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What Makes a Utility Resilient?

By incorporating resilience into a risk management framework, a utility can improve its response and recovery strategies, thereby mitigating the potential for loss of service.

BY KEVIN M. MORLEY

RESILIENCE IS defined by an array of indicators that characterize a desired end state or goal. According to Section 2013 of America's Water Infrastructure Act (AWIA) of 2018, resilience is the "ability of a community water system or an asset … to adapt to or withstand the effects of a malevolent act or natural hazard without interruption to the asset's or system's function, or if the function is interrupted, to rapidly return to a normal operating condition." AWIA requires community water systems serving populations of 3,300 or more to perform two tasks: (1) conduct a risk and resilience assessment and (2) prepare or revise an emergency response plan on a prescribed schedule every five years, starting in 2020. For more information, see Priority Action on Risk and Resilience, *Journal AWWA*, February 2019 (https://doi.org/10.1002/awwa.1229).

Drinking water and wastewater systems have been designed to be resilient given the critical functions they provide to the communities they serve. However, various incidents have revealed the need for a more strategic perspective to resilience that goes beyond some of the tactical actions typically defined in an emergency response plan. This need led to the development of the Utility Resilience Index (URI) as a means to provide an all-hazards, system-level assessment of resilience.

PUTTING THE URI INTO PRACTICE

The URI is based on 12 indicators of resilience that a utility can readily and quickly assess to determine where potential gaps or opportunities exist to improve its capacity to respond and recover from an incident. These resilience indicators were selected based on findings from historical records, after-action reports, best practices, and lessons learned from multiple incidents. When considered as a whole, the indicators provide a snapshot of a utility's resilience capacity.

The URI includes two classes of indicators that either affect utility functions or the community served:

- *Operational* (O) indicators reflect the utility's tactical capacity to react quickly and/or cope with various incidents that have the potential to disrupt service.
- *Financial* (F) indicators reflect the utility's fiscal capacity to react quickly and/or cope with various incidents that have the potential to disrupt revenue and costs.

