

Internal Monitoring Report

Policy # O-2E Sustainability
Frequency: Twice a year

Date: February 23, 2021

Policy Language:

Madison residents will benefit from a sustainably managed ground water supply to ensure that water is available to protect public health, and to maintain and improve the economy and environment in Madison, now and in the future. Sustainability encompasses many aspects of Utility operations, including the environmental benefits of reducing energy use, preserving groundwater levels, and sustaining flows in lakes, streams, and springs. The financial sustainability of the Water Utility is also a significant consideration: future generations of Utility customers, while benefitting from infrastructure renewal, will bear the cost of incurring long-term debt.

Accordingly,

1. Aquifers and wells will be monitored and the data evaluated to identify trends in water levels and potential contaminants.
2. Appropriate city, county, state and federal agencies will be called upon to enforce all pollution control and prevention measures within their authority, in order to protect water quality in the well head protection area of each unit well.
3. The adopted Conservation Plan shall be monitored and evaluated regarding progress to fulfill its goals. Plan goals should include reductions in energy use, avoiding the cost of additional wells, and minimizing complications related to over-pumping the groundwater system.
4. To prevent over pumping and improve redundancy, the Utility's service level for capacity planning shall be 50% utilization for each unit well. Therefore, the Utility shall strive to limit the average pumpage to 50% of the annual rated capacity of each well. This can be achieved through water conservation, water supply system expansion, and operating procedures.
5. The Utility shall track the carbon footprint of Utility operations using quantitative tools (for example, energy intensity analysis) so that sustainability may be considered in planning for water treatment facilities, distribution system improvements, and other infrastructure projects.

General Manager's interpretation and its justification:

This policy prescribes certain activities intended to ensure the long term environmental, public health, and economic sustainability of Madison's water supply. Our actions relating to these objectives are detailed below.

Data directly addressing the General Manager's interpretation:

1. *Aquifers and wells will be monitored and the data evaluated to identify trends in water levels and potential contaminants.*

Aquifer Levels

The water levels in the aquifers beneath Madison continue to be monitored on a routine basis. A deep groundwater monitoring well located in the basement of the State Capitol has provided

water levels since 1946. A review of the monthly data indicates levels continue to vary on a seasonal basis, a direct result of demand (COM pumping) and recharge (precipitation.)

As in past years, summer water levels were lower than those experienced during the winter. Levels in 2020 were an average of 6 feet lower during the summer months. Overall, aquifer levels appear to be increasing or rebounding with an increase of approximately 20 feet since 2005. This is a good indication that the local aquifers are in the process of rebounding/ recovering to pre-pumping levels. Recent data suggest that this rebound might be slowing or leveling off. However, levels recorded in 2019 and 2020 were significantly higher than in past years. It will be interesting to see if these levels continue to rise in the near future. The water levels beneath the central part of our city during the last 30 years are displayed in Figure 1.

Water Levels – Water Utility Wells

As expected, static and pumping water levels in many of the Utility's supply wells varied throughout 2020. Variations, however, were significantly less than those experienced during past years (i.e., 2012) when we were subject to extremely hot and dry summer conditions. Water levels in the Utility's wells continue to fluctuate seasonally and are greatly influenced by both pumping and precipitation events. A review of the recent water level data indicates that, with the exception of several wells, many of the water levels (static and pumping) are increasing as winter demands decrease. The increases this year are minor and similar to those experienced last year.

Longer term, static and pumping water levels in most of the Utility's wells have been increasing since 2012. UW 20 is a good example of the static water level increases we have been experiencing over the last 8 years (see Figure 2). Levels on average in this well have risen approximately 22' over this time.

The exception to this trend are wells UW 18 and UW 19. Both static and pumping water levels in these two wells have continued to decrease (10 - 15') over the last five years. It is thought that the bedrock pores near the surface of the bore hole have become "plugged" with scale and/or iron bacteria deposits. The borehole at UW 18 is scheduled to undergo chemical treatment in March and April of this year to alleviate this problem. The Utility is planning to investigate the situation at UW 19 before deciding a course of action there.

Sufficient water levels in all of the wells appear to be sustainable for the near future.

