Dr. Dominic Boccelli, Associate Professor in the Department of Biomedical, Chemical and Environmental Engineering at the University of Cincinnati completed an Ohio Water Resources Center funded project via Ohio Water Development Authority subaward. This project titled "**Spatial Demand Estimation: Moving Towards Real-Time Distribution System Network Modeling"** aims to develop a composite demand-hydraulic model – one that couples a demand model with a network hydraulic solver. This model will enable real-time water demand estimation and forecasting, that water utilities could use to assist with, for example, pump scheduling.

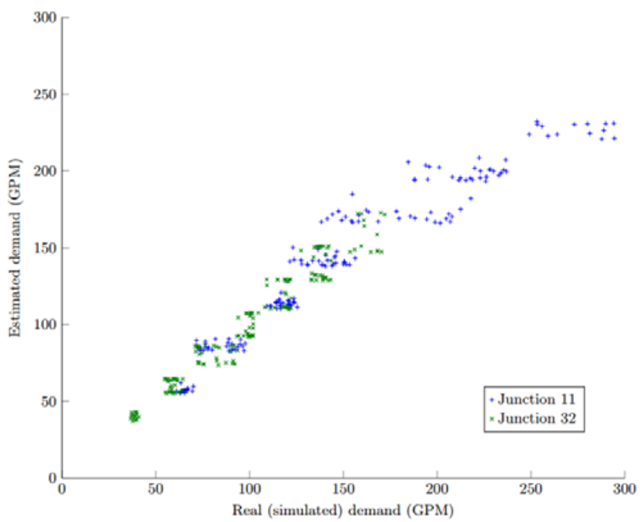

Figure 1 Scatter plot of the estimated (Y axis) versus the "real" (X axis) demands for best and worst performing consumer nodes for one-week time span. Junction 11 – blue plus signs, Junction 31 – green crosses.

The central hypothesis was that the observed hydraulic data commonly collected via utility SCADA systems can be used to estimate the expected values and uncertainty from a composite demand-hydraulic model that characterizes the temporal and spatial patterns of consumptive demands. The development of the composite demand-hydraulic model was shown capable of estimating the demands and parameters of a time series model using limited hydraulic information (Figure 1). From the figure, the estimated demands generally matched the real demands, but the estimates for the high-demand hours are not as accurate as those for low-demand hours. Noticeably, the high demands at Junction 11 (greater than 200 GPM) are mostly underestimated. Furthermore, the proposed clustering algorithm was shown capable of grouping nodes based on similarities in water quality (Figure 2). This ability to group nodes will provide opportunities to reduce the scale of network demand estimation problems. the clustering approach presented allows the grouping of nodes with similar water quality characteristics that can also help to reduce the problem scale of other applications such as locating sensors for contaminant warning systems or identifying regulatory sampling locations.

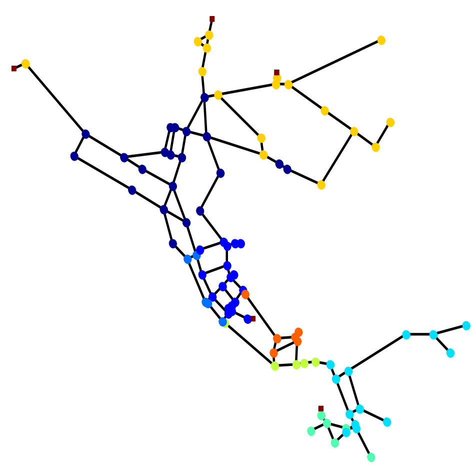

Figure 2. Results of the clustering algorithms applied to a small test case network. The consumer nodes (circles) have been clustered into eight groups of nodes with similar hydraulic impacts.

<u>Researcher Profile:</u> Dr. Dominic Boccelli's primary research interests are in the areas of Water Resources, Water Quality, and Environmental Systems Analysis. His research activities are expected to focus on developing decision support tools based on fundamental principles of environmental engineering and science to assist engineers, managers, and policy makers in making technology, design, and regulatory decisions. More explicitly, these tools will incorporate various mathematical modeling and optimization techniques to attain the desired objectives.