

Internal Monitoring Report

Policy # O-2E Sustainability

Date: January 29, 2019

Frequency: Twice a year

I certify that the following information is true.

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.

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 the goal of a 20% reduction per capita residential use of water by 2020, which equates to 58 gallons/capita/day. (Residential is defined as single family and duplex dwellings.)
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.
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.
6. Water rates will complement economic growth in Madison (as stated in 0-2D).

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.

Water 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 (pumping) and recharge (precipitation.)

As in past years, summer levels were lower than those experienced during the winter. Levels

were as much as 18 feet lower during the summer months. Overall, aquifer levels appear to be increasing or rebounding with an increase of approximately 13 – 15 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. Levels during the fall/winter of 2018, however, 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.

As expected, static and pumping water levels in many of Madison Water Utility's supply wells varied throughout the year. 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 wells continue to fluctuate seasonally and are greatly influenced by precipitation events.

A review of the recent water level data indicates that water levels in the wells are rising as winter demands decrease. The increase in water levels is higher however than we normally experience during this time of year. There are several reasons for this. First of all, total precipitation in 2018 was well above average. We received 50.6 inches of precipitation in 2018, which is about 16.2 inches (47.1%) more than the annual average of 34.4 inches. The increase in precipitation means more water available to recharge the area's aquifers. Secondly, pumpage was down again from past years – less removal/extraction means higher water levels. It should be noted that precipitation amounts in the Madison area are anticipated to be above average into the near future.

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

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.

Madison Water 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 from an October 2018 sampling 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 continue to decrease (improve).

The sentinel well planned for the UW 8 area remains postponed because of budgetary constraints. This deep monitoring well was to be installed at a location between the Madison Kipp Corporation groundwater plume and UW 8. It would be used as an early warning for any migrating contaminants. It is hopeful that this well can be installed in the 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 nineteen samplings conducted to date. The second round of sampling this year was conducted in October.

In terms of Volatile Organic Compounds (VOCs), the samples are analyzed for a total of 51 different compounds. Results from the latest October 2018 sampling revealed one minor VOC detect.

- Trichlorofluoromethane was detected in the shallowest port at a level of 0.31 ug/l. This detect is below the level of quantification (1.1 ug/l) and there is no MCL for this compound. Trichlorofluoromethane exists in the water table aquifer at low concentrations throughout the area and is not related to the landfill.
- No VOCs were detected in water from any of the other ports including UW 29.

For inorganics, 22 different parameters are analyzed for. Several different inorganics were detected at elevated levels in the water tested in October.

- Port 1 (depth of 90-95') had a chloride concentration of 265mg/l this round (MCL = 250). Chloride levels in this port have steadily increased over the last seven years and are likely a result of local road salt practices.
- As in past samplings, elevated levels of manganese were detected in the water from Port #5 (153 ug/l). It is believed that the manganese is naturally occurring and exists at these depths (400 -420') throughout the area.
- Water from UW #29 tested high for iron (0.305 mg/l) and manganese (58.2 ug/l). Water from this well is filtered for these two constituents prior to entering the distribution system.

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. This well continues to pump at half capacity (1100 gpm) on a 24/7 basis. It supplied slightly over a half billion gallons of water to Madison in 2018.

UW 14 - Chloride Study

The investigation into potential sources of chloride contamination at Well 14 is on-going. The two water table monitoring wells installed in Spring Harbor Park are currently being monitored. Monthly monitoring for chloride and sodium will continue through June 2019. Utility staff is exploring options to continuously monitor the water level and specific conductance at the monitoring wells. Finally, a project page and email distribution list have been developed to keep neighbors and customers informed about the progress of the project.

UW 27 - Radium Study

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

UW 19 - Radium Removal Study

A pilot scale test to remove iron, manganese and radium was recently 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 2025.

UW 31 - Zone 4 Production Well

Construction of the well facility at 4901 Tradewinds Parkway is now complete. This newly constructed well facility is able to provide 2.5 – 3.0 million gallons of water a day into Zone 4.

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. To date, no TCE or any other volatile organic compounds have been detected at the Tradewinds Parkway well. The Tradewinds Parkway site 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, we continue 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. We continue to remind the WDNR of the City's plans to upgrade UW #8 with an iron and manganese filter.

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

3. The adopted Conservation Plan shall be monitored and evaluated regarding progress to fulfill the goal of a 20% reduction per capita residential use of water by 2020...

MWU pumped a total of 9,222,670,000 gallons of water to the distribution system during 2018. This is approximately 2.1% less than the 9,418,637,000 gallons pumped last year - 2017.

