

How Public Works Teams Can Build (And Rally Support For) Better Rainfall/Storm Management





01. Executive summary



Whether you live in California or New York, Minnesota or Louisiana, you've seen a flood or drought transform your community or one very near it in the last few years.

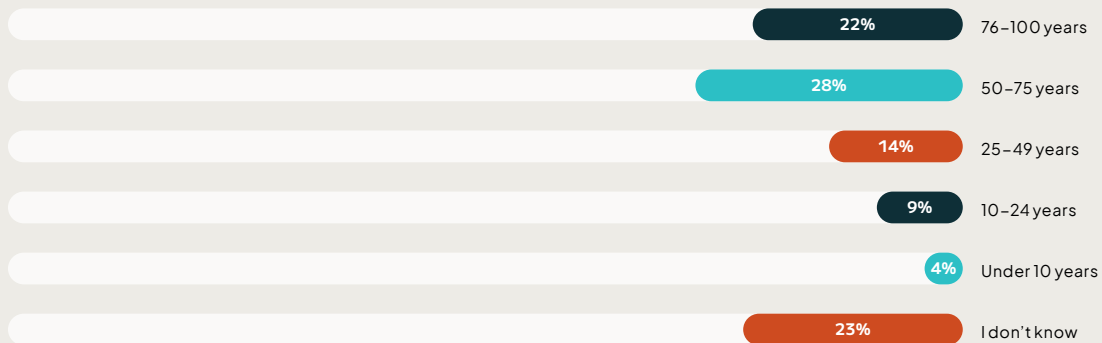
Floodplains are changing. Previously safe communities are seeing new risks. For public works teams, the work has gotten more complex and more dire rapidly.

Departments of public works across the U.S. are feeling the strain of simultaneously being asked to do more with less and align their efforts to the engineering science in the face of an ongoing political debate. Unlike most of the citizens in their community, public works professionals have enough knowledge to understand just how vulnerable they really are. They know what they need to do, but rallying funding and support are exceptionally challenging.

In late 2023, **we worked with Stormwater Solutions and Wastewater Digest** to profile the infrastructure side of the challenge. We uncovered that infrastructure age and securing funding for needed work are creating major concerns for water management leaders and that many systems across the country are approaching age-out.

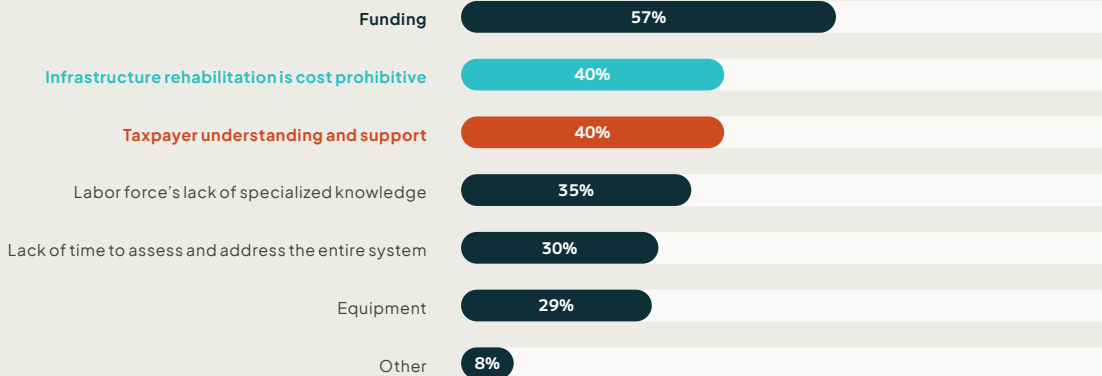


HOW LONG AGO WAS THE SYSTEM THAT SUPPORTS YOUR WATER INFRASTRUCTURE DESIGNED?



Base: All respondents (n=253).

WHAT ARE THE TOP CONCERNS ABOUT YOUR ORGANIZATION'S ABILITY TO PROPERLY AND ROUTINELY MAINTAIN ITS WATER INFRASTRUCTURE AS IT PERTAINS TO THE RISK OF CLIMATE VARIATION (I.E., FLOODING)?



