Hurricanes Harvey and Irma
After-Action Report

Prepared by the
American Water Works Association
in partnership with the
Water/Wastewater Agency Response Network
Acknowledgements
The dedicated water utility professionals who work tirelessly to maintain essential services in their communities.

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Cover photos (left to right):
- Steve Clouse, San Antonio Water Systems
- Hurricane Irma, National Oceanic and Atmospheric Administration (NOAA), Office of Satellite and Product Operations
- Hurricane Harvey, NOAA, Office of Satellite and Product Operations
- Kyle Lindsay, Renewable Water Resources
Executive Summary

This After-Action Report (AAR) is based on information shared by impacted water utilities, state and federal partners, and the Water/Wastewater Agency Response Networks (WARNs) in Florida (FlaWARN), Georgia (GAWARN), North Carolina (NCWaterWARN), South Carolina (SCWARN), Tennessee (TNWARN) and Texas (TXWARN) after Category 4 Hurricanes Harvey and Irma made landfall in Texas on Aug. 25, 2017, and in Florida on Sept. 10, 2017, respectively. The AAR also shares information gathered from two American Water Works Association (AWWA)-sponsored after action workshops conducted in San Antonio, Texas and Orlando, Florida during the week of Jan. 29, 2018.

The AAR is focused on key observations that highlight both successes and challenges, the latter being the focus of recommendations for critical policy adjustments that could improve incident response in the future. This section of the AAR provides a summary of key observations and additional detail is provided in corresponding sections. The AARs purpose is the identification of actions that can be taken to enhance response efficiency and effectiveness, reduce consequences and increase resilience in the water sector.

1. Elevating the Priority Status of Water Infrastructure and Staff

**Success:** WARNs promoted the importance of water sector needs to state and federal agencies during the response and recovery to Hurricanes Harvey and Irma.

**Improvement:** The water sector is the only critical infrastructure sector that reports through multiple Emergency Support Functions (ESFs). An ESF should be created to centralize the structure at the federal level and provide and coordinate interagency water sector support. Once established, the water sector ESF will likely be replicated at state and local levels. In addition, recognition as first responders is essential to ensure that water utility response and recovery efforts are not impeded.

**Key Actions:**
- The Federal Emergency Management Agency (FEMA) should revise the National Response Framework (NRF) to consolidate water sector related tasks into a single emergency support function (ESF), consistent with the approach used for other critical lifeline sectors.
- DHS and FEMA should recognize water utility personnel as first responders to improve site access during incidents.
- State EMAs should ensure that the water sector is represented in both local and state emergency operations centers (EOCs) during activations. At the state EOC, the water sector should be represented by primacy agency staff (at a minimum) and a WARN representative.
2. Energy and Water Nexus in Disasters

**Success:** Utilities in both Florida and Texas have taken steps to identify vulnerabilities to power loss to ensure continued operations, such as increasing fuel storage capacity and utilizing backup power strategies. In many instances water utilities coordinated with electrical providers to identify critical assets and to de-energize power lines prior to water restoration crews entering an area to begin repairs.

**Improvement:** Given the critical lifeline functions they provide communities for fire protection and public health and safety, water systems should have top priority status when power supply is at risk. Sustaining drinking water and wastewater services reduces pressure on other emergency management needs, supports shelter in place capabilities and allows for continued economic activity.

**Key Actions:**

- FEMA and DOE should establish a policy that designates water and wastewater services as top priorities for power restoration.
- Water utilities should assess emergency power requirements and identify backup power options, including alternate fuel supply plans.
- Water utilities should participate in local hazard mitigation planning to incorporate their resilience projects, a step that is an eligibility requirement for certain types of FEMA mitigation funding.
- Local emergency managers should facilitate information sharing with water utilities and power provider to review prioritization needs and associated consequences of failure.
- U.S. Army Corp of Engineers (USACE) should continue to support water sector use of Emergency Power Facilities Assessment Tool (EPFAT) and conduct a critical assessment of capability gaps for large regional incident or limits of generator relative to power demand.
- EPA, USACE, DOE and FEMA should evaluate the regulatory constraints Clean Air Act regulations place on critical lifeline functions, such as water and wastewater services, for sustaining emergency power.
- EPA, USACE, DOE and FEMA should seek opportunities to increase the number of mobile generators available thru WARNs to enhance operational resilience in the water sector.
3. Common Operating Picture

**Success:** Information sharing among impacted utilities, WARNs, state Emergency Operations Centers (EOCs) and represented federal agencies provided sufficient operational clarity to manage resource needs. For example, state and federal agencies coordinated in Texas through the Natural Disaster Operational Workgroup (NDOW) and in Florida through an impromptu call center; however, the information collected did not reach all federal agencies to provide a clear common operating picture of the water sector.