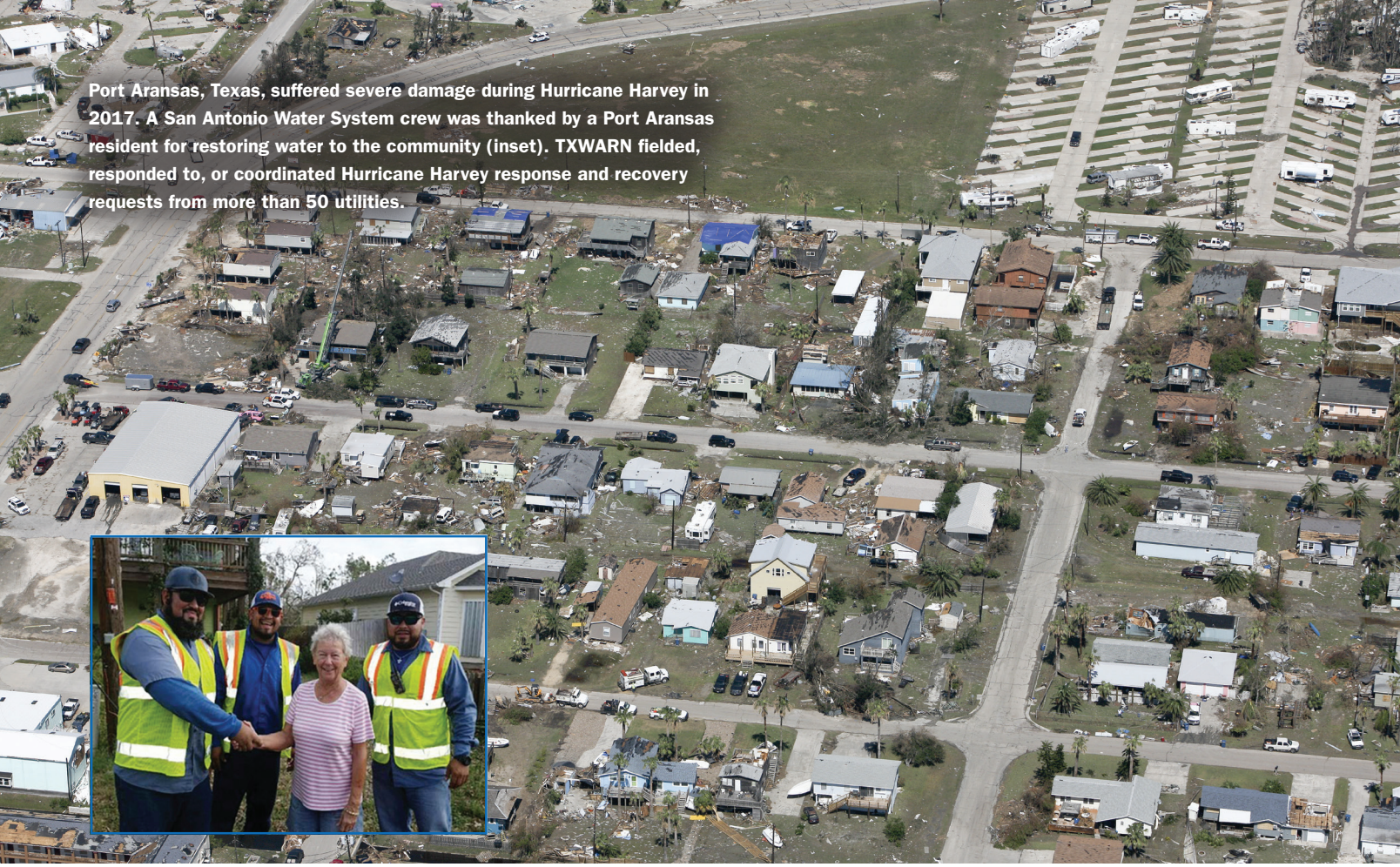
Let's apply the URI to a medium-size mid-Atlantic utility that is considering AWIA and what actions may be beneficial after some close calls in recent years. The utility's manager inputs the utility profile to the URI and finds the utility scored a 44 out of 100. What does that mean? It means there is a lot of opportunity for improvement, including accepting certain limitations that should inform strategies for alternatives, as it may not be feasible to "fix" all the limiting indicators.

Consider the following URI inputs, as reflected in the accompanying table:

O1: Emergency Response Plan (ERP) shows that while the utility has a plan, it hasn't been exercised with tabletop or functional exercises. In addition, the utility hasn't prepared any resource typing for its system that could help the utility's staff determine what they may need to request from others and what they may be able to provide others during an incident. This is all about pre-incident planning and preparedness, which reduces the stress and chaos associated with an actual incident. Training, exercises, and resource typing are examples of strategies, plans, and procedures that support the intent of AWIA's ERP provisions. For more information, download AWWA's new *Water Sector Resource Typing Guidance* manual at https://bit.ly/2G7hczw.

O2: National Incident Management System (NIMS) Compliance is voluntary, but it's an eligibility requirement for certain federal homeland security grant programs. The utility has participated in basic awareness training available from the Federal Emergency Management Agency and the US Environmental Protection Agency (USEPA). However, staff who are most likely to lead (i.e., the incident commander) would benefit from higher-level training to facilitate engagement with other stakeholders during a significant incident. Understanding the process for incident management tracking and documentation pre-incident is much better than learning it while trying to manage an emergency.

O3: Mutual Aid and Assistance has been critical to water-sector resilience for years. The value of these agreements has



Port Aransas, Texas, suffered severe damage during Hurricane Harvey in 2017. A San Antonio Water System crew was thanked by a Port Aransas resident for restoring water to the community (inset). TXWARN fielded, responded to, or coordinated Hurricane Harvey response and recovery requests from more than 50 utilities.

PHOTOGRAPHS: ROBERT L. BERRY, SHUTTERSTOCK.COM/STEVE CLOUSE, SAN ANTONIO WATER SYSTEM (INSET)

been demonstrated time after time, spanning myriad incidents from hurricanes to earthquakes to blizzards. This utility is part of its state's Water/Wastewater Agency Response Network (WARN), which provides state-level support and means by which interstate mutual aid can be facilitated.

