Preparedness and Response Practices to Support Water System Resilience:
Fundamentals, Good Practices, and Innovations
Overview

The information in this document is a snapshot of various practices that can be used to increase a utility’s resilience and build on or improve its emergency management procedures. The primary goal of this effort was to identify and disseminate unique, innovative, or otherwise notable practices and procedures in use around the country to help utilities refine existing programs and better prepare for, and respond to, emergencies. Utilities looking for industry standards and comprehensive frameworks for resilience, emergency preparedness, and security can visit www.awwa.org. A recommended framework for starting is embodied in the standard ANSI/AWWA G430-14: Security Practices for Operation and Management.

The research approach included a literature review, online survey, and follow-up interviews. The research team identified 225 literature sources; received 478 completed online surveys from water and wastewater personnel, state primacy agency personnel, emergency management personnel, and public health personnel; and interviewed 87 survey respondents. The information gathered was then categorized into six broad categories:

- **Administrative** – Practices related to legal frameworks, contracting mechanisms, funding arrangements, and creative partnerships.
- **Communications** – Practices centered on improving communications.
- **Resource Management** – Practices focused on how response personnel or equipment can be better managed or maintained.
- **Preparedness** – Practices to improve overall utility preparedness.
- **Incident Management** – Practices to better organize and manage a response.
- **Problem Solving** – Practices that help to solve a particular preparedness or response challenge.

Practices and procedures within each category were further grouped into fundamentals, good practices, or innovations. Fundamentals may already be in place at many utilities. Good practices serve as models for most utilities, and innovations include “out of the box” thinking or cutting edge technologies that may help increase utility resilience.

Remember, the categories and labels used in this document are subjective! Utilities should review the results in terms of what will be practical and implementable for their unique circumstances. Click on “Next Steps” to print a table to track the practices that you may wish to implement or investigate further. More information about the project and the research methodology can be found on the project 4601 webpage at www.waterrf.org.

**re·sil·ience**

/nəˈzīliəns/

noun: resilience; plural noun: resiliences

1. An ability to become strong, healthy, or successful again after something bad happens.
2. The capacity to recover quickly from difficulties; toughness.

noun: resil·i·ance

noun: resil·i·ant; plural noun: resil·i·ents
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• Use capital improvement projects as a customer education opportunity. Discuss how upgrades will increase resilience and decrease adverse impacts to the system, all benefits for your customers. One utility, when faced with a treatment process upgrade for arsenic removal, used this as an opportunity to inform their customers of the true cost of providing safe drinking water. As a result, the accepted rate increase not only included the cost of the treatment process upgrade, but also costs for the realistic operation and maintenance of the utility into the future.

• If you are a combined utility, cross train key staff positions to increase utility resilience.

• Build all new facilities in conformance with local seismic codes. If you have none locally, look to those produced by organizations such as the American Lifelines Alliance.

DID YOU KNOW?
You can prepare for an earthquake. Refer to the USGS’s Loma Prieta, California, Earthquake of October 17, 1989-Lifelines publication for tips on how water utilities and other “lifelines” responded to the 1989 Loma Prieta earthquake. For instance, the publication discusses the need to use flexible pipe joints in water systems (p. A61) and how to use shelf restraints to protect employees in earthquake-prone areas (p. A53). Four comprehensive articles on water and wastewater system response to the 1989 earthquake are provided with lessons learned and recommendations. In addition, the Federal Emergency Management Agency has published a Prepare Your Organization for an Earthquake Playbook. The playbook includes information on how to: hold a preparedness discussion with your organization; prepare your organization with tabletop exercises; run earthquake scenarios with exercises, discussion questions, and a facilitator’s guide; and how to maintain momentum for year-round preparation.
• One way to manage Personally Identifiable Information (PII) is to have a third party vendor store and be responsible for customers’ PII. One utility charges a 3% fee for paying a bill online with a credit card, and 1% of that charge goes to the third party vendor as payment.

• Make sure your utility is part of the local and state hazard mitigation process. Engage with your local or state hazard mitigation officer and have them ask community leaders to be sure to include water and wastewater utilities when creating or renewing hazard mitigation plans. Only projects included in a Federal Emergency Management Agency (FEMA)-approved hazard mitigation plan are eligible for certain kinds of FEMA funding.

• Learn how to conduct an After Action Review and develop an After Action Report & Improvement Plan (AAR/IP). The U.S. Fire Administration published Operational Lessons Learned in Disaster Response, and pages 49-51 outline how to conduct an After Action Review and develop an AAR/IP so that your utility can learn from its response and capture improvement planning items.

• Do you need help developing policies for how to use social media? The Power of Social Media: Legal Issues & Best Practices for Utilities Engaging Social Media article in the Energy Law Journal provides an exhaustive summary of the legal and regulatory issues potentially implicated by utility engagement in social media, and proposes good practices and guidelines for development of a social media policy that reduces the risks of social media for utilities (refer to pages 50-56).

CASE STUDY:
Many utilities rely on outside contractors and suppliers for help, especially during emergencies. But will they be there when you need them? The East Bay Municipal Utility District (EBMUD) has taken action to make sure that they will. For example, EBMUD has surveyed their critical vendors to ensure that they have a business continuity plan for their critical operations. Many times during regional disasters, like hurricanes and earthquakes, vendors can be just as affected as a utility. You want to be sure that your vendors have planned for their own sustainability. As a public entity, EBMUD cannot put vendors on retainer. But, EBMUD has established zero dollar purchase orders with certain critical vendors. In an emergency, EBMUD can allocate funds to the purchase orders. The language and specifications of the purchase orders are already established and approved.
Share specialized staff on a regular basis with other utilities. One utility has both an information technology (IT) staff and an electrician who are shared with another utility. This allows each utility to access fulltime services at part time costs.