**Improvement:** State agencies and represented federal agencies must provide consistent, accurate information to the ESFs coordinating federal interagency support for water sector incidents (e.g., ESF 3, ESF 8, ESF 10). Lack of a common operating picture at the federal level can misrepresent the associated consequences and inhibit timely assistance, which also has negative impacts on other water dependent services. Non-affected utilities need to monitor the state WARN website and email for potential resource requests.

**Key Action:**
- EPA and state primacy agency staff in collaboration with WARNs, need to develop a standardized process for capturing and reporting the operational status of drinking water and wastewater systems.
- DHS and FEMA must ensure that the water sector is always represented on federal stakeholder calls. Water sector input is critical in order to communicate operational status and potential impacts on the resource needs of other sectors such as emergency services, health care and manufacturing.

4. Intrastate Mutual Aid & Assistance

**Success:** FlaWARN, GAWARN and TXWARN activated to provide resources to water utilities impacted by Hurricanes Harvey and Irma. Water sector partners assisted in coordinating multiple assessments and moving requested resources from utility to utility.

**Improvement:** Increasing WARN participation will allow a greater number of utilities to access resources from other utilities. Further developing WARN member utility capabilities and procedures will ensure a more efficient and effective deployment of resources to support affected water sector utilities and reduce the burden on emergency management agencies to locate resources.

**Key Actions:**
- All WARNs should review operations plan and develop an overview of their activation process for utility and local decision makers that seek access to water sector mutual aid and assistance.
- Increase the number of utility signatories to respective WARN mutual aid and assistance (MAA) agreements through targeted outreach, support from state emergency management and primacy agencies, and tabletop exercises.
- WARNs should increase their visibility by sharing successful response and recovery actions with response partners.
5. Interstate Mutual Aid & Assistance

**Success:** The Emergency Management Assistance Compact (EMAC) was successfully used to deploy 10 utility crews from North Carolina, South Carolina and Tennessee to Florida. WARNs were proactive in sharing information about potential EMAC requests with both neighboring states and AWWA.

**Improvement:** Water sector utilities need to be more knowledgeable of resource typing and should determine the feasibility of developing mission ready packages (MRPs) that are capable of responding to out of state resource requests.

**Key Actions:**
- Water utilities are encouraged to develop MRPs based on the AWWA resource typing manual and incorporate them into utility emergency response plans (ERPs).
- AWWA should continue to partner with National Emergency Management Association (NEMA) to build EMAC coordinators’ familiarity with WARN and define processes that support deployment of water sector resources by each state through EMAC, including any limitations.

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Metro Water Services crews rolling south on EMAC mission to Florida Keys.
Source: Sonia Allman, Metro Water Services

SCWARN utility crews rolling out on EMAC mission to Florida Keys.
Source: Jill Miller, SCWARN

Onslow Water and Sewer Authority and the City of Jacksonville EMAC mobilization.
Source: Jeff Hudson, ONWASA
6. **Documentation to Support Cost Recovery**

**Success:** Deployed utilities provided state emergency management agencies (EMAs) documentation of expenses needed to apply for FEMA reimbursement.

**Improvement:** Utilities should incorporate cost recovery information in their asset management systems. Water sector utilities need to become more familiar with reimbursement procedures, as well as FEMA rate sheets and codes, so they can provide the required information as soon as possible after an incident. FEMA public assistance (PA) adjustors need to be more familiar with water sector operations and the costs associated with water system response and recovery actions.

**Key Actions:**
- FEMA and the state EMAs should develop a procedure to provide the water sector with the most up-to-date state and federal reimbursement criteria on an annual basis.
- FEMA should collaborate with the water sector to train Public Assistance program adjustors on the typical needs and costs associated with water sector recovery actions and aim to develop a consistent damage assessment system.

7. **Water Sector Utility Operational Policies and Procedures**

**Success:** Water sector utilities in Florida have enacted lessons learned from other hurricanes (e.g., Matthew). Some utilities hire electricians and mechanics and train them to qualify for a water or wastewater operator license. Utilities that requested assistance shared that it is helpful to develop orientation materials so responding utility teams can quickly acclimate to the requestor’s system.

**Improvement:** Responders experienced distressing situations during deployments and psychological support while deployed or on return should be considered. Identification of these resources prior to incidents is needed, including development of guidelines for requesting assistance. Evacuation announcements should include instructions to home and business owners on how to shut off the utilities servicing the properties.