Base: All respondents (n=256); multiple answers allowed.

This year, we sought to profile the human side of the challenge by connecting directly with the engineers and public works professionals at the frontlines of the battle to protect communities from the impacts of floods, heavy rainfall, and other weather-related risks. To gain a more complete understanding of the space, we interviewed six water engineers and three public works leaders who have been entrenched in this work for more than four centuries combined, asking them a series of questions about their challenges, needs, goals, and frustrations.

The following report explores the universal themes that emerged across those conversations. All the experts we talked to agreed that the way taxpayers understand and think about public works makes executing the most important work incredibly difficult. Given the ubiquity of the challenge, we probed the panel of engineers and DPW leaders to build a profile of what a “better way” would look like and how a public works team – in spite of ongoing funding and staffing challenges – can be part of bringing that better system to life to protect the community and make their own work easier.



02. Shifting the mindset from extremes to always-on thinking

How the current state sets public works teams up to fail

When a major flood occurs, there's a narrow window of opportunity to rally public support behind infrastructure improvements and new flood monitoring or warning technologies. Then, as that event gets further into the past, community flood awareness decreases, and people become less understanding of public works projects focused on drainage and floodplain management. Furthermore, due to turnover within local government, institutional understanding of flood risk management also erodes over time.



If you're dealing with flood warning systems, the single most important issue is sustainability. It's easy to sustain within the window of the flood. But if that memory was 15 years ago and there has been personnel turnover in your local agency, people don't remember why the flood warning system is even important.

David Curtis
Senior Vice President,
WESTConsultants





The next time most people think about flooding in a serious way is when the next major flood is unfolding – perhaps years or decades later. After that flood, there’s another brief period of opportunity followed by stagnancy. A cynic might say that nothing is ever learned, and nothing ever changes.

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People in our industry talk about the ‘hydro-illogical cycle’: you have a flood, so flood is top of mind and you spend a lot of money and develop a big warning system. Then, as time goes on, you get pulled in other directions – roads, building projects – and there’s a drought and all the landscaping is dead... And then it pours down rain and there’s a flood because the ground is so hard, the water can’t absorb it.

Bradley Heilwagen
President,
National Hydrologic
Warning Council



If this cycle remains unbroken, more and more property will be destroyed in floods, and more and more people will lose their lives. Public works leaders know this well, but because people fall victim to recency bias (“We don’t get floods like that here!”) or misunderstanding the science (“That was a 50-year flood, so we definitely won’t have another one like that for a very long time.”), it can be incredibly challenging simply to justify the maintenance necessary for community safety. That’s why it’s time for a change.

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You come in as a public works person with a realistic message, and it’s scary, and they think you’re overstating it. That’s a huge problem. So, the issue is building credibility and not trying to frighten people.

Jeff Pratt
Director of Public Works (Retired),
Ventura County, California



Why we should shift the discussion towards “water” generally

The public tends to think about water management in a very simplistic way: there are floods, there are droughts, and then, there are situations where it’s neither flooding nor a drought. But water engineers know well that every drought ends in a flood, and flood waters are difficult to retain safely, perpetuating the cycle of drought and increasing the destructive capacity of future floods.

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Down in North Carolina, we have predominantly clay soil, and when this stuff gets wet, it gets nasty and very difficult to deal with. You’re dealing with dust during the day when it’s dry; then, in the late afternoons or nights, when we get these storms, the clay doesn’t drain because it’s so tight, and the water just sits on top. We get in a stage where June, July, and August are extremely dry during the day, but then we get these storms at night that just pummel us.

Dan Ziehm
Director of Public Works
Gaston County, NC





Rather than looking at floods and droughts as singular events, public works teams need to start thinking about the amount of water in their area generally. When engineers and workers start asking, “How much water is in the system today, and what would happen if more was added? How much does the forecast suggest could be added? What if we got more?”, it shifts the mindset from flooding and drought being disaster management work to part of an ongoing practice that’s focused on finding a safe and sustainable balance. With good communication, that mindset should trickle down to the taxpayer level as well, making it easier to explain, justify, and build support for ongoing projects that ensure the area stays as flood-ready as possible. (More on that later.)