Is your utility prepared for the staffing impacts of a pandemic? The Department of Homeland Security (DHS) has studied the effects of pandemic on lifeline critical infrastructure and it found that the greatest risk to the water and wastewater sector comes from the loss of available operators and support staff due to illness and absenteeism. It cites a previous report from the Association of Metropolitan Water Agencies (AMWA) and WaterISAC that found that the sector deemed roughly 41 percent of workers critical to maintaining systems. Learn more about preparing for pandemics using the Department of Homeland Security’s Pandemic Influenza Preparedness, Response, and Recovery Guide for Critical Infrastructure and Key Resources guide; Section 5.0 contains many planning, preparedness, response, and recovery considerations.

Fund your emergencies before they occur. To do this, make depreciation a fundable expense each year and put that money into a capital reserve fund. This fund will ensure that you have money for planned maintenance activities and help to avoid panic budgeting when something breaks.

Keep track of your retired personnel; some may be willing to come back and help during times of emergency.

Look to non-traditional sources of funding to get things done. State revolving loan funds are great, but can’t cover all needs. Use multiple grant and loan programs. Sources of federal funding that may help you with emergency preparedness and response are described at U.S. EPA’s Fed FUNDS site. If your utility is in a major metro area, you may be eligible for funding through an Urban Areas Security Initiative (UASI) grant; check with your local emergency management agency. Don’t forget other state funding sources as well, such as those related to economic development – many of these programs cover upgrades to drinking water and wastewater infrastructure as well.
• Establish subsidized loans for employees to purchase home emergency kits and supplies to promote staff resilience. Helping staff be more prepared at home will make it easier for them to leave home to assist the utility in an emergency. One utility was reimbursed for this through homeland security grant funding. Another utility provided their staff with “credits” to purchase 50-gallon water barrels to store emergency drinking water at home.

• Encourage your officials to help get your water utility noticed by others. In one state, a letter was sent from the Governor to electrical power companies urging them to consider water utilities as a priority for power restoration both during and after an incident.

• Take advantage of virtual reality (VR) technology. VR technology could prove helpful to orient resources arriving under mutual aid to the interior specifics of your facilities, or to conduct “full scale” exercises without actually going into the field.
• Use terminology that will be understood by the public during notifications. For example, one utility used the term “non-detectable” with the public because the laboratory could not detect the contaminant in the water using their methodologies. The public was frustrated, however, because they could still smell or “detect” the contaminant in their water.

**DID YOU KNOW?**

Utility landline and cellular phone calls during a disaster qualify for “priority” status. Investigate the Department of Homeland Security’s Government Emergency Telecommunications Service (GETS) and Wireless Priority Service (WPS). One utility acquired GETS/WPS accounts for over 100 employees to increase its communication resilience. With these services in place, your utility’s call gets priority over a non-prioritized call when circuits and towers are busy. There is no monthly fee for GETS; calls are billed at $0.07 to $0.10 per minute when placed. WPS costs up to $10 per phone for initial activation, then up to $4.50 per month for the feature and $0.75 per minute when a call is placed. Check with your cellular service provider for exact charges.
• Explore useful information on how to create effective public messages and how to select spokespersons, available in Section III (p. 11-20) of California Department of Health Services’ Crisis and Emergency Risk Communication Toolkit. While some information in the workbook only applies to California utilities, most of the information applies to all utilities.

• Obtain an amateur (ham) radio license to allow for communication during an emergency that disrupts landline and cellular services or, get in touch with your local emergency manager, who can introduce you to local ham radio operators. Better yet, give your local ham radio group space within your utility offices and install their radio repeater on your water tower.

• Coordinate communication with your local fire/police department to ensure communication with other local agencies during emergencies; they may even supply you with a radio. Also consider having General Mobile Radio Service (GMRS) radios to use with utility staff during incidents; be aware that these also require a license.

• Integrate your utility into your jurisdiction’s existing emergency notification system, which will improve your ability to notify the public during water emergencies and help save money for these services through cost sharing.

• Collaborate with public safety officials that have the ability to use IPAWS (Integrated Public Alert & Warning System) to distribute water use advisories. IPAWS is the nation’s alert and warning infrastructure. IPAWS provides public safety officials with an effective way to alert and warn the public about serious emergencies using the Emergency Alert System (EAS), Wireless Emergency Alerts (WEA), the National Oceanic and Atmospheric Administration Weather Radio, and other public alerting systems from a single interface. View a list of IPAWS Organizations with Public Alerting Authority Completed in each state.
• Ensure your drinking water regulatory agency receives the state’s spill hotline and the National Response Center’s notifications about incidents. Your regulatory agency can then relay the spill notice to all drinking water utilities in the vicinity of the incident. It may be your utility that gets notified someday!

• Move to a cloud-based system for all day-to-day email, web hosting, and data storage. This will limit the need for utility servers (which can go down during power outages) and limit the need to outsource cybersecurity to an information technology (IT) vendor.

