



Memo

To: Joe Grande, Interim General Manager
From: Joe DeMorett, Water Supply Manager
Date: 5/21/2021

RE: Pressure Zone 6E supply needs without UW 15

Site Background

UW 15 is a unit well site located at 3900 East Washington Avenue in the eastern part of Madison. Construction of this unit well was completed in 1965. The well borehole, which is 22 inches in diameter, is 753 feet deep. It is cased with steel to a depth of 172 feet and then open to the well bottom. The pump is set below the cased interval at a depth of 191 feet. The well has a specific capacity of 22.6 gpm/foot of drawdown, making it one of the City's more efficient producers.

The well site consists of a deep well, a booster pump and a 150,000 gallon underground reservoir. The deep well pumps groundwater into the reservoir which is then pumped via booster pump into Pressure Zone 6E of the distribution system.

A remedial system was installed in late 2013 to remove the Volatile Organic Compounds (VOCs) present in the water at the site. This system consists of two low profile air stripper units containing perforated trays over which the water cascades down through. A set of blowers forces air upward through the holes in the trays, removing (stripping) the VOCs from the water.

Unfortunately, the stripping process raises the pH of the water, which can lead to mineral deposition in the water mains and customer meters. To lower the pH and avoid this, small amounts of sulfuric acid are added to the water at the site. The cost to do this on an annual basis is approximately \$35,000.

The original well building was added onto in 2013. During this time, much of the site was rebuilt. The rebuild included new piping, valving, MCC instrumentation and control, pump drives, lighting, and HVAC making it one of the more up-to-date sites of MWU. A bathroom and chemical room were also expanded and brought up to current code requirements.

The well was pumped regularly up until March of 2019, when it was taken out service. Elevated levels of PFOS, PFOA, and PFHxS were discovered in the water from this well.

Site Geology

The unlithified and rock deposits in the area range from recent soils near the surface to deeper Cambrian age sandstones, shales and dolomites all overlying a Precambrian basement rock (schist). The upper 123 feet of the well consists of unlithified (drift) deposits. Below this, sandstones within the Wonewoc Formation occur to a depth of 225 feet. It appears that the Tunnel City is absent from this location. The Eau Claire Formation is present from 225 to 250 feet, and is very shaley between 239 and 247 feet. This

8-foot layer would have a very low permeability and restrict the downward movement of groundwater here. The Mt. Simon Formation extends from 250 feet to the bottom of the well. This formation is predominantly sandstone.

The well is cased to a depth of 172 feet, which is 67 feet above the Eau Claire shale unit (239'). As a result, this well is considered a multi-aquifer well, receiving water from both the upper and lower aquifers.

VOC levels

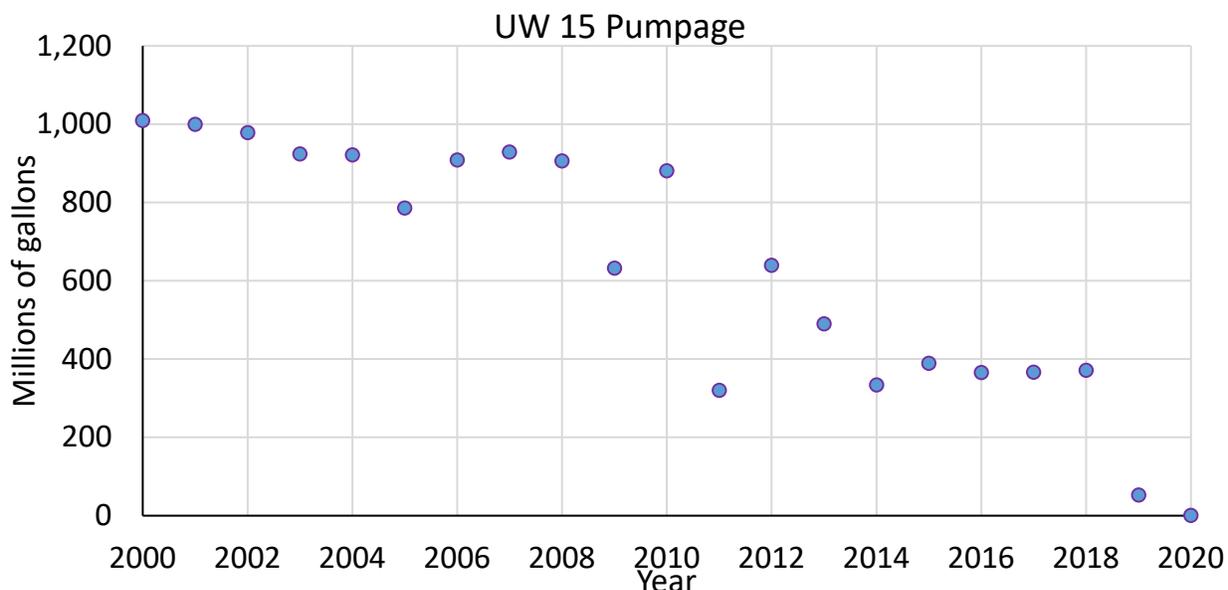
VOCs, including tetrachloroethylene (PCE), trichloroethylene (TCE), and 1,1,1-trichloroethane (1,1,1-TCA) have been detected in UW 15 since the early 1990s. It is thought that these compounds originate from a former dry cleaning business located in the immediate area. PCE concentrations in the well increased from below 1 ug/l in the early 1990s to 3 to 4 ug/l in 2013 when the remedial system was installed. Since then, concentrations in the raw water have remained constant. The maximum contaminant level established by the USEPA for PCE is 5 ug/l. The concentrations of TCE and 1,1,1-TCA have been detected below their respective MCLs, and concentrations have generally decreased or stabilized since the mid-1990s.