**Key Actions:**
- Utilities should develop critical incident stress management (CISM) programs if deploying responders or know how to access these resources when appropriate.
- Utilities should prepare resources that can be provided to a responding utility to expedite system orientation, including location of resource staging areas.
Elevating the Priority Status of Water Infrastructure and Staff

WARNs promoted the importance of water sector needs to state and federal agencies during the response and recovery to Hurricanes Harvey and Irma. Incidents such as Hurricanes Harvey and Irma continue to show that the water sector is a critical lifeline sector. In the areas heavily impacted by the hurricanes, citizens were not able to return home until water and wastewater services were reestablished, regardless of the status of their residential electrical power. As noted in two National Infrastructure Advisory Council reports1,2 and testimony by Mike Howe (TXWARN) before the U.S. House Subcommittee on the Environment, water sector response tasks are subordinate functions under four different Emergency Support Functions (ESFs) and multiple lead federal agencies.3 The water sector is the only critical infrastructure sector that reports through multiple ESFs. This results in a lack of centralized information sharing, impedes development of a common operating picture and reduced water sector prioritization during a major incident. The water sector would benefit from a mission specific ESF that can provide the necessary structure for coordinating interagency support during a response. Once established, the Water Sector ESF would likely be replicated at the state and local levels. This is consistent with approach applied in the National Response Framework for similar infrastructure such as transportation (ESF 1), communications (ESF 2), firefighting (ESF 4), mass care (ESF 6) and energy (ESF 12).

Water utilities should be represented in their local EOC. Utilities with representation in EOCs have indicated that their inclusion supports more appropriate prioritization of resource needs. In other instances, multiple utilities reported access issues during incident response at various checkpoints, despite having a utility badge or mutual aid authorization letter, even in their own jurisdictions. This is due to inconsistent recognition and classification of water utility personnel as first responders.

Key Actions:
- FEMA should revise the National Response Framework (NRF) to consolidate water sector related tasks into a single emergency support function (ESF), consistent with the approach used for other critical lifeline sectors.
- DHS and FEMA should recognize water utility personnel as first responders to improve site access during incidents.
- Implement processes to ensure that the water sector is represented in both local and state emergency operations centers (EOCs) during activation. At the state EOC, the water sector should be represented by primacy agency staff (at a minimum) and a WARN representative.

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Energy and Water Nexus in Disasters

Hurricanes Harvey and Irma caused widespread power outages in affected areas, often with significant impacts on water utility operations, drinking water and wastewater. Hundreds of generators were requested, and many were deployed to assist utilities in Florida, Georgia and Texas. While most utilities know their generator needs, not all water facilities have been able to satisfy their emergency power needs due to cost and regulatory requirements, specifically the Clean Air Act requirements. For utilities with large power demands there may not be a feasible solution available in the marketplace as many manufacturers have indicated that mobile Tier 4 generators may not be in production until 2020 or later. A mobile solution is necessary for a utility with multiple assets that may require emergency power since placing a stationary solution at all assets is not economically feasible. The constraints placed on critical lifeline functions -- such as water and wastewater services – by these regulations should be evaluated by EPA, USACE, DOE and FEMA.

Utilities, especially small utilities, need to identify their generator requirements and share those details with local EMA before a disaster to minimize acquisition time. In many cases, these requests can be fulfilled via WARN, but the scale of incidents like Harvey and Irma requires greater support from state and federal partners. FEMA’s prioritization scheme appears to have priority for sustaining critical infrastructure within an impacted area.4 However, the criteria for such action remains undefined and lacks consideration of the potential resource demand. More specifically, the generator size necessary to sustain a large treatment facility can exceed 5 MW.

Given FEMA’s prioritization, it would seem prudent to develop a more thorough understanding of the total scope and capability to fulfill such a demand. The loss of service for drinking water and wastewater operations can have cascading consequences for public health and the economy, since the operations of a hospital and various industries require bulk water and wastewater services to function properly. While it is the responsibility of state primacy agencies to provide for alternative water under catastrophic conditions,5 there is a limited understanding of the capacity to scale in response to a large, wide-area incident. Power restoration and/or sustainment of water and wastewater services should be elevated to top priority when impacted to mitigate cascading consequences that increase demands on other emergency response services.

4 FEMA, 2017, Power Outage Incident Annex to the Response and Recovery Federal Interagency Plans. Page 15 states the following: “Facilitate power restoration and maintain other CI within geographic regions where it is anticipated that power will be restored in two weeks or less. Stabilize and sustain CI in geographic regions that suffer the next shortest duration of power outages.”

5 42 U.S.C. 300g-2(a)(5)
Utilities continue to investigate sources of funding to purchase emergency power equipment. One utility, the City of Palm Coast (Florida), recently received FEMA funding through the Pre-Disaster Mitigation Grant Program to purchase generators. The goal of the program is to reduce overall risk to the population and structures from future hazard events, while also reducing reliance on federal funding in future disasters. In Florida, counties develop Local Mitigation Strategy (LMS) Plans that identify hazards and propose mitigation strategies that would reduce or eliminate these hazards. The city of Palm Coast identified the need for generators in the county LMS plan, and, after Hurricane Matthew in 2016, received $1.6 million for purchasing 30 generators for wastewater pumping stations. FEMA will reimburse the city for 75% of the total cost with generator installation expected by 2020.

Utilities also continue to work with their electrical power providers to ensure that they are aware of water sector critical infrastructure. Utilities should determine how their electrical supplier identifies critical infrastructure (e.g., meter number, account number, lat/long) and incorporate that information into their ERP.