• Look across industries for creative solutions and ideas in crisis communication. For example, the International Council of Mining and Metals, along with the United Nations Environmental Programme, has developed the Good Practice in Emergency Preparedness and Response document for the mining industry. The information can be applicable to the water/wastewater sector, particularly in relationship to crisis communication with impacted communities (see p. 53-55 for a communication plan case study from Canada).
• Leverage open-source software and social media (e.g., Twitter, Facebook) to aid in “crisis mapping,” explained here in an article about defeating disaster following the 2010 earthquake in Haiti. For example, tweets and posts could be used to identify the location and relative impact of water and wastewater main damages during an incident. Social media aggregators, which look for posts containing specified key words across multiple sites, can make this process easier for utility companies.

• Practice using effective text messaging. Refer to the Department of Homeland Security study, Comprehensive Testing of Imminent Threat Public Messages for Mobile Devices. Practices for how to make these messages more effective are provided (see sections 1-1 and 6). The report found that emergency text alerts with 280 characters, instead of 90, are more effective at informing citizens and promoting public safety. In addition, participants who received messages with the content in a new order – source, hazard, location, time, and guidance – had significantly higher levels of message understanding and belief that it pertained to them.

CASE STUDY:

The City of Bozeman Water Department has Twitter and Facebook accounts, but uses these services almost exclusively for emergencies, not day-to-day information or frequent tips. As a result, when a customer sees a message on their social media account, he or she recognizes that it is important and demands immediate attention. The news media receives these tweets and notifications as well, and can contact the water department for more information. This has saved the department valuable time, as staff no longer has to contact each media source individually. The city uses HootsuiteTM to manage all its social media accounts. Only one or two people have access to the department’s social media accounts, which provides for better control of messaging and information.
• Create a fifth general staff section, called the Public Communications Section, within the Incident Command System to manage external communications. This can help to manage the sometimes overwhelming need to keep the public up to date, keep the media informed and to create, update, and disseminate water use notifications.

• Develop/have/use a back-up communication tool. The Emergency Management Journal describes a backup communications tool called iDAWG (Intelligent Deployable Augmented Wireless Gateway) that could be helpful to utilities during an emergency. iDAWG works with a new class of software, called edgeware, to connect devices and information and helps with machine-to-machine communication. According to the article, iDAWG is designed to securely capture and share multiple wireless transmission media including police, fire, emergency medical services, municipal, private, cellular, and citizens band (CB) bands by acting as a signal repeater to provide or extend service on scene.
Would you like to be able to understand how social media practices will work for your utility during an incident before using them live? The 3 Emerging Technologies That Will Impact Emergency Management article on emerging emergency technologies highlighted the tool SimulationDeck that provides a way for agencies to test their social media and public outreach practices.

CASE STUDY:
During the West Virginia chemical spill, when it became time to start lifting the “Do Not Use” order, West Virginia American Water used an on-line GIS map application that allowed their customers to input their street address and zoom to that location on the map to see if their home was ready for flushing. A simple color code of either red or blue was used to indicate “still under a do not use” or “safe to flush”. This helped to reduce confusion among American Water’s customers and minimized phone calls to the utility inquiring about when a customer could start to flush their residential plumbing.

Photo: flickr.com/photos/iwasaround
• Prioritize the essential functions at your utility that rely on power and assess your backup power needs before an incident occurs.

• If your utility does not have an onsite backup generator, install a quick connect device in advance so that a generator brought to your facility can be put into service quickly.

• Talk to your local power company to make sure that your main power lines are kept clear of trees to help prevent outages during storms. Since the power company provides the arborists, this is a no cost preparedness measure.

• Track your generator run time and fuel usage so that you can develop a chart for estimating how long your generator fuel supplies will last based on current conditions, and under a full load.

• Exercise every valve in your system on a consistent schedule (e.g., every other year) and record the number of turns it takes to close each value. If the number of turns changes over time, it is an indication that you may need to clear debris and buildup from that pipe.
RESOURCE MANAGEMENT

• Be sure to identify your water quality sampling sites with unique identifiers before an incident occurs. This way, if mutual aid and assistance responders arrive to take samples, everyone will know where to sample. For example, local utility staff may be identifying a sampling point as “Hydrant 8”, but outside responders could be identifying the same sampling point as “5th & Main”. This causes confusion when compiling results and ensuring if samples were actually taken at the correct sites. Use the unique sampling site nomenclature on all maps that may be distributed.

• A major water quality incident may overwhelm your laboratory capability, whether that is in-house or contracted. Consider participating in or creating a laboratory network. One utility in the southeast is part of a county-wide laboratory consortium that includes public/private laboratories, public health agencies and the police forensic lab.

• Improve your GIS capabilities to make your utility more resilient. Several resources published by ESRI and other GIS providers are available specifically to help water and wastewater utilities. Implementing ArcGIS for Water Utilities provides a starting point for water utilities that are interested in updating their current implementation of GIS technology or starting fresh with a new GIS project, including examples on pages 14-20. In addition, another report, GIS Supports Sustainable and Effective Water Utility Practices, helps utilities improve resilience to short-and long-term disasters and highlights specific GIS applications in a table on pages 2-4.

• Construct pump stations with by-pass vaults that provide time to react during inflow/infiltration events and facilitate quick pump outs.

• When expanding or constructing new facilities, leave older infrastructure in place as feasible to provide surge capacity and resilience for the primary system. For example, build a new tank or tower by an older one.

• Know where you can go in an emergency to obtain resources you don’t have on hand or that you may run out of.