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A lot of these ditches, culverts, and infrastructure were all designed for a 25-year flood whenever they were built – say the 1950s, ‘60s, or ‘70s. Over time, as a community becomes more and more urbanized, there’s more impervious area laid down and more runoff as a result... And we’re seeing a lot of extreme events out there that are overwhelming infrastructure.

Bradley Heilwagen
President
National Hydrologic
Warning Council



That’s why public works needs to lead the conversation away from exclusive focus on extreme events towards an “always-on” way of thinking about water resources, management, and infrastructure. While it’s an up-front challenge to shift mindsets (first within the team, then within local government, then within the community as a whole), it’s a significant investment in the long-term safety of the community and public works’ ability to achieve the work they know they need to do.

With an always-on approach to water management and infrastructure, departments of public works can ensure that small but important maintenance tasks like clearing culverts and ditches don’t slip through the cracks. Furthermore, as water awareness becomes a bigger part of daily operational intelligence, public works teams grow in their own level of literacy and expertise, enabling them to anticipate or respond even better than before during times of acute need. That’s why thinking beyond flood and drought is key to taking public works to the next level.



03. Building buy-in with the community

Meet the public at their level of weather literacy (and increase it)

One of the biggest challenges facing every public works department is that a very small percentage of the population understands how what the team does is essential to their safety. The average citizen is quick to assume the forecast was “wrong” because a 50% chance of rain didn’t result in precipitation at their house. Similarly, when they see a proactive road or bridge closure without intimidating flood waters around it, they incorrectly assume that “someone screwed up.”



It’s funny – with our vertical construction projects, you always know some of the citizens that drive by them every day perceive that work is at a standstill because they think, ‘Oh, the sun is out shining today. Why aren’t they working?’ Well, yesterday it rained an inch or two in a very short period of time. We have to wait for Mother Nature to dry that site out, and people that aren’t familiar with construction don’t realize that.

Dan Ziehm
Director of Public Works
Gaston County, NC





Correcting that perception is key to taking public works as a whole to the next level. It's also incredibly tricky because of the politically charged dialogue around weather and climate. With that said, local public works professionals are some of the best equipped in the community to talk to citizens about the realities of evolving weather challenges in an objective and easy-to-understand way. Engineers can quantify and present the impact of recent events to help people connect their personal experiences to the science. Public works employees provide a recognizable local face that can speak to how flood, rainfall, and drought affect quality of life and facilities in the area.

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Taxpayers typically don't understand the amount of engineering and design that goes into supporting each household, let alone accounting for a growing community. They just expect the toilet to flush... The people who do the work of making sure the toilet flushes understand the financial and human costs extremely well. We need to close that gap.

James Logan
Water Market Sector Leader
AEM



While it's not public works' responsibility alone to re-educate the public, it undeniably behooves teams to start and facilitate an ongoing conversation about weather impacts in their communities in order to build understanding and support for key projects.

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I'm seeing a lot of conversations where residents are seeking information. For the most part, they know they're in a challenging situation, and they're up for the challenge if they are given the right information and the tools to be able to make the right decisions for themselves.

Brianna O'Brien
Conservation Coordinator
Town of Hampton, NH





Market the value of public works

Public works is a calling for doers, not talkers, but it's time for public works to toot its own horn a little more. City and county departments deliver incredible value to the communities they serve, from supporting transportation and economic development to protecting both the value and safety of people's property. If it weren't for departments of public works, our communities would be dirtier, less safe, and much less livable.

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The public often doesn't see that you've got a community of 300,000 people covering 24 square miles, so maybe there's a particular block where you receive repeated complaints about their issue, but they don't understand that you're managing another critical issue that's impacting several hundred people somewhere else... And that's really a struggle for both people – the public works director and the citizen. It's hard to look at people and say, 'I know this is really important to you..., ' but it's necessary.

Bradley Heilwagen
President
National Hydrologic
Warning Council



To get the respect and support they deserve, public works teams need to proactively communicate with taxpayers about what they're doing, why it's necessary, and how it's improving the community's present and future. Directors of public works need to find local channels – whether it's traditional media, direct outreach, or partnering with other community organizations (such as chambers of commerce) – that can help spread awareness of what they're doing and why it's vital. While it's impossible to win everybody over, and there will always be funding challenges in the public sector, good communication is a tool that local teams can employ to rally as much support as possible around their efforts.