Average Day: 25,268,000 gpd (last year 25,804,000 gpd)

Max Day: 34,750,000 gpd on May 30 (38,887,000 gpd on June 16)

Min Day: 17,600,000 gpd on November 23 (16,800,000 gpd on November 24)

As mentioned earlier in this report, precipitation for the year was well 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:

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 ***

Goal: 2020 58.0 *

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

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

*** Average per-person daily consumption for **all** Madison residents - includes people living in both single-family homes 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. Madison Water 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 during 2018 were very similar to those experienced in 2017. Through December 31, 2018, four different wells exceeded the 50% utilization rate (11, 12, 14, and 30.) The rates at two of the wells (11 and 12) were reduced this year by increasing pumpage at adjacent sites. We will continue to increase pumpage at the adjacent sites to lessen the usage of 11 and 12 even more in 2019. Rates at the other two well sites (14 and 30) cannot be lessened without improvements to our 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 us to directly minimize the utilization rates of these wells. In addition, the VFDs help in lowering our electrical usage/costs by lowering drawdowns in the wells. Nine deep wells currently have VFDs – 7, 15, 17, 23, 26, 25, 29, 30, and 31. UW 26 was recently fitted with a VFD in December of 2018. We will save approximately \$12,500/year in electrical usage by running this well at a slower rate. At these savings, the payback on this unit is 1.8 years.

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 12 and 25. The booster pumps at Wells 19 and 27 will have VFDs installed on their booster pumps in the near future.

MWU recently completed several projects that effect utilization rates:

- The completion of UW 31 in mid-2018. The addition of this well has significantly lowered the utilization rate of UW 9, the only other well in Zone 4.
- The construction of the Blackhawk Tower (228) on the far west side in late 2018. The addition of this tower has allowed us to reduce the utilization rate of UW 26/Tower 126.

MWU is also 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 2022.
- 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 2023.

Actual utilization rates for 2018 are depicted in Table 1.

Graduate Student Energy Research

MWU's Graduate Student, Adam Luthin, continues his work researching energy conservation in the pumping operations. It is anticipated that Adam will finish his degree in May and he will then start his career with a job in Milwaukee. The overall objectives of this energy conservation research project include: 1) identify pumping operations that will optimize energy conservation, 2) identify projects with the highest potential for energy reduction; 3) evaluate, recommend, and demonstrate energy conservation projects to MWU, and 4) lay the framework for system operational optimization.

As reported to the Water Board in August, Adam outlined an off peak pumping schedule for the west side of the system (Zones 8, 10, and 11). Preliminary findings from this study indicate a savings of approximately \$7,000 per month are possible by pumping at night during off peak times. We have not observed any adverse impacts to system operations.

The second phase of the west side work involved the installation of a variable speed drive on the deep well pump at Well 26. This modification will investigate additional energy savings resulting from lower rate pumping at Well 26.

Adam is working on the groundwork for analyzing energy requirements for Pressure Zone 6e, the east side of the system. This work builds on the work completed on the west side and intends to build an optimized pump operating schedule. Once completed, energy savings similar to the west side could be realized using off peak pumping. Ideally, protocols developed

will guide further optimization of operations and additional opportunities for energy conservation.

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 City of Madison (COM) calculates the carbon footprint of all of its departments every two years. Madison Water Utility is waiting for the results of the most recent analysis conducted by the City. We plan to do an in-house analysis for the year 2018.

6. Water rates will complement economic growth in Madison (as stated in O-2D).

Please refer to the Monitoring report for the Affordability Outcomes Policy (O2-D).

I report compliance.

Attachments:

Aquifer Water Levels Graph
Unit Well Capacity Table

Figure 1: Aquifer Water Levels - State Capitol Well

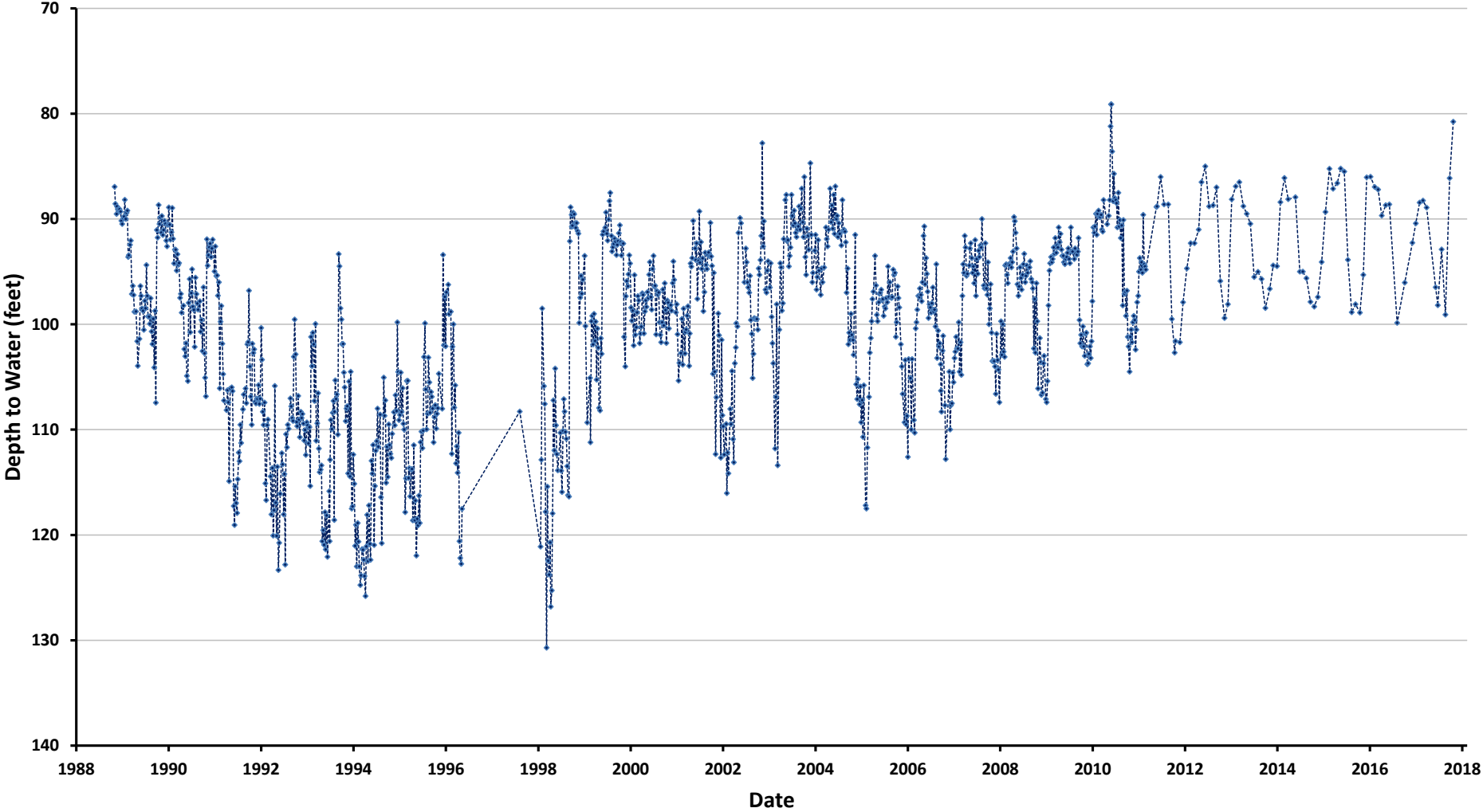


Table 1: 2018 Unit Well Capacity

Start Date: January 01, 2018

End Date: December 31, 2018

Unit Well	DW Capacity GPM	Total Daily Capacity MGD	Total Capacity To Date Mil Gal	Actual Pumpage To Date Mil Gal	% DW Utilization		DW Run Hours To Date	DW Rest Hours To Date	% DW At Rest To Date	% DW Running To Date
6	2,650	3.8	1,392.8	395.8	28.4%		2,523.3	6,236.7	71.2%	28.8%
7 *	2,200	3.2	1,156.3	453.3	39.2%		4,464.2	4,295.8	49.0%	51.0%
8	1,980	2.9	1,040.7	54.5	5.2%		462.5	8,297.5	94.7%	5.3%
9	1,720	2.5	904.0	213.4	23.6%		2,142.7	6,617.3	75.5%	24.5%
11	2,090	3.0	1,098.5	604.7	55.0%		4,678.3	4,081.7	46.6%	53.4%
12	2,160	3.1	1,135.3	694.4	61.2%		5,323.8	3,436.2	39.2%	60.8%
13	2,620	3.8	1,377.1	405.4	29.4%		2,593.1	6,166.9	70.4%	29.6%
14	2,450	3.5	1,287.7	865.5	67.2%		5,886.7	2,873.3	32.8%	67.2%
15 *	2,200	3.2	1,156.3	370.7	32.1%		5,587.9	3,172.1	36.2%	63.8%
16	2,300	3.3	1,208.9	511.6	42.3%		3,525.0	5,235.0	59.8%	40.2%
17 *	2,290	3.3	1,203.6	327.9	27.2%		3,506.5	5,253.5	60.0%	40.0%
18	1,720	2.5	904.0	450.8	49.9%		4,516.1	4,243.9	48.4%	51.6%
19	2,150	3.1	1,130.0	341.7	30.2%		2,597.7	6,162.3	70.3%	29.7%
20	2,025	2.9	1,064.1	465.9	43.8%		3,832.9	4,927.1	56.2%	43.8%
23 *	1,310	1.9	688.5	0.0	0.0%		0.0	8,760.0	100.0%	0.0%
24	2,025	2.9	1,064.3	419.3	39.4%		3,467.1	5,292.9	60.4%	39.6%
25 *	2,000	2.9	1,051.2	359.2	34.2%		3,788.6	4,971.4	56.8%	43.2%
26	2,250	3.2	1,182.6	454.6	38.4%		3,572.7	5,187.3	59.2%	40.8%
27	1,775	2.6	932.9	67.6	7.2%		597.0	8,163.0	93.2%	6.8%
28	2,300	3.3	1,208.9	435.1	36.0%		3,252.7	5,507.3	62.9%	37.1%
29 *	2,200	3.2	1,156.3	543.2	47.0%		8,421.6	338.4	3.9%	96.1%
30 *	2,400	3.5	1,261.4	663.8	52.6%		8,238.7	521.3	6.0%	94.0%
31 *	2,200	3.2	1,156.3	124.3	10.8%		1,629.1	7,130.9	81.4%	18.6%

* Denotes wells with variable frequency drives (VFDs)