• Meet with local, county and state emergency managers to get an understanding of what resources they may have available to assist during an emergency and how to access these resources.
Some utilities have agreements with military bases to help provide them with generators and other equipment, especially if these utilities also supply the drinking water and wastewater services for the bases. If your utility supplies, or is near, a military base, inquire about assistance with generators and other equipment during an emergency.

To build up your parts inventory and thereby be better prepared, establish a policy of buying two parts when one is needed when possible.

Protect pumps with phase failure detectors. If your power source experiences a total loss of power in a phase or a significant reduction in its value due to uneven load conditions, these devices automatically cut off the load from the supply to help prevent pump failure.

Have backup generators available that run on multiple types of fuel (e.g., natural gas, diesel, propane). Diesel generators can be run when there is no natural gas line in the vicinity, or if a power loss has shut off natural gas pressure pumps. Propane generators can be used in environmentally-sensitive areas.

Diversify your backup power options, including adding solar or wind power. If your utility cannot do this, see if your customers have alternative power sources and ask if you can share their power if other backup sources fail.

DID YOU KNOW?
The New Jersey Department of Environmental Protection’s Auxiliary Power Guidance and Good Practices provides important information about planning for backup power in an emergency. The guidance outlines essential elements for providing sufficient auxiliary power, including: service standard; selecting auxiliary power; location equipment; fuel sources/reserves; response time; maintaining, testing, and record-keeping; duration of operation; maintenance needs; air quality/advance technology option; redundant and alternative power sources; and energy utility providers.
RESOURCE MANAGEMENT

• Have your generators serviced and maintained by a contracted generator service company that is also one of your water customers. This may help in ensuring quick response times.

• Allow your electrical company to build an electrical substation on your property. The electrical company will save on land costs, and you can negotiate to directly connect your main pumping station to that substation. With your pumping station connected to an electrical substation (rather than regular power distribution lines), the pumping station is a de facto priority electrical power restoration facility.

CASE STUDY:
Assess your preparation plan for significant storms by comparing it to the Lessons Learned from Superstorm Sandy survey presented by Uptime Institute. While this article focuses on how data centers fared in the storm, a variety of survey results are applicable to the water sector. For example, given the number and significance of fuel supply problems, some respondents indicated that they plan to procure an additional supplier. Others plan to bring a fuel truck on site in advance of an expected event, and some plan to increase on-site storage.

Photo: www.noaa.gov
• Determine if your water treatment plant has the ability to generate its own chlorine disinfection chemicals from salt, which lowers costs and can provide a disinfection source when external chlorine sources are unavailable in an emergency.

• Look for cooperative agreements with other utilities. For example, an electrical provider can be granted access to your utility’s generators during high use periods to take pressure off the electrical grid if, in turn, your utility could receive low or no cost emergency power when needed.

• Use your state’s Federal Property Assistance Agency to purchase vehicles, equipment, generators and furniture for pennies on the dollar. Contact your State Agency for Surplus Property (SASP) to purchase federal surplus equipment, vehicles, generators, and furniture at significantly discounted prices.

CASE STUDY:
The Tupper Plains-Chester Water District in Ohio has approached backup power and communications in two unique ways. First, the District has contractually ensured that its fuel supplier has backup power and can continue to supply fuel to the District during an outage. To improve phone network reliability, the District suggested that its phone company move their substation (currently in a flood zone) to District property where it could also be provided with backup power supplied by the District.
The San Jose Water Company (SJWC) approached emergency fuel planning with the motto “No Fuel...No Water...No Recovery!” The process began with meetings, followed by a multiagency tabletop exercise to ensure that all aspects of maintaining reliable emergency fuel supplies would be covered in the new plan. The planning then began in earnest when SJWC calculated how much fuel each of their 50+ backup generators would burn in a 24-hour period, which then led to determining the number of daily refueling trips. Based on these calculations, SJWC realized a 40% deficit in fuel under these conditions. Solutions being examined include contractual arrangements with providers for additional storage, working with fuel haulers and service station owners to access their supply during power outages, increasing onsite storage and working more closely with local emergency management staff to better coordinate the effort for fuel procurement.

SJWC also realized that its generators were not the only asset that would require emergency fuel. For example, fleet operations were expected to increase from eight hours a day to 24 hours a day, mutual assistance from contractors and other water utilities would also require regular fueling; and SJWC staff would need fuel for their personal vehicles to get to and from work. With most service stations expected to be unable to pump gas during a regional power outage, SJWC decided it needed to provide fuel to its own workers until some normalcy returned. To minimize the amount of fuel needed for staff, SJWC is working on a carpool plan that assigns employees who live close to each other to the same shift, which would reduce staff fuel needs by a factor of three to four. One of the most important lessons learned from the planning process is that successful emergency fuel planning requires partnerships with outside agencies and others; a utility cannot resolve this challenge on its own. It is best to work on this planning with city, county and regional emergency management agencies to insure water systems are coordinated into one master plan that takes into consideration all critical infrastructure and key resources needed in an effective response and recovery.
• Learn how to prepare for water, sanitation and hygiene (WASH)-related emergencies and outbreaks by visiting the Centers for Disease Control and Prevention One-Stop-Shop: Resources for the Field Before and After a WASH-related Emergency. In particular, the One-Stop-Shop has information about hauled or bulk water delivery that could be useful to a drinking water utility, especially if your state does not have a policy.