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It's always easier for the public to deal with a cost increase if they can understand what they're getting out of it and the value it's providing. It's part of the job to educate the people on how their money is spent, why it's needed, and to actually spell out how the project is going to either improve or maintain the services that the citizens depend on every day.

James Logan
Water Market Sector Leader
AEM



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I saw a great example of this in the town of Cary, North Carolina. They put out a one-page pamphlet – 'Have You Seen These Signs?' – explaining the new flood warning signs they'd installed and their cost-to-benefit ratio. It was extremely cool because that effort increased public acceptance and measurably reduced vandalism on the stations.

Ryan Guerrero
Hardware Product Manager
AEM



Public works teams don't need to look far for inspiration on how to market themselves as pillars of community safety and pride. There are likely sources of inspiration within their own local governments.

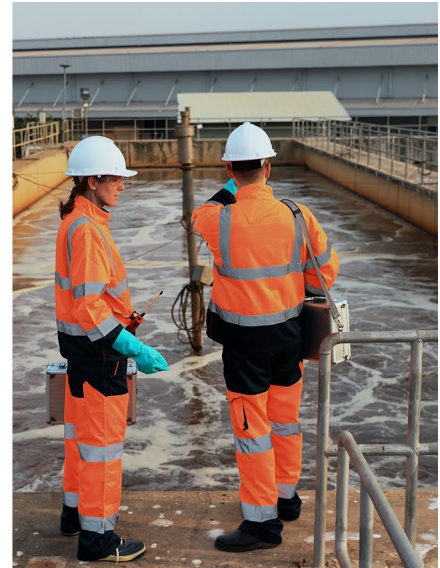


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Public works really needs to get out there, put their image out there, and lay it on the line with what they do... There ought to be some sort of universal brand for public works across the nation – kind of like the star is associated with law enforcement.

Jeff Pratt

Director of Public Works (Retired)
Ventura County, California



Become part of the public safety tripod

Just about every municipality has three teams that work together to ensure the safety of the community: the police department, the fire department, and the department of public works. In the hearts and minds of the people, one of those things is not like the others. Law enforcement and fire teams certainly experience some of the same staffing challenges as departments of public works, but when it comes to funding and public perception, it's night and day. Police officers and firefighters are heroic and necessary; public works professionals tear up the road and raise the property taxes.

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Every time I go into a public meeting, I remind people: we're the other public safety agency, even if the public safety agencies don't like us to call ourselves that. It got to the point where I would ride a scooter into the board meetings with flashing blue lights and my safety gear on to reinforce the point.

Jeff Pratt

Director of Public Works (Retired)
Ventura County, California



Again, this is a marketing and communication challenge. If public works departments can build visibility for their work, awareness of the “why” behind it, and demonstrate value they provide within the community, they can get over some of the hurdles that have held back funding, staffing, and public support.

Police, firefighters, and public works already work together on a daily basis. By shining a light on that collaboration and working together with other public safety professionals when they do community outreach, public works teams can increase their visibility and standing among taxpayers.



04. Getting the data necessary to do better

Use AI in ways that lead to better human results

One of the biggest challenges for public works teams is staffing. That's why artificial intelligence has a lot to offer in this space. With that said, the rapid rollout of AI technologies over the last few years has raised as many questions as it's answered.

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The AI forecasting I've seen is as good as the models we've been using. The technology made a huge jump very quickly, and it's gone a little bit stagnant over the last few months, but I think the next jump is blending our human understanding of the physical science (which we understand very well) with machine learning – then the models would be even better than they are today.

Chad Ballard
Senior Engineer
AEM



While public works remains a “humans doing work for humans” job, AI can provide greater context for how focused work fits into the larger system of the world as a whole. For example, AI can model storm systems much faster than traditional means and fill in gaps in the data based on previous events to present a reliable projection of an incoming storm that public works professionals can use to maximize preparedness in the hours before the storm. It can monitor roadways or dams and alert human professionals when something doesn't seem right to trigger maintenance or inspection. AI can also provide daily value by helping team leaders catch tasks that have fallen through the cracks or suggesting pivots when weather conditions prevent planned work.