Water utilities found that it made the most sense for worker safety to coordinate with their electrical utility before beginning repairs in the distribution or collection system. For example, in Palm Coast, Florida Power and Light shut down electricity to the entire city before debris clearing and repairs began. Similar coordination happened in Victoria, Texas.

It is important for water utilities to have primary and secondary fueling options, because many disasters can lead to fuel shortages. Fuel shortages were common in Florida due to the combination of mass evacuations leading up to the storm, as well as Hurricane Irma impacting almost the entire state. To help mitigate conditions such as these, the City of Boca Raton has five fuel tankers and interlocal agreements with gas stations.

Utilities that requested a generator from the USACE noted that although they sent the specifics of what they needed, USACE sent someone to verify the information before the generator could be deployed, which led to delays in power restoration in at least one instance. The USACE Emergency Power Facility Assessment Tool (EPFAT) is a secure web-based tool that can be used by critical public facility owners/operators, or emergency response agencies, to input, store, update and/or view temporary emergency power assessment data. Having pre-installation assessment data in EPFAT in advance will expedite USACE’s abilities to provide temporary power.

Finally, the DHS assessment of infrastructure criticality during incidents like Harvey and Irma requires significant review and recalibration. Documents issued by the DHS Office of Cyber and Infrastructure Analysis (OCIA) estimating the criticality of various assets along the Texas coast were extremely misleading and could have negative implications for future recovery efforts if considered credible. DHS OCIA prepared an Infrastructure of Concern list prior to Harvey making landfall in Texas that ranked multiple healthcare facilities as “Priority 1” because their “loss or disruption could cause national or regional consequences, and which may be critical in incident response operations.” This analysis failed to recognize that these facilities have significant dependence on drinking water and wastewater services to ensure continuity of operations and to avoid patient evacuation.
The same assessment rated the water treatment facility in the same general area as “Priority 3”, meaning OCIA had determined the asset had a “low to moderate consequence” if impacted and its inclusion was “provided for situational awareness for response activities.” This type of misclassification is dangerous and not representative of similar incidents where loss of water and wastewater service required hospital patient evacuation.6 This also erroneously communicates to others engaged in emergency management that the water utility is not critical and if impacted the consequence is insignificant.

Key Actions:

- FEMA and DOE should establish a policy that designates water and wastewater services as a top priority for power restoration.
- Water utilities should assess emergency power requirements and identify backup power options, including alternate fuel supply plans.
- Water utilities should participate in local hazard mitigation planning to incorporate their resilience projects, a step that is an eligibility requirement for certain types of FEMA mitigation funding.
- Local emergency managers should facilitate information sharing with water utilities and power provider to review prioritization needs and associated consequences of failure.
- U.S. Army Corp of Engineers (USACE) should continue to support water sector use of Emergency Power Facilities Assessment Tool (EPFAT) and conduct a critical assessment of capability gaps for large regional incident or limits of generator relative to power demand.
- EPA, USACE, DOE and FEMA should evaluate the regulatory constraints Clean Air Act regulations place on critical lifeline functions, such as water and wastewater services, for sustaining emergency power.
- EPA, USACE, DOE and FEMA should seek opportunities to increase the number of mobile generators available thru WARNs to enhance operational resilience in the water sector.

Common Operating Picture

As the hurricanes caused widespread damage in Florida and Texas, it was an overwhelming task for the state primacy agencies to keep track of utility status, so WARN representatives, water associations, EPA regions and other entities worked together to contact utilities and develop an accurate understanding of water sector needs. Impacted utilities provided status updates and resource needs through their WARNs and local EMAs. WARN

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6 Several hospitals required full evacuation following Hurricane Katrina due in part to loss of water/wastewater services. [https://www.urban.org/sites/default/files/publication/50896/411348-Hospitals-in-Hurricane-Katrina.PDF](https://www.urban.org/sites/default/files/publication/50896/411348-Hospitals-in-Hurricane-Katrina.PDF)
representatives and response partners worked together to facilitate the assistance as needed and coordinated with utilities that had not provided status updates to ensure that they did not, in fact, need assistance. However, the methods by which the water sectors situational status were captured at the state and EPA regional levels and reported to the federal headquarters level were inconsistent and did not provide a clear picture of water sector impacts. Additionally, EPA headquarters was not consistently on the agenda for the daily federal briefing calls hosted by the Department of Homeland Security and as result water sector situation reports were not available on a consistent basis.

At the state level, many agency databases are static and do not have automated outreach systems to gather information from water utilities. Utilities will self-report on their operational status after an incident, but in some cases not enough information is provided about operational impacts or associated needs. Data collection tends to be siloed at the state and federal level, but clearly exists as the EPA Drinking Water Status Map in Hurricane Harvey Affected Areas map indicates. Keeping this type of data internal provides limited benefit to the greater good, so there is a need to improve information sharing with WARNs, emergency management and other sectors to enhance the big picture understanding of an incidents impact on a community or region. This also provides a more complete assessment of prospective response and recovery needs.