• Ensure the health and safety of your employees during an emergency. The OSHA Emergency Preparedness and Response website provides information for employers and workers across industries, and for workers who will be responding to the emergency. In addition to general emergency safety guidance, the website has resources geared towards specific types of natural disasters, biological hazards, and human-induced threats. For example, the website’s updated earthquake section offers specific tips for improving employee safety during earthquakes.

DID YOU KNOW?
The U.S. Department of Transportation Emergency Response Guidebook (ERG) is a tool for pre-planning responses to the hazards associated with materials utilities work with on a daily basis. The ERG helps identify hazards and provides critical information on first aid, fire extinguishment, and evacuation distances to protect your utility staff and the community that surrounds your workplace.
• Collaborate with local law enforcement. For example, request that police check water and wastewater treatment facilities and infrastructure on their patrol routes, particularly outside of normal business hours. In return, offer them areas to conduct drills or exercises on utility property.

• Routinely check your state homeland security or emergency management agency website to look for training and exercise opportunities, such as those related to the Incident Command System. If available, join these agencies’ mailing lists to receive notifications.


• Learn/explore more about extreme weather. The Responding to Extreme Weather and Climate Events compendium contains case studies from across the country that document how extreme weather events impacted drinking water and wastewater systems. The report includes tools, data sources, and links for planning and responding to extreme events. For example, under a case study of the Russian River Watershed in California (p. 4), the report provides links for the NOAA National Weather Service CA/NV River Forecast Center, Sonoma County Water Agency and USGS integrated flood control/groundwater recharge studies, and Golden Gate Bridge long-term sea level rise data, among others. Utilities in the same regions as the case study regions may find some of these listed tools and resources helpful to their own extreme weather planning.
• Identify physical security needs through the Department of Homeland Security Protective Security Advisor (PSA) no-cost assessment program. Apply for grants (e.g., state homeland security grants) to fund recommended security improvements.

• Collaborate with local fire departments. One utility located in a large, rural area installed a connection at their facility for fire department use (if the utility is the closest water supply to the fire). In return, the fire department regularly helps the utility flush their lines and inspect their hydrants.

• If you rely on a Supervisory Control and Data Acquisition (SCADA) system at your utility, develop procedures for running your utility at various levels of automation (e.g., with SCADA but no telemetry, without SCADA but with functioning programmable logic controllers [PLCs], completely manual).

• Learn how the Cleveland Division of Water responded to the August 2003 blackout, which left greater Cleveland without power for almost 30 hours. In particular, Chapter 12 of the BLACKOUT 2003 report covers several relevant lessons learned that could benefit other water utilities.

• Equip emergency enclosed trailers; one for drinking water and/or one for wastewater. The trailers can be stocked with various size pumps and hoses, traffic control devices, lights, and generators. This helps minimize damage during a line break or sewer back up, by reducing the mobilization time finding pumps or other equipment needed for repairs.
PREPAREDNESS

- Conduct practice exercises regularly. For example, present utility employees with an incident scenario and the Emergency Response Plan (ERP) and ask them to react to the incident based on the ERP. This allows the employees to go through the ERP page by page and learn the response procedure and suggest edits to the procedure as necessary. When you’re ready, scale your efforts up. One utility plans and implements a full scale exercise every year. As part of the exercise they deploy trained Damage Assessment Teams (DATs) to assigned sectors of the city or watershed. The DATs partner with utility operations staff to conduct both rapid and detailed damage assessments. This also helps staff to become more familiar with Incident Command System practices.

- If your utility uses the Incident Command System (ICS), create position specific guides for those staff who will fill ICS positions such as Public Information Officer or Operations Section Chief.

DID YOU KNOW?

If you are having a hard time creating an Emergency Response Plan (ERP) that works, contact your state regulator to see if they have a template for you to follow. Some states, like Maine, have more than one based on the size of the utility. The state also updates these ERP templates every two years to ensure that they are current. Maine also offers pre-written drinking water orders in a number of languages to assist utilities. The Kansas guidance includes a useful description of a Pairwise Comparison Matrix (p. 49) to help a utility rank its vulnerabilities, and has links to a Simplified Vulnerability Assessment Tool for Drinking Water. Kentucky’s Emergency Response Plan Template for Public Drinking Water Systems is user-friendly and includes several innovative practices, such as filling tanks before high winds hit (Appendix E). Another example of an ERP template is the Oregon Health Authority’s ERP guidance for drinking water utilities, which has helpful tools like a form for an annual system hazard review (p. 17).
• Refer to the Department of Homeland Security’s Planning and Response to an Active Shooter: An Interagency Security Committee Policy and Best Practices Guide for strategies to prepare your utility for workplace violence. This active shooter guide includes procedures for preparedness, training and exercises, response (e.g., run, hide, or fight on p. 20-22), and recovery along with other resources and templates. Elements of this guide could also be used to plan for other workplace violence scenarios.

• Learn more about wildfires with the Federal Emergency Management Association’s How to Prepare for a Wildfire, which explains how to protect yourself and your property, and details the steps to take now so that you can act quickly when the time comes. This guidance document contains good tips for water utilities, including how to evacuate from wildfire areas (p. 8-9) and equipment needs such as a National Oceanic and Atmospheric Administration Weather Radio (NWR) All Hazards receiver (p. 5).