With AI, public works teams can significantly increase their ability to take in and process data to make decisions without increasing their headcount. While it's never going to replace the work that human public works professionals do, AI can make the work more purposeful and more efficient.

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At some point down the road, we'll be looking at automation where the system is actually making the decisions about warnings and controls itself – not necessarily a human professional. For some people, that's a little scary to think about at first, but it's actually a much faster feedback loop and a better use of resources, as long as the data is right.

Ryan Guerrero
Hardware Product Manager
AEM





Combine intelligence from a variety of sources

Protecting people and infrastructure from the weather often comes down to intelligence. If you have a strong understanding of what’s already happened, what’s happening right now, and what’s likely to happen in the future, you have a high chance for success. If even one link in that chain of knowledge is broken, it’s hard to be sure you’re leading in a correct manner and even harder to defend afterwards when something goes wrong.



Even the most dense rain gauge networks are still only measuring rainfall at parts per trillion, so you’re really only getting a tiny, tiny sample... The fundamental way that we go about estimating rainfall from rain gauges is just filled with all sorts of problems.

David Curtis
Senior Vice President
WEST Consultants



That’s why public works leaders need to find ways to gather and analyze more data – but it’s not enough to find one source of weather information that you like. An example that most public works teams can relate to is the use of rain gauges. Rain gauges are great tools for quantifying rainfall totals, and, depending on the type of gauge, even rainfall intensity, but they don’t provide enough data on their own to create a trustworthy backbone for a decision-making framework.

Even though rain gauges don’t tell the full story on their own, they are still incredibly valuable for public works and water management teams, as long as they’re cross-referenced with other sources of data, like radar, which can transform specific gauge readings into a big-picture story about the present and near future.



The beauty of radar is that it does a really good job of figuring out that relative spatial distribution that can tell you where it’s raining hard in between the gauges and where it’s not... You have to merge the strength of a rain gauge network with the strength of a radar image, and you come up with a better overall estimate of rainfall volume.

David Curtis
Senior Vice President
WEST Consultants





Leverage sensors that maximize insight

As we've said, data drives decisions. That's why in-field sensors are essential to any approach to water management, whether you're striving to adopt an "always-on" mentality or still stuck focused on those major events.

With that said, many flood warning systems still use sensors that attempt to apply last century's technology to understand this century's weather challenges. Those sensors are often placed directly into the water, which means they're at risk for damage as they do their work, especially during an extreme weather event. That's why many teams are switching to contactless sensors that use radar or other technology to monitor water in a way that's more accurate and reliable.



Sensors that are more non-contact with the water – like a radar sensor – require way less maintenance than an in-water water sensor. Since there's no water touching that sensor, it's more reliable. We're also moving towards more sensors that provide true real-time data, which enables quicker outreach to the public and faster decisions.

Ryan Guerrero
Hardware Product Manager
AEM



Another way public works teams can increase intelligence is by pairing cameras with their traditional environmental sensors. As they say, "a picture is worth a thousand words," and a camera in the field helps complete the story formed by the readings the environmental sensors are reporting. In a flood scenario, a camera near a dam or reservoir can help water management professionals make decisions about flow control. Alternately, a live view of important intersections can help public works and safety teams understand the most important places to deploy their resources during a road weather event.



Increase collaboration and decision-making intelligence across teams

As we've explored, public works professionals are constantly collaborating with their colleagues in the police and fire departments – as well as emergency managers on an as-needed basis – to keep the community as safe as possible. Getting that right in the face of larger storms, more serious floods, and higher public expectations requires a clear, straightforward language for understanding what's happening and what must be done.

The more that local teams can break down the silo walls between departments to directly share information and problem-solve together, the better they can serve their communities to protect people and property. In some situations, that might require an upfront investment by public works in training their colleagues to understand the always-on approach to water and what they should expect during a major event, but that initial investment is well worth the results.