As an example of data gathering and sharing, Texas used Natural Disaster Operational Workgroup (NDOW), which was created by EPA Region 6 after Hurricane Ike to improve coordination between state and federal agencies. Members of the EPA Region 6 Water Team deployed to Austin to work with TCEQ staff. EPA Region 6 assisted the response by contacting water sector utilities in the 58 counties that received a pre-landfall disaster declaration to determine if they needed assistance. The NDOW plans to update its reporting features and assign standardized timeframes for reporting based on experiences during Hurricane Harvey. However, it should be noted that this data gathering system was not shared with other key partners in the federal family or the water sector, including the USACE which is the lead agency for ESF 3. In addition, there is a need to consider options to improve efficiency and coordination, since TXWARN has an automated system for gathering operational status from utilities. WARNs should be provided access to commonly shared database and reporting information systems such as Texas NDOW and State WebEOC.

As another example, the Florida Department of Environmental Protection (DEP), EPA Region 4, USACE, FlaWARN and FRWA representatives established an impromptu call center to manage MAA requests and utility status. FlaWARN brought in utility directors from unaffected areas of the state to assist with managing resource requests.

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7 Natural Disaster Operational Workgroup (NDOW), [http://ndow.net/](http://ndow.net/)
and liaising with response partners. However, resource requests and utility status updates made through Florida DEP's StormTracker, Florida Department of Health website and FlaWARN's website had to be reconciled manually, as the systems do not interface electronically. The entities should coordinate to combine efforts and reduce duplication.

**Key Action:**
- EPA and state primacy agency staff in collaboration with WARNs, need to develop a standardized process for capturing and reporting the operational status of drinking water and wastewater systems.
- DHS and FEMA must ensure that the water sector is always represented on federal stakeholder calls. Water sector input is critical in order to communicate operational status and potential impacts on the resource needs of other sectors such as emergency services, health care and manufacturing.

**Intrastate Mutual Aid & Assistance**

FlaWARN, GAWARN and TXWARN actively monitored and prepared for Hurricanes Harvey and Irma. Impacts from the hurricanes were widespread throughout all three states. The WARNs communicated with member utilities before, during and after hurricane landfall to assess operational conditions and fulfill resource requests. Below are examples of WARN response actions.

TXWARN fielded, responded to or coordinated Hurricane Harvey response and recovery requests from over 50 utilities. The following are examples of TXWARN deployments:

- San Antonio Water System (SAWS) provided resources to multiple communities including recovery teams to Nueces County Water Control and Improvement District #4 in Port Aransas.
- SAWS and Austin Water provided multiple recovery teams to Rockport.
- Aqua Texas provided two potable water tankers to the City of Beaumont at the request of the Jefferson County Office of Emergency Management.

TXWARN and the Texas Rural Water Association (TRWA) worked closely throughout the response and recovery period to coordinate assessments and provide requested resources. A resource management technique, later echoed in Florida, consisted of moving generators from utility to utility as commercial
power was restored. Often the original receiving utility would be tasked by TXWARN or TRWA to move the generators to the next utility in-need. TXWARN also identified response teams to work with the state’s Public Works Response Team (PWRT) to assist Port Arthur, Brazoria and other communities as requested. The PWRT is a state asset deployed by the state EOC under the direction of the Chief, Texas Division of Emergency Management, as required to support local jurisdictions in the event of a catastrophic incident.

FlaWARN received 130 requests for assistance, primarily for emergency generators, as a result of Hurricane Irma. Utilities located in the Florida Panhandle including Auburn Water, Pace Water, Destin Water Users, South Walton Utility, Regional Utilities and the Emerald Coast Utilities Authority (ECUA) provided generators through FlaWARN. Due to the wide swath of the hurricane, over 200 facilities required emergency backup power. As described previously, Texas generators were moved from utility to utility as commercial power was restored. The following are examples of other FlaWARN deployments:

- Destin Water Users provided two lift station repair teams to the Jacksonville Electric Authority (JEA).
- ECUA provided lift station repair teams to JEA and Gainesville Regional Utilities (GRU). In addition, ECUA provided GRU with a 6,000-gallon tanker used to pump down lift stations to prevent overflows.
- Pace Water System provided JEA with three trailer mounted generators. The 40, 80 and 90 kW generators were used to power sewer lift stations.
- West Palm Beach sent electricians and utility personnel to fix lift station panels and move generators between lift stations at the Collier County Public Utilities Department.
- FlaWARN received additional support from FRWA which transported 37 generators between 200 utilities in the weeks following Hurricane Irma.
- The Florida Keys Aqueduct Authority (FKAA) received assistance through both FlaWARN and EMAC. The intrastate assistance was provided by:
  - Jupiter Water Utilities provided a distribution repair team.
  - Indian River Utilities provided a distribution repair team.
  - Miami Dade County Water & Sewer provided two distribution repair teams.