• Have employees attend emergency preparedness training at the Federal Emergency Management Agency’s Emergency Management Institute. In many cases, the federal government will cover all travel expenses, tuition, and costs for course materials.
• Learn more about integrating climate change into your utility plans. An *Actionable Science in Practice* white paper describes four case studies where utilities did just that. Instead of asking climate experts what they thought the utilities should do regarding climate change, these utilities agreed to forge partnerships with scientific institutions to explore how to integrate climate considerations into their specific management context. Of particular interest in the white paper is an example of a “no-regrets strategy” used by the New York City Department of Environmental Protection (p. 13) and a series of “science talks” and a potential “climate college” at Seattle Public Utilities that others might model to integrate climate adaptation into their utility (p. 24).

• Incorporate resiliency into utility master planning. One utility is developing an Environmental Systems Research Institute (ESRI)-based Emergency Management Mapping Service using open source information for natural hazards such as seismic information for ground motion, liquefaction, and historical landslides. Additional map layers include water infrastructure assets and public buildings such as fire stations, schools, and hospitals. These data can also be examined in conjunction with past after action reporting and improvement planning documents to identify and mitigate potential problems. Looking both into the past and the future can better guide resiliency efforts and preparedness/mitigation planning.

• Form a Computer Security Incident Response Team (CSIRT) to manage cybersecurity threats. One-day CSIRT trainings are available through Carnegie Mellon University’s Software Engineering Institute, as well as three-day companion courses on Managing CSIRTs.

**DID YOU KNOW?**

The Department of Homeland Security is expanding its Cyber Security Advisors (CSAs) program. These individuals provide direct coordination, outreach, and regional support in order to protect cyber components essential to the sustainability, preparedness, and protection of the Nation’s Critical Infrastructure and Key Resources (CIKR), under which water utilities are categorized. Ask your Protective Security Advisor if there is a CSA who can help you.
The Jordan Valley Water Conservancy District (JVWCD) is primarily a wholesaler of water to cities and improvement districts within Salt Lake County, Utah and serves over 800,000 customers. In addition, JVWCD treats and delivers water to the Metropolitan Water District of Salt Lake & Sandy on a contractual basis for delivery to Salt Lake City and Sandy City, even though neither city is within JVWCD’s service boundaries. JVWCD also delivers untreated water to irrigators in Salt Lake and Utah Counties to meet commitments under irrigation exchanges.

To improve communications, JVWCD has provided handheld radios with JVWCD’s frequencies to its 17 member agencies and three peer agencies. New repeaters have been added at strategic locations to give full radio coverage throughout the Salt Lake Valley, based on dead and shadow zones found when the system was tested during the 2016 Great Utah Shake Out exercise.
The JVWCD is an active member of the Salt Lake County Grants Council that applies for Homeland Security grant funds from the state. In previous years, homeland security grant funding has reimbursed JVWCD’s costs for purchasing radios, receivers and eight 2,000-gallon water trailers. In an emergency, these fully loaded water trailers can be pulled with a dump truck to supply emergency water to areas where normal water supplies have been damaged or cut off. In a recent event, two emergency water trailers were used in the Town of Stockton as an alternate drinking water source after the town’s water supply was accidently contaminated due to a wild fire.

Facility improvements are also underway. The JVWCD seismically upgraded their 180 MGD water purification plant and its administration and distribution buildings at its headquarters site. With the improvements made to the administration building, JVWCD also added and equipped an Emergency Operations Center (EOC). These upgrades were completed in accordance with priorities within JVWCD’s vulnerability assessment.

In addition, JVWCD developed an “Employee Area Captain” program that enables communication after hours to employees. The areas where employees live are divided into 13 areas, each with an Area Captain and a designated backup. The Employee Area Captains have been issued a handheld radio. In the event of an afterhours emergency, they would be asked by the Incident Commander from the EOC to make contact with any employees in their area unaccounted for after a disaster such as an earthquake.

“Area Facility Captains” and designated backups have also been identified. Area Facility Captains have also been issued a handheld radio for emergency communications. They are responsible for conducting a windshield damage assessment of facilities within their identified area and to give an update or status of the facilities after a disaster.
INCIDENT MANAGEMENT

- Communicate with upstream utilities. Establish a “river phone” for improved communication with other utilities and communities that use your source water to promote awareness of potential water quality issues.

- Collaborate with your Local Emergency Planning Committee (LEPC). For example, develop your ERP in tandem with the LEPC’s county plans for consistency. Also request assistance from your LEPC for writing grant applications (e.g., Federal Emergency Management Agency Hazard Mitigation Grant Program [HMGP]) that can fund preparedness measures at your utility.

- Identify alternatives for source water intake failures. For example, a connection can be fitted to a fire truck and, with the assistance of a diesel fuel pump, used to draft water directly from a river into a water treatment plant.

CASE STUDY:
Using WordPress™ the Beaufort-Jasper Water & Sewer Authority (BJWSA) created a secure emergency planning and response website that is hosted external to their information technology network. The website enables BJWSA employees to easily view, navigate, search, and update the website on their smart phones, tablets, and laptops. Pages in this website have interactive tools that help managers make decisions from discovery of an incident through to response and recovery. Communication is also possible using the website’s chat feature. The website cannot be found by internet search engines and can be accessed only by employees knowing its location and having the proper user specific login information. Regardless of the calamity BJWSA experiences, employees can access important information through an internet connection anywhere.
• Help your community respond to hazards by providing equipment staging areas. Some utilities, for instance, have volunteered to store shipping containers filled by state agencies with materials needed to prepare and respond to floods. These containers are then available for quick deployment near where a flood is predicted to occur.