For local teams, water data from neighbors is often the most under-utilized asset that's available to them. People in each community want to say, 'We've got this,' and that pride just winds up hurting everybody. Sharing information with up- and downstream communities increases everybody's capacity for advanced warning and makes it easier to make decisions you can be confident in.

Ryan Guerrero
Hardware Product Manager
AEM



We can work together and use the resources we already have to make this happen. The social capital exists out there. I think fostering community, allowing people to talk to one another and help one another and share ideas makes a big difference. Then, you take the low-hanging fruit and run with it.

Brianna O'Brien
Conservation Coordinator
Town of Hampton, NH





05. Key takeaways/recommendations



Communities tend to compartmentalize individual flood events rather than seeing them as part of an ongoing cycle of water and weather. This creates significant impediments for public works teams, who are tasked with thinking about drainage, infrastructure, and water management on an ongoing basis.



Public works teams must embrace an always-on approach to thinking about water in their area. The mindset must start within the department and then expand out to the rest of government and community through communication and education.



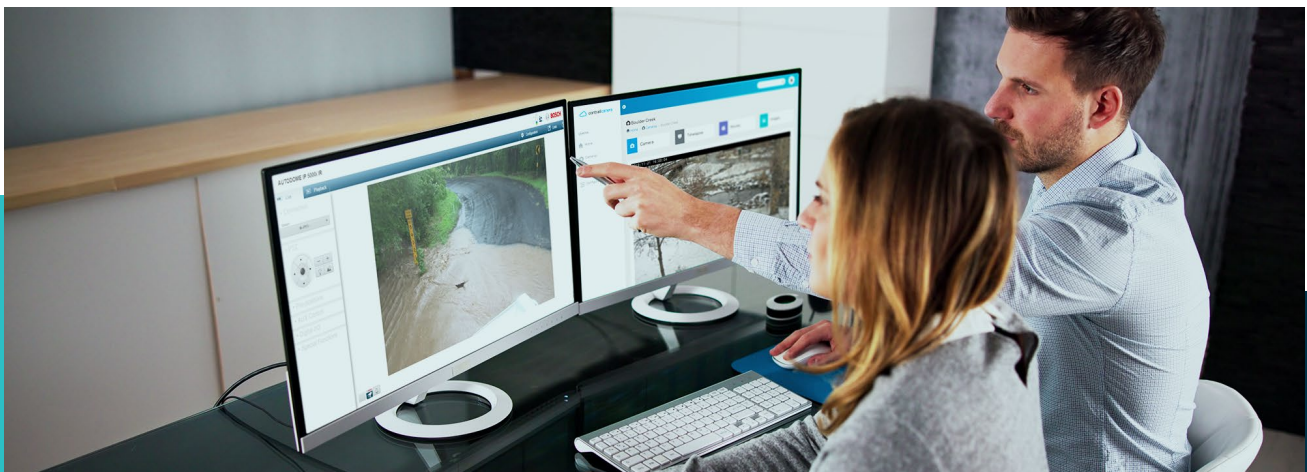
To get public buy-in into this new way of thinking, public works teams need to market their services and impacts more effectively within their communities. Public works must learn to present itself more like the police or fire department in terms of self-advocacy.



With that mindset and buy-in in place, it's easier for public works teams to get funding for the projects they know they need to do to keep the community safe.



Public works departments must become collaboration leaders within their local governments. By strengthening relationships with other departments with shared responsibilities and fostering important dialogues around public and infrastructure safety, public works can improve their ability to achieve their goals and overall public safety outcomes.





06. Contributors



Chad Ballard, PE, CFM

Senior Engineer, AEM

Chad is a licensed civil engineer in multiple states and a certified floodplain manager. He has spent his career working with clients to solve challenging water resource problems using the latest advances in technology. In addition, Chad has taught undergraduate, graduate, and professional continuing education courses in water resources, including advanced hydraulics and hydrology. Chad holds bachelor's and master's degrees in Civil and Environmental Engineering, and he is active in a variety of professional organizations at the national and state level, including the American Society of Civil Engineers (ASCE), Environmental and Water Resources Institute (EWRI), and the Texas Floodplain Management Association (TFMA).



David Curtis, Ph.D.