Total precipitation during 2020 was above average. Madison received 38.9 inches of precipitation from January through December, 2020. This is about 4.5 inches more (13.1% more) than the annual average of 34.4 inches. It is anticipated that precipitation amounts in the Madison area will continue to be above average into the near future. This is important to note as the aquifers are recharged to a great extent by precipitation events.

Madison Kipp Corporation/UW #8 Sentinel Well

The Madison Kipp Corporation (MKC) continues to operate its groundwater extraction and treatment system at its Waubesa Street site. The remedial system is being utilized to remove

volatile organic compound (VOC) mass and hydraulically contain VOC contaminated groundwater present in the upper bedrock aquifer beneath the site.

The Utility continues to work with MKC, their consultant, the WDNR, and the WGNHS on the area's groundwater contamination issues. Groundwater at and adjacent to the facility continues to be monitored routinely for VOCs. The most recent groundwater results indicate that PCE levels in the groundwater between the site source and UW 8 remain relatively constant. The southeastern extent of the plume appears stable with the edge approximately 600 horizontal feet from UW 8. Levels within the extraction well's zone of contribution are stable or continue to decrease (improve).

The sentinel well planned for the UW 8 area has been postponed because of budgetary constraints. This deep monitoring well was to be installed at a location between the Madison Kipp Corporation groundwater contaminant plume and UW 8. Initial sampling would have provided MWU with deep groundwater quality information immediately north of the unit well. Subsequent routine sampling would have provided an early warning for any migrating contaminants. It is hopeful that this well can be installed in the near future.

UW 29 Sentinel Well

Water from the sentinel well located between UW 29 and the Sycamore Landfill continues to be monitored for both inorganic and volatile organic compounds on a semi-annual basis. Sampling is typically conducted in April and October of each year with 23 samplings conducted to date.

The October 2020 sampling indicates that the migration of contaminants from the Sycamore Landfill is not a significant threat to water quality at Unit Well 29 at this time. Unit Well 29 continues to pump at half capacity on a 24/7 basis, supplying slightly over a half billion gallons of water to Madison in 2020.

UW 14 - Chloride Study

The Utility is planning to conduct some bore hole sampling at the well site later this year. Water from the bore hole will be sampled and analyzed for chloride at various intervals or depths utilizing a packer and pump sampling system. If the chloride entry points/depths within the borehole can be determined, a remedial option might be devised to restrict these areas within the well. A project page and email distribution list have been developed to keep neighbors and customers up to date on any future progress.

UW 15 - PFAS Removal Study

UW 15 has been out of service since March of 2019 because of PFAS concerns. The Utility is reviewing possible remedial options that might be applicable at this site. A consultant, TRC/Evoqua, was recently hired to conduct a feasibility study on the removal of PFAS from the water at UW 15. Water was collected from the well in November of 2020 and used in a series of benchtop tests to evaluate several treatment technologies. The results of this study will be used to determine possible treatment techniques, designs, and system costs. The Utility is currently waiting for a draft of the final report.

This well is a very important component in our system as it once supplied approximately 1 million gallons per day to Zone 6E.

UW 19 - Radium Removal Study

A pilot scale test to remove iron, manganese and radium was completed at UW 19. The conclusions and results of this study will be utilized in designing the appropriate filter system for this site. The construction of the filter system has been postponed until the year 2024.

UW 27 - Radium Study

This study, including the groundwater monitoring well, has been put on hold until the appropriate funds become available

UW 31 – GE Health care site

The WDNR continues to monitor the groundwater monitoring and remedial activities associated with the GE Health care site, a contaminated site located to the northeast of UW 31. There are no new updates to report for this site, which has elevated levels of PCE in its groundwater. To date, no TCE or any other volatile organic compounds have been detected at UW 31, which is located over 6000 feet from the source of the TCE contamination.

2. Appropriate city, county, state and federal agencies will be called upon to enforce all pollution control and prevention measures within their authority...