PFAS/PFOS

Perfluorosulfonic Acids (PFSA) and Perfluorocarboxylic Acids (PFCA) have been detected in the water from this well at low parts per trillion (ppt) levels. Concentrations to date are below established EPA and state guidelines. New standards however, both single compound and combined totals, are being proposed at the state level. It appears that the proposed standards will still be above the levels currently found in the water at this well. However, when the cumulative risk of exposure to multiple PFAS with similar health effects is assessed using the proposed hazard index, water from UW 15 may not be suitable for human consumption. As a result, UW 15 is currently off-line and will remain out of service indefinitely while the Utility investigates options to make up the lost supply, including treatment to remove these compounds.

Past Pumpage

This well has always been a major workhorse for the Utility. The centralized location of the well within the pressure zone, its close proximity to booster station/reservoir 115, and its high specific capacity make it a valuable asset. There were a number of years when it was MWU's number one supplier of water, pumping close to a billion gallons a year. The well was last used heavily in 2012 to meet demand during a very hot and dry year. For the following years 2013 - 2018, the well was pumped constantly but at a lower rate, averaging approximately 400 million gallons a year. It was determined that operating the well and the site's remedial equipment at half capacity (1100 gallons on 24/7 basis) was more efficient and energy saving.



MWU Zone 6E Capacity

Zone 6E is a fairly large pressure zone. In addition to UW 15, it contains five wells, three booster stations, and three large ground-level reservoirs. A sixth well, UW 23, was permanently removed from service in late 2020 because of water quality concerns. The five wells collectively can produce approximately **11.8 million gallons per day (mgpd)**.

A newly connected booster station at UW 9 (Spaanem Ave) located near the northern edge of Pressure Zone 4 now is able to transfer water to Zone 6E. Because UW 9 must supply water to Zone 4, that leaves approximately **1.6 mgpd** available for Zone 6E.

Well Capacity - Zone 6E

Well Site	MGPD
UW 7 (Sherman Ave)	3.0
UW 8 (Lakeland Ave)	1.7
UW 11 (Dempsey Rd)	2.8
UW 13 (Wheeler Rd)	2.8
UW 29 (Thompson Dr)	1.5
<u>UW 9 Booster (Spaanem Ave)</u>	<u>1.6</u>
Total:	13.4

The three large reservoirs in Zone 6E are capable of holding close to 10 million gallons of water and allow us to employ several different pumping scenarios. We are currently filling these reservoirs at night when electricity is cheapest and then using the stored water to meet daytime demands. However, during periods of extremely hot and dry weather daytime pumping is also required. Eventually, meeting daytime demands becomes possible only by using water supplemented by the reservoirs. If weather conditions persist for prolonged periods, it becomes difficult to fill these reservoirs and eventually they begin draining even with all the wells running 24/7.

113 (Lakeview Ave)	750,000 gallons
BS 115 (Bunker Hill Ln)	3,000,000 gallons
229 (Felland Rd)	6,000,000 gallons

MWU Future Needs

A review of the demand during summer months in Zone 6E over the last five years (2016 – 2020) reveals monthly averages between 6.1 – 9.1 mgpd. The volume of water used depended heavily on the amount of precipitation we had received and the temperatures we were experiencing. It is evident that during an average summer month we are able to meet demand with our existing combination of six wells.

A review of past data however also reveals that summer demand can significantly increase quite quickly. During 2012, a drought-like summer of low precipitation and high temperatures, Zone 6E posted an average demand of 9.6 mgpd for the month of June and 10.4 mgpd for the month of July. These higher demands begin to tax our supply. If one or more of our wells were to go off-line for repairs even for short periods, demand might not be met. Volunteer or forced conservation would be required.