• Hold regular meetings with industrial users in your service area to discuss drinking water source protection and promote communication. This will also give you a better idea of what chemicals are being stored and used in your watershed. Ask industrial users what analytical methods they use to detect their chemicals in water; this may be useful if you ever need to analyze for an unregulated contaminant in your water. You can also work with your local fire department to obtain lists of chemicals reported by industrial users in your community.

**CASE STUDY:**

Learn from a multi-agency response to a major water main break in Massachusetts. The *Multi-agency Response to a Major Water Pipe Break: A Massachusetts Case Study and Evaluation* presents an example of the drinking water emergency response process, and analyzes the challenges, successes, and lessons learned related to this process. It identifies areas that utility and the other state and local responders conducted successfully as well as areas where the responders encountered challenges. The purpose of this report is to present a case study that provides an opportunity for drinking water and wastewater utilities to better understand how to achieve a successful response to a significant emergency event. Highlights include a summary of lessons learned (pages S-4 and S-5) and Exhibit 2-7 (p. 15), which could be a useful checklist for roles and responsibilities in an incident.
INCIDENT MANAGEMENT

CASE STUDY:

Consider using a ranking system as part of your Emergency Response Plan. The Portland Water District (PWD) in Maine asked each of its 12 departments to create a list of what they would do during extreme weather events based on level of emergency (e.g., Level 1, 2, or 3). When weather is approaching, three decision makers designate the emergency level based on the best available weather information. Once the level is determined and shared with all utility departments via email, each department enacts their appropriate, pre-determined responses for that level. PWD also makes use of a “virtual” Emergency Operations Center (VEOC), an email group comprised of representatives from each department. Using email, assuming network function hasn’t been interrupted, each department responds back to the VEOC with its planned actions, which can then be viewed by all departments. In other words, there is no “assumption” about what other departments are doing. The lists inform each utility department what the other departments will be doing and improves overall situational awareness.
INCIDENT MANAGEMENT

• Collaborate with local response partners to have your preparedness needs met. One small utility helped pay for a community fire truck. In return, the fire department delivers alternate water to this utility at no cost if they temporarily lose their water supply.

• Use your local community emergency response team (CERT) as a resource. One mobile home development established a CERT that meets regularly with local emergency management personnel. Two of the CERT team members have been deputized by the local sheriff. These deputies can help with door-to-door water use notices or other orders.

• If you are a utility in a region with several other utilities nearby, create a multi-agency coordination system (MACS) to coordinate day-to-day utility operations within your region, as well as your operations (e.g., public messaging, resource management) during emergencies.

• If you serve more than one community, work with the jurisdictions in your service area to help them develop community-specific water outage plans as a part of overall regional resiliency measures.
DC Water provides more than 672,000 residents, 17.8 million annual visitors, and 700,000 people who are employed in the District of Columbia with water and wastewater treatment. Blue Plains, the largest advanced wastewater treatment facility in the world, also treats wastewater from jurisdictions in Maryland and Virginia for an additional 1.6 million people. In preparing for and responding to emergencies, DC Water utilizes an Incident Management Team (IMT) and the Incident Command System (ICS) in all aspects of its operations as it carries out its mission to “serve all of our customers with outstanding service by providing reliable and cost-effective water and wastewater services in accordance with best practices.” This effort is facilitated through DC Water’s Office of Emergency Management which includes six positions to manage emergency planning, fire, life safety, and critical infrastructure protection. In addition, DC Water’s Critical Infrastructure Program manager is assigned half-time in the Washington Regional Threat Analysis Center (the District’s intelligence fusion center). This staff member routinely coordinates with regional emergency management staff and leadership as well as the intelligence analysts, greatly enhancing DC Water’s situational awareness and threat mitigation.

To support its overall Emergency Management Program, DC Water develops Training & Exercise (T & E) Plans consisting of a variety of preparedness and response activities that include both discussion-based and operations-based trainings and exercises. Seminars and on-line learning modules cover diverse topics from the overall EMP program to field crew security awareness. DC Water employs a building block approach to training, and conducts on-site ICS training from introductory courses up to Advanced ICS-400 training for designated staff. In addition to ICS training, DC Water conducts annual critical
customer seminars, scenario specific staff exercises such as an active shooter tabletop exercise, Continuity of Operation Plan (COOP) drills that include activating alternate work spaces, evacuation/shelter-in-place drills, and functional and partial full-scale exercises that include multiple agencies from both the District of Columbia and the National Capital Region.

DC Water also established an IMT with sufficient staff depth to cover 24-hour operations. The IMT activates (full or partial) for incidents such as drinking water contamination, severe weather, complex repairs, security threats, and national special security events in the District of Columbia. Designated team members also attend position specific training courses (e.g., Planning Section Chief, Public Information Officer, Strike Team/Task Force Unit Leader) at the Federal Emergency Management Agency’s Emergency Management Institute in Emmitsburg, Maryland and elsewhere.

A facilitated after action conference and improvement planning session is held at the conclusion of each exercise and after each IMT activation. The conferences employ a third party facilitator to ensure open discussion, emphasize an open, stress-free environment, and focus on how to improve response to incidents. A detailed after action report and improvement plan captures both the lessons learned and best practices, and identifies actionable items that serve as a road map for future improvements in plans and procedures.

