New Mexico and EPA regulations allow for blending; Albuquerque does this to some extent. The “2008 Water Use Analysis and Options Evaluation” has an extensive discussion of the blending option, and explains why it is not feasible for the Coop:

- The existing “plumbing” does not support mixing. Each well, and the tanks “float” on a the distribution pipes. So water from well #3 first goes to Sundance Mesa houses and excess goes into the tanks. There are not pipes that run directly from any of the wells to the tanks.
- More important, we do not have enough low arsenic water to blend with well 3 water. For example with well 5 at 7 ppb and well 3 at 27 ppb, it would require nine gallons from well 5 mixed with one gallon from well 3 to produce 9 ppb water. In the summer, when well 3 water is needed, there is little surplus water to blend. In the winter, when there is available low arsenic water, well 3 is not needed.

Drill a New Well

A new well is always a possibility, and may be needed in the ten to thirty year timeframe. The question is where, how much water can we expect, and what arsenic level. In Placitas, and specifically in the La Mesa and Sundance Mesa area, the closer to the Rio Grande, the more water is available. At the same time, arsenic level increases closer to the river. Well 5 hit the “sweet spot” – good water production that is just under the arsenic limit. Well 6 was drilled next to and deeper than well 1; water production came out very close to expectation, without any excess. There are not any obvious locations that are likely to produce adequate low arsenic water.

Household Treatment such as Reverse Osmosis

The EPA and New Mexico arsenic regulations allow for what are called “Point Of Use” (POU) treatment systems. The most common are reverse osmosis systems installed under a kitchen sink to supply treated water just for drinking and cooking. This is appealing because almost all the high summer use water goes to landscaping, which does not need low arsenic water. However, New Mexico regulations only allow POU to meet the arsenic rule for water utilities having 100 or fewer users.

Use Well 3 Water Only for Landscaping

Since the bulk of summer water use goes to landscaping, is there some way to use untreated well 3 water for landscaping and reduce demand for low arsenic water? In short, not easily. The Coop distribution system has a single set of pipes, with a single service connection to each house. So without re-plumbing the entire neighborhood, there is not a way to pipe two sources of water to each house. An alternative would be to truck water, but since most homeowners run watering systems several times each week in the summer, water deliveries would have to be made several times a day throughout the neighborhood.

Water Treatment for Well 3 Water

The remaining alternative is to install and operate a treatment plant for well 3 to reduce arsenic to an acceptable level. This is what all of the water systems in the lower (western) part of Placitas have done, as well as Bernalillo and Santa Anna.

Applying the same assumptions and estimates, Figure 13 shows the estimated demand and capacity with well 3 and an associated treatment plant in operation, initially at 125 GPM in June 2018. This rate is larger than necessary just to carry the load if only well 5 were to be out of service in a peak month, and is smaller than needed to carry the entire coop (150 GPM in 2029 with the middle estimate). One of the limiting factors with well 3 is that the pipe that connects it to the distribution system is only 3”, and 125 GPM is the estimated maximum flow through that. If the duty cycle were to be extended to 72%, 125 GPM would support the entire coop in 2029. Or the 3” pipe could be replaced with a larger one, and well #3 run at a higher flow, such as 150 GPM.