Zone 6E Historical Summer Pumpage/Demand

1000s of gallons

Date	7	8	11	13	15	23	29	BP 9	Average	
									Total	GPD
May-20	43,770	9,030	45,000	46,950	0	0	47,950	0	192,700	6,216
Jun-20	54,670	11,300	50,130	38,350	0	0	44,630	0	199,080	6,636
Jul-20	60,690	13,530	43,800	44,830	0	0	47,738	0	210,588	6,793
Aug-20	49,280	13,600	58,860	52,860	0	0	47,820	0	222,420	7,175
Sep-20	39,310	9,700	46,310	42,300	0	0	46,190	2,196	186,006	6,200
May-19	50,010	0	58,290	33,340	0	0	49,350	0	190,990	6,161
Jun-19	56,670	0	57,720	35,130	0	0	47,290	0	196,810	6,560
Jul-19	59,420	20,970	54,060	34,080	0	0	48,190	0	216,720	6,991
Aug-19	53,850	24,145	49,390	31,200	0	0	48,250	0	206,835	6,672
Sep-19	43,060	21,450	56,550	37,100	0	0	34,220	0	192,380	6,413
May-18	37,550	0	54,840	35,560	33,790	0	46,970	0	208,710	6,733
Jun-18	46,380	0	56,460	28,970	34,770	0	43,010	0	209,590	6,986
Jul-18	46,881	0	55,790	41,340	34,330	0	46,970	0	225,311	7,268
Aug-18	34,976	16,993	42,630	35,020	38,040	0	47,150	0	214,809	6,929
Sep-18	36,900	5,390	42,430	35,560	29,870	0	45,540	0	195,690	6,523
May-17	40,535	0	43,192	37,670	27,697	0	53,438	0	202,532	6,533
Jun-17	49,252	0	46,667	33,040	41,623	0	47,193	0	217,775	7,259
Jul-17	45,600	9,646	47,490	29,190	40,290	0	42,460	0	214,676	6,925
Aug-17	36,340	14,286	38,129	36,580	38,250	21,567	46,092	0	231,244	7,459
Sep-17	37,180	12,668	69,400	29,050	46,490	0	45,420	0	240,208	8,007
May-16	22,092	0	25,501	74,188	39,937	0	59,463	0	221,181	7,135
Jun-16	35,785	0	37,639	70,317	33,270	12,753	53,475	0	243,239	8,108
Jul-16	33,364	2,432	45,770	75,783	37,900	30,921	57,690	0	283,860	9,157
Aug-16	34,070	10,918	38,871	56,846	40,630	7,726	56,835	0	245,896	7,932
Sep-16	13,770	4,707	46,130	75,450	20,230	0	54,890	0	215,177	7,173
May-12	2,710	0	49,454	69,957	69,314	18,474	35,324	0	245,233	7,911
Jun-12	26,849	0	54,992	74,025	65,758	15,678	51,090	0	288,392	9,613
Jul-12	41,933	1,326	50,700	72,870	75,560	27,378	53,208	0	322,975	10,419
Aug-12	27,270	7,414	42,328	68,845	50,796	16,252	54,101	0	267,006	8,613
Sep-12	31,014	0	34,126	62,908	44,600	12,960	51,529	0	237,137	7,905

In addition to providing water for everyday residential, commercial, industrial and institutional use, MWU's supply must be capable of providing an adequate and dependable flow for firefighting purposes. Engineering consultant firm SEH completed a mass balance analysis for the eastern side of the City, which included Zone 6E, in MWU's most recent Master Plan. Their evaluation included testing on a zone basis for supply, booster pump, and storage capacities. MWU's system was modeled under standard system operating parameters including a fire event. Reservoir levels were the primary basis for determining if the system was deficient in supply or storage.

The results of SEH's steady-state fire flow evaluation indicated that standard fire flow criteria could be met on a maximum day pumping with no wells out of service. Minimum required pressures were sustained throughout the system and reservoir levels did not decrease significantly. However, with one

or more wells out of service, the fire flow criteria could not be met. During the simulation, minimum required pressures across the zone were not obtainable and reservoirs drained down to very low levels. MWU is in discussions with SEH to provide additional analysis of the distribution system in terms of fire flow characteristics to ensure the resiliency of our system and reduce risk.

Criteria for Implementing MWU Demand Reduction Strategies

As described in the accompanying memo by Interim Public Information Officer Amy Deming, demand reduction strategies may be necessary to moderate water demand especially during hot, dry periods. The implementation of the more severe demand reduction strategies would be conditional upon exhausting all available options for increasing supply in Zone 6E. A number of criteria would indicate the necessity of initiating such measures:

- One or more wells off-line for an extended period.
- Unable to fill the three large reservoirs during nighttime hours.
- Demand greater than 9 mgpd for more than 10 days
- Demand greater than 10 mgpd for more than 5 days.
- Hot > 90 degrees with little rainfall.

When the above criteria are met, they would trigger progressive water use restrictions that are outlined in the accompanying Demand Reduction Strategies memo.