As previously mentioned, the Utility continues to work with the Mayor's office and the WDNR in monitoring the remediation of the PCE contaminated groundwater at the Madison Kipp site. At the request of the WDNR, the Madison Water Utility, City Engineering, and Public Health continue to review the remedial strategies and plans proposed by MKC and their consultants.

MWU is also working with the appropriate agencies regarding the PFAS contamination identified in the soil and groundwater at the TRUAX National Guard facility, located to the northwest of UW 15.

3. The adopted Conservation Plan shall be monitored and evaluated regarding progress to fulfill its goals. Plan goals should include ...

MWU pumped a total of **8.74 billion gallons** of water to the distribution system during 2020. This is approximately 2.5% less than last year when MWU pumped 8.97 billion gallons. It is the sixth straight year our pumpage has declined.

It appears that some of the drop in 2020 can be attributed to the COVID Pandemic. Pumpage during the months of March, April, and May was down considerably (- 7% from 2019) as UW shut down and many of the students left school and their Madison residences.

In addition to influencing the overall pumpage amount, the pandemic also significantly changed the amount of water used by individual customer categories. Residential use was up 7.8% in 2020 as people worked from their homes instead of their places of work. Commercial and governmental use was down as their folks went home.

	2020	2019
<u>Average Day:</u>	23.9 million gallons	24.6 million gallons
<u>Max Day:</u>	33.6 million gallons on Aug 25	31.9 million gallons on July 16
<u>Min Day:</u>	17.5 million gallons on Nov 28	15.9 million gallons on December 25

As mentioned earlier in this report, precipitation for the year was above average. In addition, rainfall events occurred on a regular basis limiting the number of heavy pumpage days.

Residential consumption in gallons per capita by year:

<u>Year</u>	<u>Single Family ¹</u>	<u>Multi Family ²</u>	<u>All Residents ³</u>
1980–2000	81.5		
2002–2007	71.8		
2008	69.8		
2009	67.8		
2010	65.0		
2011	65.2		
2012	70.3		
2013	61.0		
2014	62.2		
2015	60.9	55.0	
2016	55.4	46.7	51.4
2017	55.4	46.0	51.1
2018	53.0	44.3	48.9
2019	50.8	43.1	47.1
2020	55.5	45.1	50.5

Goal: 2020 58.0 *

¹ Average per-person daily consumption for Single family only (includes duplexes).

² Average per-person daily consumption for multi-family residents only (includes apartments).

³ Average per-person daily consumption for **all** Madison residents - includes people living in both single-family homes, duplexes and apartments.

4. The water supply system shall be expanded so that the pumpage from individual unit wells shall not exceed 50% of the annual rated capacity of the unit well.

Our service level for capacity planning is 50% utilization and system expansion is being planned to accomplish this level. The Utility continues to propose and build additional booster stations and new well facilities to help achieve this goal. In addition, variable speed drives

(VFDs) are being added to existing motors/pumps each year to optimize system flows.

Overall, utilization rates for the wells during 2020 were very similar to those experienced in 2019. Through December 31, 2020, three different wells exceeded the annual 50% utilization rate (wells 12, 14, and 30.) Actual utilization rates for 2020 are depicted in Table 1.

- The utilization rate at UW 12 was slightly over 50% again this year. This well was placed on Time of Day (TOD) pumping beginning late last year. As result, the well is now only pumped during the off peak hours of 9 PM till 10 AM. During On peak hours, Zone 7 water is supplied from adjacent sites which have lower utilization rates. The rate at UW 12 should drop considerably in 2021.
- Rates at the other two well sites (14 and 30) cannot be lessened without improvements to the Utility's infrastructure. Well repair/reconstruction projects and the necessary use of seasonal wells on a year round basis continue to significantly influence individual well rates.

The addition of VFDs on the deep wells at a number of its sites has allowed the Utility to directly minimize the utilization rates of these wells. In addition, the VFDs help in lowering the Utility's electrical usage/costs by lowering drawdowns in the wells. Thirteen deep wells currently have VFDs – 6, 7, 9, 13, 14, 15, 17, 25, 26, 27, 29, 30, and 31. VFDs are planned for the deep wells at 11, 16, 18, 20, and 28 in 2021. The addition of these five VFDs should save the Utility roughly \$7,500 per month or \$90,000 a year in electric costs.

