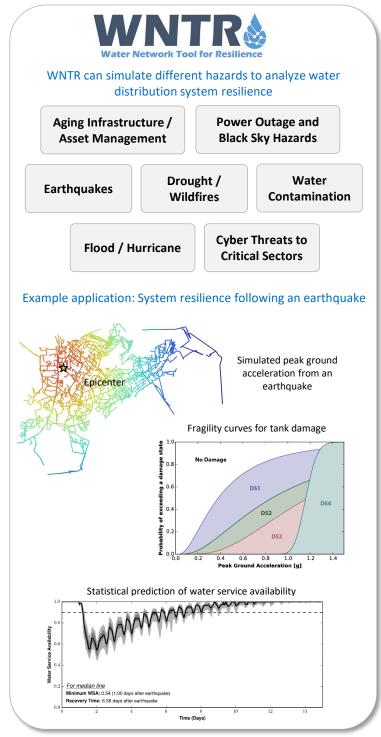Drinking water distribution systems face multiple challenges, including aging infrastructure, water quality concerns, pipe breaks, uncertainty in supply and demand, natural disasters, environmental emergencies, and targeted attacks. All of these factors have the potential to disrupt a large area. Increasing resilience to these types of hazards is essential to improving water security. Simulation and analysis can help water utilities predict how their system will respond to incidents and help inform decisions to make water distribution systems more resilient over time.

The **Water Network Tool for Resilience (WNTR)** is an open-source Python package designed to simulate and analyze resilience of water distribution systems. The United States Environmental Protection Agency (EPA), in partnership with Sandia National Laboratories, developed WNTR to integrate multiple critical aspects of resilience modeling for water distribution systems into a single software framework.

The software includes capability to:
- Build water network models
- Integrate geographic information system (GIS) data into models and analysis
- Modify network structure and operations
- Assign fragility and survival curves to network components
- Model disruptions such as power outages, earthquakes, fires, pipe breaks, and contamination incidents
- Model response and repair strategies
- Simulate hydraulics and water quality
- Evaluate resilience using a wide range of metrics
- Integrate dependency with other critical infrastructure and supply chains
- Analyze results and generate graphics

WNTR can be used to estimate infrastructure damage, evaluate preparedness strategies, prioritize response actions, and identify worst case scenarios and best practices for maintenance and operations. WNTR can be installed through EPA's GitHub site at https://github.com/USEPA/WNTR. Documentation is available at https://usepa.github.io/WNTR/. EPA summary report, EPA/600/S-23/240, provides example WNTR case study applications to long term power outages, earthquakes, and source water loss scenarios. WNTR tutorials are also available at the WNTR GitHub site.

WNTR
Water Network Tool for Resilience

WNTR can simulate different hazards to analyze water distribution system resilience

Aging Infrastructure / Asset Management	Power Outage and Black Sky Hazards

Earthquakes	Drought / Wildfires	Water Contamination

Flood / Hurricane	Cyber Threats to Critical Sectors

Example application: System resilience following an earthquake

Epicenter

Simulated peak ground acceleration from an earthquake

Fragility curves for tank damage

Statistical prediction of water service availability

For median line
Minimum WSA: 0.54 (1.00 days after earthquake)
Recovery Time: 6.58 days after earthquake

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