GAWARN activated prior to Hurricane Irma’s Florida landfall to distribute storm information, inclement weather procedures, damage assessment forms, emergency generator site profile templates and to remind utilities to coordinate with their local EMA director. GAWARN, in coordination with water utilities, Georgia Rural Water Association and other responders, deployed an estimated 100 generators during Hurricane Irma response and recovery.
In addition, the City of Beaumont, TX benefited from a public-private response mobilization that was critical in restoring water services. ExxonMobil, Tiger Industries, and Bomac worked with the utility to engineer a network of flexible pipes and pumps to bypass the flooded intakes to provide an alternative raw water delivery system for the treatment plant.⁸,⁹

**Key Actions:**
- All WARNs should review their operations plan and develop an activation process overview for utility and local decision makers that seek access to water sector mutual aid and assistance.
- Increase the number of utility signatories to respective WARN mutual aid and assistance (MAA) agreements through targeted outreach, support from state emergency management and primacy agencies, and tabletop exercises.
- WARNs should increase their visibility by sharing successful response and recovery actions with response partners.

**Interstate Mutual Aid & Assistance**

The water sector’s understanding of the EMAC process is improving. WARN representatives are more aware of their potential role in identifying utilities capable of fulfilling EMAC requests. This improved knowledge of EMAC can be attributed to increased contact with state EMAC coordinators, resource management training and focused exercises. Several FlaWARN members remarked that using EMAC procedures to request water sector resources from Georgia during an EPA-sponsored 2015 Florida State Water Sector Exercise helped

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After Hurricane Irma made landfall, FKAA requested resources through FlaWARN to repair mains and service lines, but it quickly became apparent that few utilities in Florida would be able to respond due to the widespread damage within the state. AWWA facilitated a regional WARN conference call in coordination with FlaWARN to provide updates regarding a prospective EMAC request from Florida utilities, including FKAA. This allowed the WARN chairs in surrounding states to notify their member utilities and assess capacity to provide assistance and allow available utilities to prepare for deployment once the authorization was given. Once the EMAC request was issued, a total of 10 distribution repair teams were provided by utilities from North Carolina, South Carolina and Tennessee:

- **North Carolina WARN** – The City of Jacksonville and the Onslow Water and Sewer Authority provided one combined distribution repair team.
- **South Carolina WARN** – Greenville Water, Renewable Water Resources and Mount Pleasant Waterworks each deployed one distribution repair team. Additional utilities offered teams but were unable to gain local approval in a timely manner.
- **Tennessee WARN** – Metro Water Nashville deployed six distribution repair teams, with additional utilities identified to provide backup teams if needed.

Distribution repair teams were initially on two-week mission assignment, but FKAA worked with the state EMAC coordinator to extend the mission of several deployed teams since they were already fully oriented to tasks. Once recovery was underway in Georgia, six GAWARN utilities developed MRPs in case the deployed distribution repair teams from Tennessee, North Carolina and South Carolina in Florida needed relief.

In addition, TXWARN coordinated through AWWA for national outreach via WARNs to gather information on MRPs from utilities in anticipation of possible EMAC request should it become necessary. Ultimately, TXWARN was able to fulfill requests for assistance internally and no EMAC mission request was issued.
Overall, the EMAC deployments to Florida were a success. Out-of-state crews prepared and mobilized to respond to Hurricane Irma, despite the less than ideal working conditions. The response illustrated the importance of coordination between WARNs and their state EMA during both intra- and interstate water sector resource requests. WARNs in affected states coordinated with surrounding states in order to notify them of pending EMAC resource requests proved an important time-saving technique. AWWA shared information nationally to keep all WARNs and partners up-to-date with utility needs in Florida and Texas. The utilities that deployed personnel through EMAC to Florida described positive experiences and noted:

- Additional training is needed to expedite the development of MRPs and cost estimates.
- Utilities found that the cost estimators used to fill out EMAC request paperwork varied from state to state and recommend standardization.
- The process for EMAC activation in each state is different and utilities willing and able to deploy under EMAC should coordinate with their state EMA to clarify the process. This may include signing an agreement that defines authority, reimbursement, workers’ compensation and benefits, and liability. It would be dependent on the state whether private utility resources can be deployed under EMAC. For example, in South Carolina, EMAC only covered South Carolina Emergency Management Division staff, so the state’s attorney drafted a memorandum of understanding (MOU) to allow public utility staff to respond under EMAC. However, the MOU would not cover private utility staff.

**Key Actions:**
- Water utilities are encouraged to develop MRPs based on the AWWA resource typing manual and incorporate them into utility emergency response plans (ERPs).
- AWWA should continue to partner with National Emergency Management Association (NEMA) to build EMAC coordinators’ familiarity with WARN and define processes that support deployment of water sector resources by each state through EMAC, including any limitations.
Documentation to Support Cost Recovery

Utilities must track costs incurred as part of incident response. Most utilities can track expenses through their own internal processes, but for purposes of FEMA reimbursement, some found that their internal systems were not aligned with what was expected from FEMA. It is important for utilities to be able to provide the required information as soon as possible after an incident. FEMA may also wish to see documents that a water utility might not be expecting to share as part of the cost reimbursement process, such as the utility’s capital improvement plan (if available).