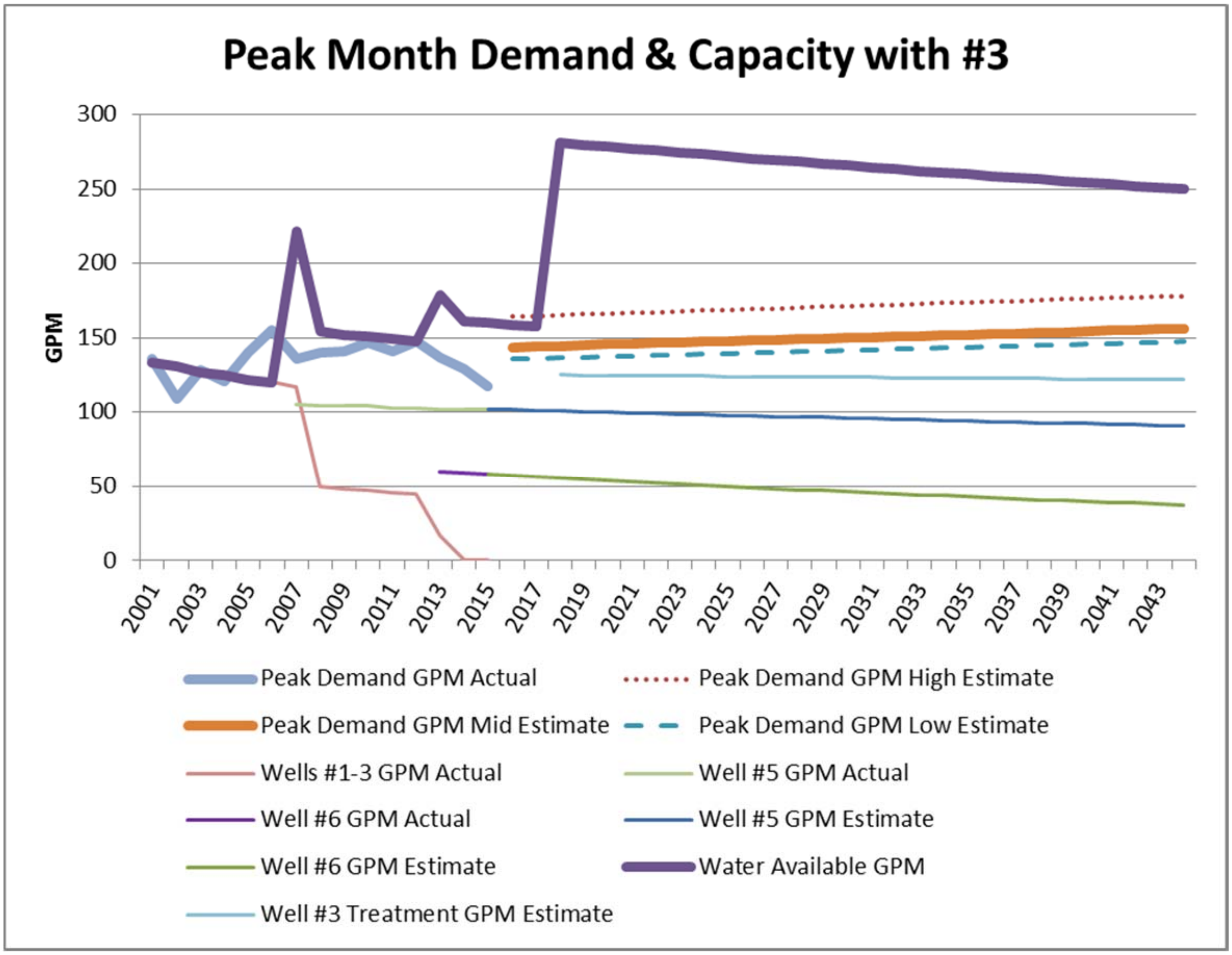


Figure 13– Projected Demand and Capacity, with Well #3

Observations on this chart:

- The boost in capacity provides ample redundancy if any one well is out of service.
- This provides total capacity substantially above even the high demand estimate out to 2044.
- This chart does not reflect any improvement in the lifetimes of wells 5 and 6 as of result of them being used less. There is most probably a positive effect, but it is difficult to estimate.
- Unless one of the wells fails or declines more than estimated, there is not a need for a well 7 in this time frame.

Load Balancing

With three wells in operation, there are several alternative schemes for sharing the load.

- "Equal share" – All wells are turned on and off based on the tank level (as done today), so each contributes its "normal" capacity.
- Minimal use of #3 – Set the well control system so that well #3 is used regularly, but not at its full capacity.
- Optimized costs – Based on the marginal operating cost of each well, set the load balance to minimize overall costs.

Table 7 shows example of how the first two alternatives could work, using an arbitrary date of 2020 estimates, and an arbitrary 10% for well 3. Since well #3 with a treatment plant will undoubtedly have operational costs higher than #5, it is hard to imagine a scenario where well 3 would be used to provide more than an "equal share" for a period more than a month or two.

	Well #5	**Well #6**	**Well #3 Treatment**	**Total**
2020 GPM Estimate	100	54	125	279
equal share percent	36%	19%	45%	100%
equal share gallons	10,712,167	5,762,217	13,366,616	29,841,000
minimal #3 use percent	59%	31%	10%	100%
minimal #3 use gallons	17,463,208	9,393,692	2,984,100	29,841,000

Table 7 – Load Balancing

Contingency Plans

Until a treatment plant for well 3 is operational, there are several plans to handle an outage of either well #5 or #6.

- Extend the runtime of the functioning well beyond the planned 60% duty cycle.
- Ask the community for immediate short term conservation.
- Use available spare parts – the Coop has a spare motor and pump for each well, since these have long lead times.
- Put well #3 into service on a temporary basis, recognizing that would go against the spirit of the arsenic rule. It is not clear if this would incur a violation, which is based on a running average of four quarterly samples. Members would be advised to use bottled water if they do not already have a reverse osmosis system. There has been consideration of the coop providing bottled water in such a situation.
- There is an informal agreement with the neighboring North Los Ranchos Water District to share water on an emergency basis. This has not been formalized or tested. It is not clear if they could supply water in the amount we would need for more than a few days.

Recommendations

1. Put into operation an arsenic treatment plant for well 3.
2. Upgrade well 3 to increase capacity and extend life.

Well 3 Requirements, Constraints, and Priorities

1. Treatment must produce water that meets NMED and EPA standards.
2. Treatment plant must meet local, state and federal regulations, such as New Mexico Environment Department (NMED) Drinking Water Bureau (DWB), New Mexico Construction Industries Division (CID), OSHA, Corps of Engineers, Sandoval County, La Mesa HOA, Sundance Mesa HOA, etc.
3. Well #3 and treatment plant should be capable of supporting entire coop for up to a month in peak summer use. Flow of 125 GPM, for up to 18 hours per day (75% duty cycle) will be sufficient.
4. Plan operations to share load across all three wells. Simple load balancing would have well #3 providing about 44% of capacity; this can be adjusted depending on operational costs.
   Yearly volume to treat: 3,000,000 to 13,500,000 gallons, in 2020. (See Table 7)
5. All treatment waste, solid and liquid, must be minimized since it has to be disposed of off-site.
6. Unregulated water quality factors, such as pH, silica, etc. must be comparable to or better than current water.
7. Avoid or minimize use and storage of hazardous chemicals such as acid, caustic soda, or ferric chloride.
8. Treatment plant must be able to run normally without an operator present, including:
   - well start and stop
   - injection of treatment chemicals
   - fault detection
9. Operator intervention is expected for:
   - pH monitoring and adjustment
   - backwash / media “fluff” cycles ***[May depend on specific technology / equipment.]***
   - chemical replenishment
   - waste removal
   - media replacement
   - fault isolation and correction
10. Treatment plant must be able to be shut down periodically, with restart time in two days.
11. Distribution pressure at well #3 is 120 PSI; if the treatment system operates at a lower pressure, such as 60 PSI, booster pump(s) will be necessary.
12. Plan for 20 year lifetime.
13. Implementation priorities: Good over fast over cheap

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