Indirectly, VFDs on booster pumps have also allowed us to minimize deep well pumping at some sites. MWU recently installed VFDs on the booster pumps at Wells 9, 14, and 27. The booster pumps at UW 18 and BS 128 are scheduled to have VFDs installed on their booster pumps in 2021.

MWU has recently automated the operations at a number of its well sites utilizing its SCADA system. Certain wells and boosters now operate on a time basis (TOD), insuring that a certain amount of run time/volume is produced on a daily basis. This, where implemented, has allowed us to control utilization rates significantly. We will continue to expand the automated operations where possible in the near future.

MWU is currently planning/working on several construction projects that will affect utilization rates:

- The reconstruction of UW 12, making it a two zone well, will reduce utilization rates in the far west pressure zones (UW 12, UW 20, and UW 26). This project is scheduled for 2024
- The construction of Booster Station 129 on the Far East side of the city. The addition of this facility will reduce utilization rates at UW 25, the only well site located in Zone 3. This project is scheduled for 2025.
- The construction of a new well on the far west side of the city. The project would lower the utilization rates for all of the wells located in Zone 8. It is projected to occur in 2025.

Graduate Student Energy Research

Our 11th MWU sponsored Graduate Student, Tara Hawes, has continued her energy conservation and cost saving research on our pumping operations. The overall objectives of this energy conservation research project include: 1) identifying pumping operation protocols and schedules that will optimize energy conservation; 2) identifying projects with the highest potential for energy reduction; 3) evaluating ways to reduce energy costs through off-peak pumping; 4) evaluating, recommending, and demonstrating energy conservation projects; and 5) laying the framework for system operational optimization.

Tara is currently analyzing energy requirements and pumping schedules for Pressure Zone 6E. This zone constitutes a large portion of our distribution system on the east side of the City. It is fairly complex, containing seven wells, four booster stations and four stand-alone reservoirs. In addition to optimizing cost savings through time of day pumping here she is looking into opportunities for energy conservation throughout the system. She is hoping to be finished with her research project in late August of this year.

5. The Utility shall track the carbon footprint of Utility operations using quantitative tools (for example, energy intensity analysis) so that sustainability may be considered in planning...

The Utility has reached out to the City of Madison's (COM) sustainability staff for direction and assistance in determining MWU's carbon footprint. COM has calculated the footprints of all of its departments in the past and is planning to do so again in the future. The process however, is complex and takes a great amount of staff time. As a result, the Water Utility has placed money in the 2021 budget to hire a UW student to assist in determining its own carbon footprint. After completion, the intent is to calculate it on an annual basis. We will hopefully have some numbers later this year.

I report compliance.

Attachments:

Aquifer Water Levels Graph
Unit Well Capacity Table

Figure 1: Aquifer Water Levels - State Capitol Well

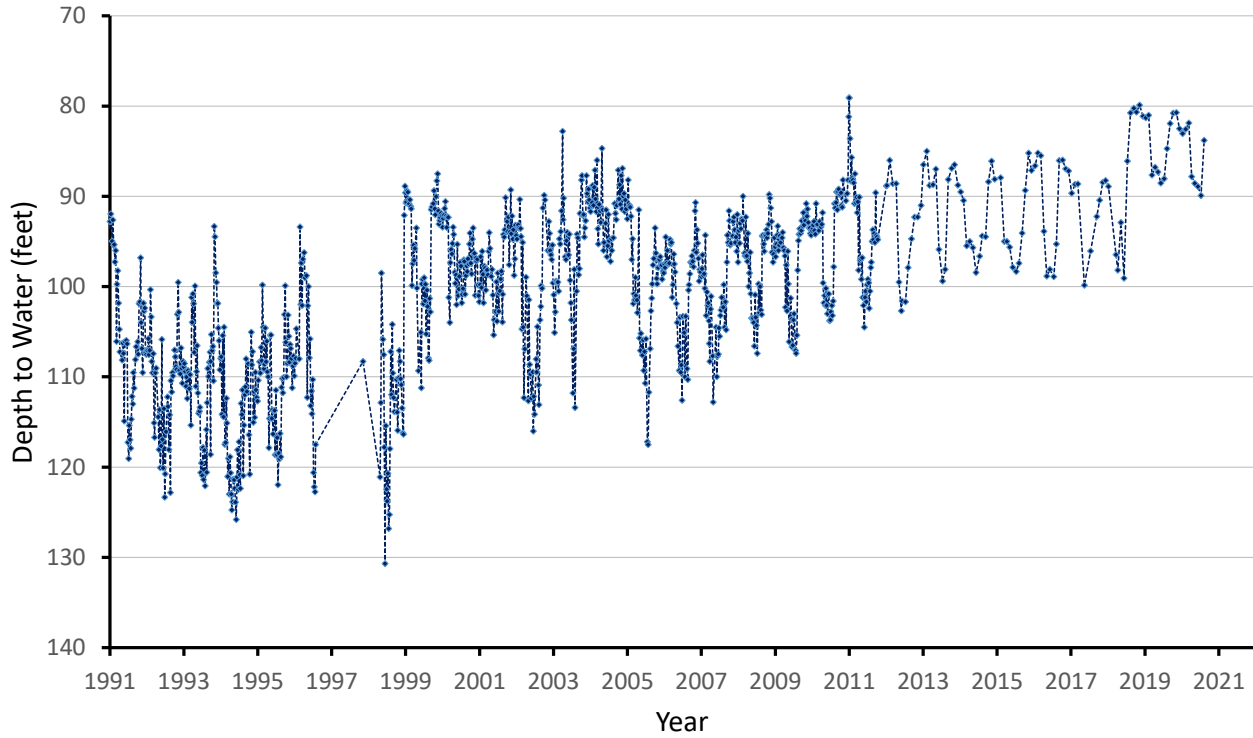


Figure 2: UW 20 Static Water Levels

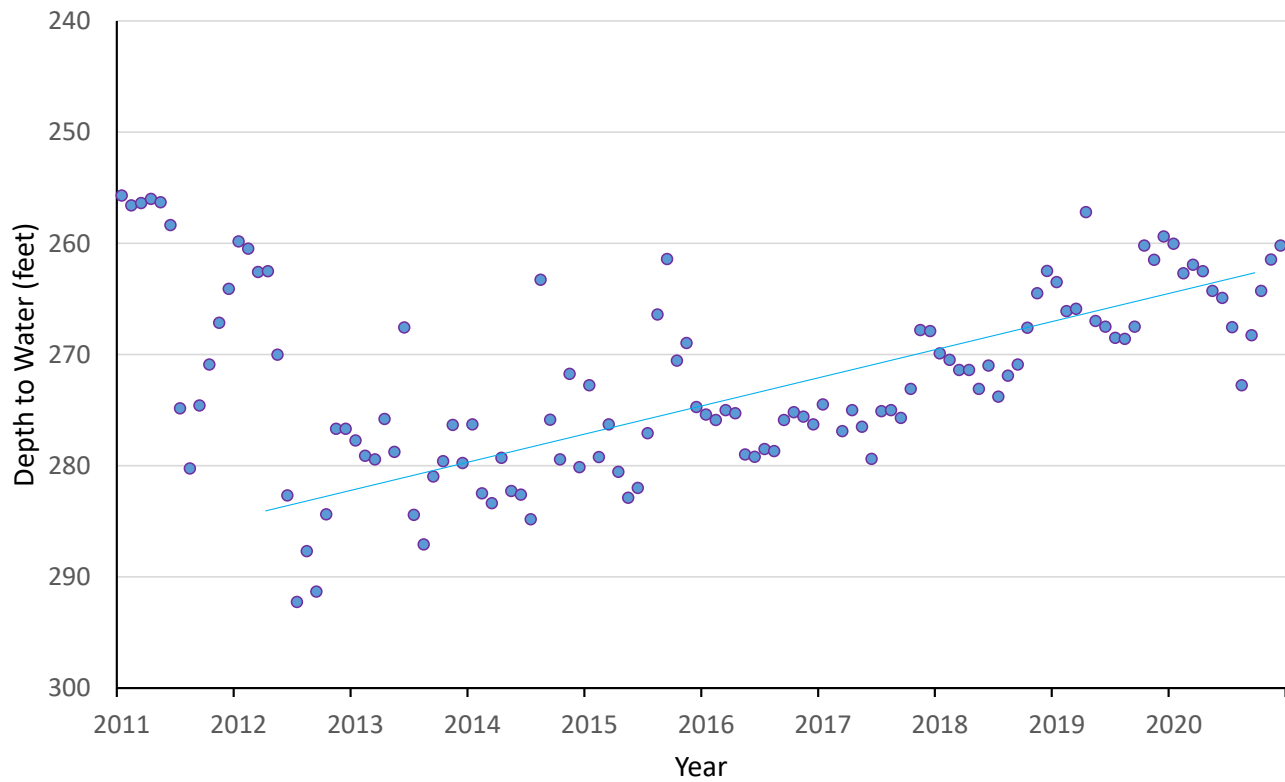


Table 1: 2020 Unit Well Capacity

Start Date: January 01, 2020

End Date: December 31, 2020

Unit Well	Well Capacity GPM	Total Daily Capacity MGD	Total Capacity To Date Mil Gal	Actual Pumpage To Date Mil Gal	% Well Utilization		Well Run Hours To Date	Well Rest Hours To Date	% Well At Rest To Date	% Well Running To Date
6 *	2,650	3.8	1,396.7	455.6	32.6%		3,226.1	5,557.9	63.3%	36.7%
7 *	2,200	3.2	1,159.5	573.4	49.4%		5,515.4	3,268.6	37.2%	62.8%
8	1,980	2.9	1,043.5	92.5	8.9%		814.7	7,969.3	90.7%	9.3%
9 *	1,640	2.4	864.3	157.0	18.2%		1,597.1	7,186.9	81.8%	18.2%
11	2,090	3.0	1,101.5	531.9	48.3%		4,246.3	4,537.7	51.7%	48.3%
12	2,160	3.1	1,138.4	584.8	51.4%		4,327.8	4,456.2	50.7%	49.3%
13 *	2,620	3.8	1,380.8	451.4	32.7%		3,037.4	5,746.6	65.4%	34.6%