Based on their experiences during the hurricanes, several utilities indicated that they are planning to preload FEMA cost codes into their asset management systems to make the process easier in the future. Utilities that know they will be seeking reimbursement are advised to work through MAA agreements and EMAs.

Multiple utilities reported frustration with what appears to be shifting eligibility criteria and documentation requirements. This seemed to correspond to changes in work details for staff supporting the Public Assistance (PA) program. In addition, the lack of functional knowledge and familiarity with the equipment and operations needs of drinking water or wastewater systems significantly impeded damage assessment evaluations. One utility reported that they were visited on three occasions by three different assessors for a claim that the utility estimated was likely less than the associated travel and payroll expenses. Consideration should be given to some type of collaboration with FEMA’s PA program to build knowledge related to typical cost ranges for recovery/replacement of various types of water system assets.

Key Actions:
- FEMA and the state EMAs should develop a procedure to provide the water sector with the most up-to-date state and federal reimbursement criteria on an annual basis.
- FEMA should collaborate with the water sector to train Public Assistance program adjustors on the typical needs and costs associated with water sector recovery actions and aim to develop a consistent damage assessment system.

Water Sector Utility Operational Policies and Procedures

Utilities that have received assistance during prior disasters noted the importance of being able to provide system orientation materials to responders. For example, when the City of Tallahassee received assistance after Hurricane Hermine in 2016, it took two days before responding personnel had sufficient system knowledge to operate independently. As a result, the city developed forms, descriptions of stations, maps, checklists and station criticality information to provide responders upon their arrival to expedite orientation. As an alternative, the utility receiving support can assign an individual to work directly with responding crews for the first few days to help orient the crews until they can work independently.
Most utilities that responded through FlaWARN, GAWARN, TXWARN or EMAC noted that they had existing processes in place for staffing MRPs, which allowed them to quickly respond to resource requests. MRPs should consist of trained personnel with a mix of capabilities (e.g., operators, electricians, mechanics) and equipment.

Several coastal utilities impacted by the hurricanes, including FKAA and Rockport, Texas noted that a majority of the water loss was due to thousands of leaks in customer homes or on service lines, not large main breaks as originally suspected. One utility described this as a “death by a thousand cuts.” In one case, a utility spent three days looking for water main breaks before realizing that there weren’t any. In Rockport, there were only three minor water main breaks in over 300 miles of distribution lines, but up to 5,000 service line leaks. Some utilities, including Boca Raton shut down water service in mandatory evacuation zones (e.g., barrier islands) to avoid small line break issues. It is important for the water utility to coordinate any service closures with response partners (e.g., fire departments) and customers. Another technique is to develop instructions for customers on how to shut off their utility services prior to evacuating. This information could be included in evacuation orders.

Water utilities noted that their operational policies and procedures contributed to successful response and recovery actions in their communities and identified the following as best management practices:

- Cross train personnel to increase capabilities during an emergency. For example, Aqua Texas employs personnel with commercial driver’s licenses who maintain tanker endorsements and have water operator licenses. In addition, the Orlando Utilities Commission hires journeymen electricians and mechanics as technicians and trains them to be water and wastewater operators, so they don’t have to rely solely on contractors to make repairs.
- After conducting an initial damage assessment, determine internal capabilities and what resources may be required, if any. Order/request resources as soon as possible, as it can take several hours to days to deploy resources from both in state and out of state.
- Be aware that responders may experience upsetting situations during deployments and may need psychological support while deployed or once they have returned. For example, responding teams in Florida interacted with hurricane victims, destroyed property and angry residents.
- Create a policy on “leave behind” equipment (e.g., How is it eventually returned? What if it gets damaged?).
• Take pictures of equipment in pre-deployment condition. For example, Pace Water System (Florida) took pictures of all deployed equipment. One of their pumps had spare tires and rims that didn't come back after the deployment, so they charged the requestor.

• Responses to resource requests need to include information about what capabilities the requesting utility may need to provide (e.g., forklifts, cranes, drivers, electricians).

• Keep key, retired utility staff on contractual retainers. They can be called-in as needed on an hourly basis for advice, training and emergency response assistance.

• If utility staff needs to evacuate, consider allowing them to take company vehicles. For example, FKAA had personnel drive utility trucks out of the area so they were less likely to be damaged by the hurricane.

• During the response, bring in “housekeeping” staff to support personnel that have been out in the field. These staff can cook meals, do laundry and provide other support services.

• Post staff at key facilities during a storm so they can be immediately available to respond, conduct damage assessments and initiate repairs once conditions allow.

• During an incident, keep track of treatment chemical and determine a date for resupply to avoid emergency deliveries.

