

AN OVERVIEW OF THE WATER NETWORK TOOL FOR RESILIENCE (WNTR)

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ABSTRACT

Drinking water systems face multiple challenges, including aging infrastructure, water quality concerns, uncertainty in supply and demand, natural disasters, environmental emergencies, and cyber and terrorist attacks. All of these incidents have the potential to disrupt a large portion of a water system causing damage to critical infrastructure and interrupting service to customers. Recent events, including the floods and winter storms in the southern United States, highlight vulnerabilities in water systems and the need to minimize service loss. Simulation and analysis tools can help water utilities better understand how their system would respond to a wide range of disruptive incidents and inform planning to make systems more resilient over time.

The Water Network Tool for Resilience (WNTR) is a new open source Python package designed to meet this need (Klise et al., 20217). WNTR integrates hydraulic and water quality simulation, a wide range of damage and response options, and resilience metrics into a single software framework, allowing for end-to-end evaluation of water network resilience. WNTR includes capabilities to 1) generate and modify water network structure and operations, 2) simulate disaster scenarios, 3) model response and repair strategies, 4) simulate pressure dependent demand and demand-driven hydraulics, 5) simulate water quality, 6) calculate resilience metrics and 7) visualize results. These capabilities can be used to evaluate resilience of water distribution systems to a wide range of hazards and to prioritize resilience-enhancing actions. Furthermore, the flexibility of the Python environment allows the user to easily customize analysis. For example, utilities can simulate a specific incident or run stochastic analysis considering range of probabilistic scenarios.

The U.S. Environmental Protection Agency and Sandia National Laboratories are working with water utilities to ensure that WNTR can be used to efficiently evaluate resilience under different use cases. The software has been used to evaluate resilience under earthquake and power outage scenarios, run fire-fighting capacity and pipe criticality analysis, evaluate sampling and flushing locations, and prioritize damage repair strategies.

This talk will include discussion on WNTR capabilities, water utility case studies, and resources to help get new users started using the software. WNTR can be installed through the U.S. Environmental Protection Agency GitHub organization at <https://github.com/USEPA/WNTR>. The GitHub site includes links to software documentation, software testing results, and contact information.

Klise, K.A., Hart, D.B., Moriarty, D., Bynum, M., Murray, R., Burkhardt, J., Haxton, T. (2017). Water Network Tool for Resilience (WNTR) User Manual, U.S. Environmental Protection Agency Technical Report, EPA/600/R-17/264, 47p.

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