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MEMORANDUM

Date: December 23, 2014

To: Water Utility Board

From: Adam Wiederhoeft and Al Larson

Re: Unit Well 31 – Energy Analysis
Graduate Research Project

Background

Matt Hayes, our current UW-Engineering Grad Student, has been working on energy saving strategies as a part of his Master's Thesis work at the University. Matt has been focusing on Pressure Zone 4 using the distribution system computer model to evaluate energy use and potential savings. Using the model to estimate energy use under different pumping conditions, Matt has been able to determine the energy use and overall energy cost for Pressure Zone 4. The calculated cost of energy within PZ 4 is based on MGE rate schedule Cg-4 for 2014 and includes distribution system charges and peaking factors. The analysis also takes into account the time of day in calculating total energy costs. Matt has prepared a short technical memo on his work in an effort to provide additional information for the evaluation of Well 31.

At the November Water Utility Board meeting there were several questions about the operating cost and configuration of Well 31. Matt has been looking at how Well 31 and Well 9 could be operated to provide water supply to Pressure Zone 4. Due to the difference in the specific capacity between the two wells, Well 31 estimated at 10 gpm/ft of drawdown and Well 9 estimated at 26 gpm/ft, the general cost to operate Well 31 will be greater than Well 9. Matt is working on evaluating how to mitigate that difference in energy requirements.

Analysis

In the attached energy analysis a flow distribution of 50% from each well was considered using a total average water demand in PZ 4 of 1.31 million gallons. Variable speed pumping for the deep well at Well 31 was the only option considered to mitigate power costs at the well at this time.

A base cost estimate of approximately $82,000 per year to operate Well 9 to supply 100% of the water to PZ 4 was developed as a comparison point. This cost is compared to the total operational cost of providing 50% of the water for PZ 4 from Well 31 and 50% of the water from Well 9. This analysis is presented on page 2 of the attached memo in two

plots. The first plot provides the total kwhr per year and the second provides power costs per year in 2014 dollars based on the current rate schedule.

Without a VFD on the deep well at Well 31 the additional cost to operate Well 31 to provide 50% of the water is estimated to be approximately $28,000 per year. With a VFD on the deep well operating at 80% speed, the difference in energy costs drops to approximately $12,000 per year. This results in an estimated saving of $16,000 per year.

With implementation of off peak pumping an additional estimated $7,500 per year savings could be realized. With off peak pumping there is no energy savings. The cost savings is a result of a reduced kwhr rate when pumping at night.

Future Work

Matt will continue to evaluate different operating scenarios, VFD operation, well specific capacity impacts, and hydraulic gradient impacts using the Utility's computer model as he finishes up his Master's thesis. From this work the impact of well specific capacity on energy demand is significant. The well specific capacity is also very important when considering the benefit of adding a VFD to the well pump configuration.

Conclusions and Recommendations

Based on the information developed in the graduate research project, early analysis would indicate that the difference in energy efficiency resulting from the difference in specific capacity between Well 9 and Well 31 can be mitigated with the use of a VFD on the deep well.

Additional study will determine if manipulating the hydraulic grade line will provide additional energy savings. Off peak pumping will also be considered as a way to cut costs.