DR17.17 SCE Flexible Load Opportunities IRWD Recycled Water System Hydraulic Modeling

PURPOSE

The operation of water and wastewater (W-WW) utilities – specifically moving and treating water – requires large amounts of energy. Shifting the time of W-WW utility operations through adjustments to daily time-of-use and seasonal storage availability has the potential to change the associated energy demand patterns.

This study investigates if W-WW hydraulic models can be used to estimate how changes to water system operations impact time of electrical use while meeting all supply and hydraulic requirements, and in turn provide overgeneration mitigation support. Irvine Ranch Water District (IRWD) is a Southern California Edison (SCE) water-energy partner and with SCE's approval selected the Lake Forest service area of their recycled water system and the hydraulic model to use as a case study for this project.

Image 1: IRWD Recycled Water System

Electrical energy overgeneration occurs when real-time electric supply exceeds real-time electric demand. The highest value means to mitigate overgeneration is therefore the ability to increase electric use during periods of time when overgeneration occurs. This project was designed to utilize IRWD's existing hydraulic modeling tools to simulate shifting pumping operations to occur during periods of overgeneration.

APPROACH

This project was designed to utilize IRWD's existing hydraulic modeling tools to simulate shifting pumping operations to occur during periods of overgeneration. Daily overgeneration was assumed to be 9:00 am to 4:00 pm, and seasonal overgeneration was assumed to start on February 15 and end on June 15, based upon information provided by SCE.

Two operational alternatives were developed and simulated within the hydraulic model:

- **Alternative 1** maximized pumping between 9:00 am to 4:00 pm
- **Alternative 2** built on the daily adjustments of Alternative 1, and also maximized pumping between February 15 and June 15 by adding seasonal recycled water storage

Model results were used to quantify the impact of changing the pumping schedules in terms of annual energy use. The difference between the current energy use and the energy use of the two alternatives defined the potential for overgeneration mitigation support.

FINDINGS

The table below displays the results for energy consumed during daily overgeneration and seasonal overgeneration periods. As shown in Table 1, Alternative 1 provides almost no improvement compared to baseline conditions with regard to energy consumed during seasonal overgeneration periods. Alternative 2, provides significant increases in energy consumption during both daily and seasonal overgeneration periods.

Table 1. Results Summary – Total Energy Consumed, Daily and Seasonal Overgeneration

PUMP ENERGY CONSUMED, kWh					
Alternative	**Total During Daily Overgeneration**	**Total During Daily Non-Overgeneration**	**Total During Seasonal Overgeneration**	**Total During Seasonal Non-Overgeneration**	**Total Energy**
Baseline (Existing Conditions)	471,000	1,007,000	288,000	1,190,000	1,478,000
Alternative 1 (Daily)	1,051,000	549,000	312,000	1,288,000	1,600,000
Alternative 2 (Daily and Seasonally)	1,243,000	668,000	1,287,000	624,000	1,911,000

The energy used during both daily and seasonal overgeneration periods consists of the intersection of the energy used during the daily overgeneration period and the energy used during the seasonal overgeneration period. As an intersection (subset) of these values, the energy used during both daily and seasonal overgeneration periods is a smaller value than either value separately. The results for this value for each alternative are shown below. Although increasing the energy consumed during any overgeneration period can be valuable, energy consumed during both the daily and the seasonal overgeneration periods provide a convenient summary of effectiveness for each alternative.

Table 2. Results Summary – Total Annual Energy Consumed, Daily + Seasonal Overgeneration Period

Alternative	**Pump Energy Consumed, kWh**		**Percent of Total Energy During Daily + Seasonal Overgeneration**
	Total Energy Used	**Total During Daily + Seasonal Overgeneration**	
Baseline (Existing Conditions)	1,478,000	92,000	6%
Alternative 1 (Daily)	1,600,000	205,000	13%
Alternative 2 (Daily and Seasonally)	1,911,000	831,000	43%

Conclusion

The results presented in this report indicate that there is potential to mitigate overgeneration, both on a daily and seasonal basis, in the Lake Forest service area of the IRWD recycled water system. As a result of this project, several critical lessons were identified:

- While the hydraulic model is critical for evaluation, the hydraulic model can only provide a snapshot of a particular hydraulic scenario.
- Seasonal storage provides the ability to mitigate seasonal overgeneration. However, it is difficult to locate and expensive to construct.
- A water quality evaluation should be considered in future studies if such a project is being seriously considered.
- W-WW hydraulic models can be a valuable tool for assessing electric impacts of changes to W-WW systems and operations and provided the basis for the evaluation.
- For other potential study areas looking to be evaluated for overgeneration impacts, a preliminary feasibility evaluation method should be developed.

These Findings are based on the report "SCE Flexible Load Opportunities IRWD Recycled Water System Hydraulic Modeling" which is available on the Demand Response Emerging Technologies website: **https://www.dret-ca.com/**