O4: Emergency Power for Critical Operations is often the rate-limiting factor in recovery following an incident that affects power supply. This utility reports the ability to sustain power for critical operations for up to 24 hours, which is likely limited by fuel capacity. Regulation can also hamper investment in backup power generators, as their use during nonemergency periods often triggers stringent Clean Air Act limits. The cost of generators has made them a key shared resource among WARN utilities, especially in regions depending on multiple booster pump or lift stations.

O5: Ability to Meet Minimum Daily Demand or Treatment is at the core of a utility's function. In the case of a drinking water system, how long can typical daily demand be sustained? The answer depends on a combination of finished water storage and, where applicable, the ability to service customers with gravity. Whatever the threshold, this represents a critical planning decision point at which alternative water supply options may become necessary. This is one of the new provisions in AWIA that a utility is expected to determine. Resources such as the USEPA's report *Planning for an Emergency Drinking Water Supply* (https://bit.ly/32zADL0) can be used to assess options and consider how distribution would be achieved in coordination with state/local partners. In less than 24 hours this utility would be in crisis, which could be caused by source water contamination, cyanotoxins, or the plant's physical impairment from a natural or man-made incident. This low threshold suggests that some critical planning is needed to ensure options to mitigate the impacts on the community are developed and ready to be implemented if necessary. AWIA requires systems to develop alternative source water options.

O6: Critical Parts and Equipment is an important factor in recovery, especially in this era of just-in-time delivery. A robust asset management program may aid a utility considering this indicator. This utility has a moderate maintenance yard with a limited stock of critical spares, meaning it could take several weeks to locate and deliver a replacement. Mutual aid has facilitated the location and delivery of unique parts. It's important to consider these limitations within a risk and resilience assessment, and staff knowledge should support preparation of a "what if" strategy if a spare part isn't economically feasible. Resource typing can also help a utility assess the limitations of its capacity to assist others and identify resources it may need to request.

O7: Critical Staff Resilience is the percentage of response-capable staff available for critical operations and maintenance positions who have cross-trained backups. Given the size of this utility, there is a fair amount of cross-training—likely out of necessity. Utilities that have prepared for staffing outages for pandemic planning or work stoppage may have a higher level of capability in this category.

F1: Business Continuity Plan (BCP) provides an indication of the integration

Utility Resilience Index (URI) Worksheet

The URI is the product of the weighting developed for each indicator (V_{ij}) and the maximum value indicated in the utility profile (w_j).

Utility Resilience Indicators (*j*)	Utility Profile	w_j	V_{ij}	MAX w_j*V_{ij}
O1: Emergency Response Plan (ERP)			**0.1389**	0.0347
No ERP		**0.00**		
ERP developed and/or updated	x	**0.25**		
Staff training on ERP (i.e., Tabletop)		**0.50**		
Resource typed assets/teams defined and inventoried		**0.75**		
Functional exercises on the ERP conducted		**1.00**		
O2: National Incident Management System (NIMS) Compliance			**0.1561**	0.0781
No ICS/NIMS training		**0.00**		
ICS 100/200 provided to key staff	x	**0.25**		
ICS 700/800 provided to key staff	x	**0.50**		
ICS 300/400 provided to key staff		**0.75**		
Utility certified as NIMS compliant		**1.00**		
O3: Mutual Aid and Assistance			**0.1868**	0.1401
None		**0.00**		
Mutual aid/intramunicipal (within own city/town agencies)		**0.25**		
Mutual aid/local-local (with adjacent city/town)		**0.50**		
Mutual aid/intrastate (e.g., Water/Wastewater Agency Response Network [WARN])	x	**0.75**		
Mutual aid/interstate and intrastate		**1.00**		
O4: Emergency Power for Critical Operations			**0.0595**	0.0149
None		**0.00**		
Up to 24 hrs	x	**0.25**		
25–48 hrs		**0.50**		
49–72 hrs		**0.75**		
Greater than or equal to 73 hrs		**1.00**		
O5: Ability to Meet Minimum Daily Demand (Water) or Treatment (Wastewater)			**0.0966**	0.0483
None		**0.00**		
Up to 24 hrs		**0.25**		
25–48 hrs	x	**0.50**		
49–72 hrs		**0.75**		
Greater than or equal to 73 hrs		**1.00**		
O6: Critical Parts and Equipment			**0.0878**	0.0220
3–4 weeks or greater		**0.00**		
1 – <3 weeks	x	**0.25**		
3 – <7 days		**0.50**		
1 – <3 days		**0.75**		
Less than 24 hrs		**1.00**		
O7: Critical Staff Resilience			**0.0605**	0.0303
<10%		**0.00**		
10–25%		**0.25**		
>25–50%	x	**0.50**		
>50–75%		**0.75**		
>75–100%		**1.00**		