• Utilities should update facility maps that identify potential resource staging areas. For example, Corpus Christi (Texas) had ongoing construction projects at its water treatment plant, so the available space for a staging area was smaller than originally planned.

• Communications are often difficult in areas heavily impacted by hurricanes with damage to radio repeaters, landline and cell phone services. This makes daily staff briefings essential.

• Prior to deployment, determine the availability of resources within certain distances of the deployment location (e.g., within 100 miles, within 50 miles).

• Determine the goods and services available en route and within the deployment location. Determine if credit cards are accepted. During the EMAC responses, utilities found out that some procurement cards had low limits and others were not able to be used out of state.

• If possible, a responding utility should consider sending an advance team to assess field conditions and needs to right-size the deployment team prior to departure, especially for long-distance responses.

• Utilize technology during the response. For example, deployed crews used Google Earth to locate meters.

**Key Actions:**

- Utilities should develop critical incident stress management (CISM) programs if deploying responders or know how to access these resources when appropriate.

- Utilities should prepare resources that can be provided to a responding utility to expedite system orientation, including location of resource staging areas.
### Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>AAR</td>
<td>After Action Report</td>
</tr>
<tr>
<td>ANSI</td>
<td>American National Standards Institute</td>
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<td>AWWA</td>
<td>American Water Works Association</td>
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<tr>
<td>CISM</td>
<td>Critical Incident Stress Management</td>
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<tr>
<td>DEP</td>
<td>Department of Environmental Protection</td>
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<tr>
<td>DOE</td>
<td>United States Department of Energy</td>
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<tr>
<td>ECUA</td>
<td>Emerald Coast Utilities Authority</td>
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<tr>
<td>EMA</td>
<td>Emergency Management Agency</td>
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<td>EMAC</td>
<td>Emergency Management Assistance Compact</td>
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<td>EOC</td>
<td>Emergency Operations Center</td>
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<td>EPA</td>
<td>United States Environmental Protection Agency</td>
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<td>EPFAT</td>
<td>Emergency Power Facility Assessment Tool</td>
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<td>ERP</td>
<td>Emergency Response Plan</td>
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<td>ESF</td>
<td>Emergency Support Function</td>
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<td>FEMA</td>
<td>Federal Emergency Management Agency</td>
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<td>FKAA</td>
<td>Florida Keys Aqueduct Authority</td>
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<td>FlaWARN</td>
<td>Florida Water and Wastewater Agency Response Network</td>
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<tr>
<td>FRWA</td>
<td>Florida Rural Water Association</td>
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<td>GAWARN</td>
<td>Georgia Water and Wastewater Agency Response Network</td>
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<td>GRU</td>
<td>Gainesville Regional Utilities</td>
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<td>IMT</td>
<td>Incident Management Team</td>
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<td>JEA</td>
<td>Jacksonville Electric Authority</td>
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<td>LMS</td>
<td>Local Mitigation Strategy</td>
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<td>MAA</td>
<td>Mutual Aid and Assistance</td>
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<td>MOU</td>
<td>Memorandum of Understanding</td>
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<td>MRP</td>
<td>Mission Ready Package</td>
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<td>NCWaterWARN</td>
<td>North Carolina Water and Wastewater Agency Response Network</td>
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<td>NDOW</td>
<td>National Disaster Operational Workgroup</td>
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<td>NEMA</td>
<td>National Emergency Management Agency</td>
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<td>NRF</td>
<td>National Response Framework</td>
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<td>PA</td>
<td>Public Assistance</td>
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<td>Public Works Response Team</td>
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<td>SAWS</td>
<td>San Antonio Water System</td>
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<tr>
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<td>South Carolina Water and Wastewater Agency Response Network</td>
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<td>SEOC</td>
<td>State Emergency Operations Center</td>
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<td>TCEQ</td>
<td>Texas Commission on Environmental Quality</td>
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<tr>
<td>USACE</td>
<td>United States Army Corps of Engineers</td>
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<tr>
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<td>Water and Wastewater Agency Response Network</td>
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</tbody>
</table>
City of Jacksonville crew ready to roll out with 500 ft of OS90 pipe. Source: Jeff Hudson, ONWASA

Aqua Texas water tanker arrival in Beaumont, TX. Source: Darryl Waldock, Aqua Texas

Metro Water Services crew savoring debris from meter box. Source: Sonia Allman, Metro Water Services

Metro Water Services crew shutting off meter due to service line leak. Source: Sonia Allman, Metro Water Services

Team from ExxonMobil, Tiger Industries and Sonneic building alternative raw water delivery for Beaumont, TX. Source: Derek Richard, City of Beaumont
ONWASA crew assessing damage and searching for meters.
Source: Jeff Hudson, ONWASA

The search continues for shutoff valves and open services to be isolated.
Source: Steve Clouse, SAWS

Always keep the crews well fed and hydrated!
Source: Jeff Hudson, ONWASA
For more information on WARN, go to www.NationalWARN.org

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