

SUMMARY OF MADISON WATER UTILITY/UW-MADISON CEE RESEARCH PROGRAM

January 2021

The collaborative research partnership between Madison Water Utility and UW-Madison's Department of Civil and Environmental Engineering has been in place since September 2002. Since that time, 10 graduate students have completed an MS Thesis having practical value to the utility and an 11th graduate student is working toward completion in Summer 2021.

There have been three general areas of research covered by these thesis reports:

- Free chlorine residual and control of microbial growth in the distribution system.
- Unidirectional flushing strategies for control of turbidity spikes in the distribution system.
- Energy saving strategies for system operational optimization.

Key findings in each of these areas are as follows:

- The chlorine residual and microbial control research led to a policy requiring a chlorine residual of at least 0.3 mg/L throughout MWU's distribution system. Prior to the research, MWU maintained a "non-zero" chlorine concentration throughout the distribution system. This reduced need for follow-up microbial sampling and improved customer confidence in water quality.
- Unidirectional flushing research showed that approximately 60% of the distribution system could be unidirectionally flushed at a frequency of once every 2 to 3 years, instead of annually. This provided scientific support for a significant savings in person-hours and labor costs needed for unidirectional flushing. This also reduced the number of customer complaints and the costs of responding to those complaints.
- Energy savings are best achieved by reducing the amount of well drawdown, which can be achieved by installing variable frequency drives (VFDs) on deep well pumps. This was demonstrated by installing a VFD at Unit Well 30. The top remaining candidates for VFD installation on deep well pumps are Unit Wells 6, 13, 9, and 11. Purchase and installation of VFDs on these five deep well pumps are estimated to save over 840 MWh and over \$75,000 annually, with payback periods less than 5 years. VFDs could be installed with a payback of 10 years or less on approximately half of the deep well pumps in the system.
- Energy cost savings are best achieved by pumping at hours of reduced electrical costs, known as off-peak pumping. For example, off-peak pumping in Pressure Zone 8 can save approximately 40% of the annual electricity costs in this portion of the system. Preliminary results with east side pressure zones suggest 30% savings is possible in that part of the system.

Overall, these studies have yielded significant annual savings in salaries and energy expenses for MWU. After accounting for the costs of the graduate program, MWU estimates that the graduate program will have collectively saved over \$3 million in operational costs from its inception in 2002 through August 2024.

Intangible benefits to this collaborative research partnership between MWU and UW-Madison's CEE Dept is the relationship building and knowledge resource sharing. Informal discussions of issues facing MWU, participation in Senior Capstone projects, and membership on the Utility Water Quality Technical Advisory Committee provide invaluable benefit to MWU.

Other areas of study being considered by MWU for the coming years include but definitely are not limited to: System Pressure Optimization; Leakage Management; Water Conservation; Asset Management; PFAS Mitigation, and Roadsalt impact to Ground Water.