Utility Resilience Indicators (*j*)	Utility Profile	w_j	V_{ij}	MAX w_j*V_{ij}	Utility URI
F1: Business Continuity Plan (BCP)			**0.0463**	0.0000	
No BCP	x	**0.00**			
BCP under development		**0.25**			
BCP completed		**0.50**			
BCP fully implemented		**0.75**			
Annual commutment of resources and BCP exercised		**1.00**			
F2: Utility Bond Rating			**0.064**	0.0480	
Caa, less than or equal to		**0.00**			
B-Ba		**0.25**			
Baa-A		**0.50**			
AA	x	**0.75**			
AAA		**1.00**			
F3: GASB Assessment			**0.0176**	0.0044	
Less than 20% assessed		**0.00**			
20–40% assessed	x	**0.25**			
41–60% assessed		**0.50**			
61–80% assessed		**0.75**			
Greater than 81% assessed		**1.00**			
F4: Unemployment			**0.0459**	0.0115	
≥5% national average		**0.00**			
>2–4% national average	x	**0.25**			
±2% national average		**0.50**			
<2–4% national average		**0.75**			
≤5% national average		**1.00**			
F5: Median Household Income			**0.04**	0.0100	
≤10% state median		**0.00**			
<5–10% state median	x	**0.25**			
±5% state median		**0.50**			
>5–10% state median		**0.75**			
≥10% state median		**1.00**			
					44.2%

Source: Morley, Kevin. Evaluating Resilience in the Water Sector: Application of the Utility Resilience Index (URI), PhD diss. George Mason University, 2012.

of risk management into the utility's culture. A BCP is often where/how a utility has addressed some level of cybersecurity risk management as part of a disaster recovery plan. In addition, a BCP is typically where continuity of enterprise functions like payroll and accounting are documented. This utility hasn't developed a BCP, suggesting there is likely a need to address critical AWIA provisions related to securing cyber assets and financial infrastructure.

F2: Utility Bond Rating indicates a utility's financial stability and capacity to repay debt. This utility has received a good rating from an independent bond agency, and the utility's fiscal health is sound.

F3: GASB Assessment entails determining how the utility has evaluated its infrastructure risk. Specifically, it determines how much of the system has undergone a condition assessment to evaluate the remaining life of its assets so rehabilitation and replacement investments can be properly considered with financial risk management plans. This utility has assessed a small proportion of its system, meaning it doesn't have a complete estimate of prospective future financial obligations.

F4: Unemployment and *F5: Median Household Income* are included to reflect the capacity of the community to react quickly and/or cope with various incidents that have the potential to disrupt utility revenue and/or influence operational response. Research has demonstrated that communities with high levels of unemployment and low median household income are more vulnerable. Although a utility can't directly alter such measures, it can provide key indicators of the potential impact a loss-of-service incident may have on the population served.

LOOKING AHEAD

Collectively, the URI provides a utility with a high-level assessment of its general resilience status. Preparing the URI is also a good opportunity to consider risk and resilience management options to ensure AWIA compliance. Also, AWWA has developed free training on AWIA and offers resources that facilitate compliance, all of which are part of the association's Utility Risk & Resilience Certificate Program (www.awwa.org/risk).