In addition, DC Water is piloting an automated database that will catalog improvement planning action items, assign primary responsibility for the accomplishment of each item, and track the progress of each improvement planning item. The database will also inform the following year’s T & E Plan as well as the goals and objectives of future individual training and exercise activities, will be used to inform needs for capital improvement projects and equipment, and will be used to identify additional plans and procedures to be developed. DC Water is implementing the principles of the National Preparedness System including the National Incident Management System and Homeland Security Exercise and Evaluation Program within its emergency management programs to build staff competences and resilience within the Authority.
• Set up automatic calendar reminders for recurrent preparedness activities, such as obtaining and filling extra fuel tanks at the start of hurricane season.

• Maintain an accurate contact/notification list. Enter and regularly update the list in staff cell phones.

• Sign up for the Do One Thing 12-month program for businesses that provides you with monthly instructions for one small step that you can take to be better prepared for an emergency. This program can make the process of emergency preparedness less overwhelming and more manageable.

• Create “cheat sheets” for a variety of emergency procedures and actions and post them at the place where that action will need to be performed. This serves as a reminder to staff or in case an untrained person is asked to fill in for absent staff.
PROBLEM SOLVING

- Use utility vehicles to haul your own fuel – just be sure that the fuel tanks you place on them are sized so that you will not need to placard the vehicles or be concerned with special licensing requirements. This practice allows you to refuel generators and other equipment on your own.

- Use collapsible, sterilized plastic bags at bulk water distribution points and tell people not to bring their own containers. This will greatly reduce the chances of contamination and other water quality problems caused by unclean containers brought from home.

- Ration water when your utility is running low on generator fuel during an extended power outage. For example, develop “water hours” where customers can use water from 7-9 AM, 12-1 PM, 5-6 PM, and 9-10 PM and then shut down the system/generator during the off hours.

- Build the resilience of your water utility. American Water released the Sustainability and Resiliency Planning for Water Utilities white paper on business continuity planning and emergency response for water utilities. The document references a number of factors that have a potential impact on the sustainability and resiliency of utility operations. It also offers recommendations to manage associated risks, including such tips as using blind flanges during response (p. 6) and using United States Geological Survey data to track past and present quality and quantity of groundwater and surface water supplies (p. 5).
PROBLEM SOLVING

- Chemical feeds can blow off a line and spray chemicals everywhere. To prevent this, construct a Plexiglas box around the connection. This helps to contain the chemical in one spot if the feed line becomes disconnected for some reason.

- Wrap a pump house in plastic as a fast and easy way to help keep water out. This tip is especially useful if you don’t have the time or manpower to build a sandbag wall or construct a berm.

- Require proof of address (e.g., utility bill, driver’s license) at bottled water distribution points to ensure that residents who need the water are receiving it.

- Explore innovative technology, like 3D printers, to solve complex problems during disasters and beyond. The When disaster strikes, it’s time to fly in the 3D printers news article describes the use of 3D printers to create parts used to mend water supply pipes in Nepal after an earthquake. This type of rapid, customizable, relatively portable technology could radically change your utility’s disaster response.

- Monitor the news and stay informed. For example, the White House hosted an Innovation for Disaster Response and Recovery Demo Day to find the most effective ways technology can empower survivors; first responders; and local, state, tribal, territorial, and federal governments with critical information and resources. Some relevant resources highlighted during that event included FEMA’s Mobile App and Disaster Reporter to crowd source photos and captions of disasters (potentially useful in assessing utility facility conditions), and private sector resources such as Airbnb, Disaster Response, which pre-identifies hosts for emergency service workers (like those responding under mutual aid and assistance).
**PROBLEM SOLVING**

- Explore alternative ways to access your utility’s facilities post-disaster with innovative technology like drones. Getting to facilities can be a problem, with debris-strewn roads and law enforcement road blocks. Drones may be one way to inspect utility facilities without getting into a vehicle and driving. The Drones Take Legwork out of Infrastructure Inspection article discusses both aerial and underwater drones. Drones show promise, but legal, licensing and privacy issues can be a challenge depending on where your utility is located.

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**DID YOU KNOW?**

You can send a text to someone’s cell phone from your email account. This is a great way to both email and text a response partner at the same time, or to send a text if your cell phone has lost charge but you have access to your email through a computer. You do need to know both the cell phone number and carrier of the person you are trying to text. See the table for the email address to use to send a text.
Next Steps

The practices, procedures, and ideas in this guide came from your peers in the water sector and represent a snapshot in time. Whether a very small system (serving just a few hundred customers or less) or a large system (serving well over 100,000 customers), every utility interviewed had something to say about preparedness and response practices and what tips and tricks they learned along the way.

The practices presented in this guide will be helpful to you as you continue to build and mature your utility’s existing resilience program. If your utility does not already have resilience programs in place, you can learn more about a comprehensive framework for building resilience in the American Water Works Association’s standard ANSI/AWWA G430-14: Security Practices for Operation and Management.

Did some ideas and practices in this guide look familiar? Did you see some new ideas and practices that intrigued you? To take full advantage of the information in this guide, print out this page and use it to track what you already do and to list items to consider for future implementation. Adapt ideas and practices as necessary to make them better fit your utility and your unique circumstances.

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More resources regarding emergency preparedness, response, and resilience can be found on various websites, such as those maintained by the Water Research Foundation (www.waterrf.org), the American Water Works Association (www.awwa.org/resources-tools/water-knowledge/emergency-preparedness.aspx), the U.S. Environmental Protection Agency (www.epa.gov/waterresilience), and the Federal Emergency Management Agency (www.fema.gov/national-preparedness and www.fema.gov/hazard-mitigation-assistance).