14 *	2,450	3.5	1,291.2	691.5	53.6%		6,973.4	1,810.6	20.6%	79.4%
15 *	2,200	3.2	1,159.5	0.0	0.0%		0.0	8,784.0	100.0%	0.0%
16	2,400	3.5	1,264.9	450.0	35.6%		3,133.6	5,650.4	64.3%	35.7%
17 *	2,290	3.3	1,206.9	251.4	20.8%		3,428.0	5,356.0	61.0%	39.0%
18	1,620	2.3	853.8	397.7	46.6%		4,131.9	4,652.1	53.0%	47.0%
19	2,350	3.4	1,238.5	288.8	23.3%		2,017.0	6,767.0	77.0%	23.0%
20	2,025	2.9	1,067.3	441.4	41.4%		3,588.6	5,195.4	59.1%	40.9%
24	2,025	2.9	1,067.3	312.2	29.3%		2,524.8	6,259.2	71.3%	28.7%
25 *	2,000	2.9	1,054.1	381.0	36.1%		3,953.6	4,830.4	55.0%	45.0%
26 *	2,250	3.2	1,185.8	497.9	42.0%		3,913.4	4,870.6	55.4%	44.6%
27 *	1,775	2.6	935.5	213.7	22.8%		2,324.2	6,459.8	73.5%	26.5%
28	2,300	3.3	1,212.2	484.4	40.0%		3,594.4	5,189.6	59.1%	40.9%
29 *	2,200	3.2	1,159.5	564.6	48.7%		8,565.2	218.8	2.5%	97.5%
30 *	2,400	3.5	1,264.9	682.4	53.9%		8,330.7	453.3	5.2%	94.8%
31 *	2,200	3.2	1,159.5	224.6	19.4%		2,774.0	6,010.0	68.4%	31.6%

* Denotes wells with variable frequency drives (VFDs)