Senior Vice President, West Consultants

For more than 50 years, David has led cutting edge hydro-meteorological, water resources, and flood risk management services. He has been involved in the design, development, and implementation of award-winning innovations in more than 50 automated environmental and flood monitoring systems across the U.S. and in eighteen countries abroad. His flood warning system development efforts led to the Connecticut Statewide Flood Warning System, the nation's first statewide system.



Ryan Guerrero

Hardware Product Manager, AEM

Ryan brings more than a decade of experience in hardware testing, field work, sales, and business development within the environmental monitoring hardware market with special emphasis on hydrological monitoring. His prior experience in both component and system-level electronic work, coupled with his degrees in Applied Management and Applied Science in Robotics & Communications, give him the right blend of technical and management expertise to drive the AEM hardware line forward.



Bradley Heilwagen, PE, CFM

President, National Hydrologic Warning Council

Brad has nearly 20 years of experience as a water resource engineer and project manager. He currently serves as the President of the National Hydrologic Warning Council. As a consultant, he has worked with clients across the U.S. and Canada to solve a variety of water resources problems: hydrologic and hydraulic modeling, stormwater design, flood warning systems, flood risk analysis, pipeline scour, dam design, and more.



James Logan

Water Market Sector Leader, AEM

James has been involved in the assessment, design, development, and implementation of more than 200 automated flood early warning and environmental monitoring systems across the U.S. and abroad. He has also led numerous consulting studies relating to rainfall and hydrologic analysis, flooding, stormwater, dam safety, hydrology, and water resource management. James holds degrees in both Computer Science and Geophysical Engineering. He is a member and contributor to the U.S. National Hydrologic Warning Council's Technical Working Group for the ALERT2 protocol standard.



Brianna O'Brien

Conservation Coordinator, Town of Hampton, NH

Brianna is a Certified Floodplain Manager and conservation leader committed to taking on the messy, nuanced work that makes communities more connected, resilient, and sustainable. In her current role, she coordinates community outreach to foster a dialogue around how citizens and local government can collaborate to establish a meaningful dialogue and take action around climate, weather, flood, and natural resource issues.



Jeff Pratt

Director of Public Works Agency, County of Ventura, CA (Retired)

Before retiring in April 2024, Jeff was Director of Public Works for Ventura County for more than 15 years. In that capacity, he managed five departments, more than 400 staff members, and a budget of over \$350M. Prior to becoming agency director, Jeff also served as Director of the Watershed Protection District.

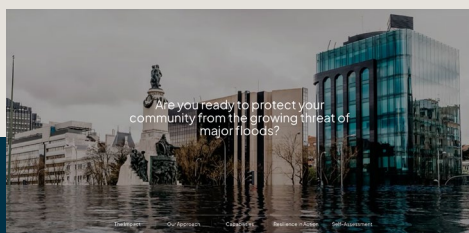


Dan Ziehm, PE

Director of Public Works, Gaston County, NC

Dan has been Director of Public Works in Gaston County since January of 2021, having previously served as Assistant Director for more than 12 years. He is a member of the American Society of Civil Engineers (ASCE), Solid Waste Association of North America (SWANA), American Public Works Association (APWA), the Gaston County Safety Committee, and is the ADA liaison for Gaston County Public Works. Dan also has been certified by the APWA as a Public Works Professional with a concentration in management.

07. Related resources



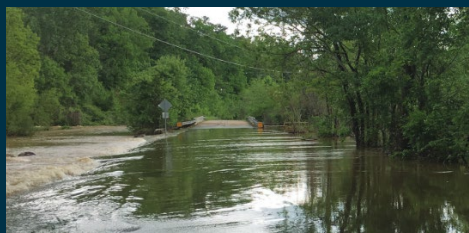
OUR VISION FOR FLOOD READINESS

- Discover a scalable whole-lifecycle vision for water management and flood readiness
- Assess your community's level of readiness for floods and severe storms
- See what you can achieve with the right flood risk management partner



FLOOD BEST PRACTICES IN ACTION

- See what innovative and safety-minded communities are doing to address flood risk
- Learn the six practices for managing successful flood warning systems
- Explore real examples of flood resilience in action



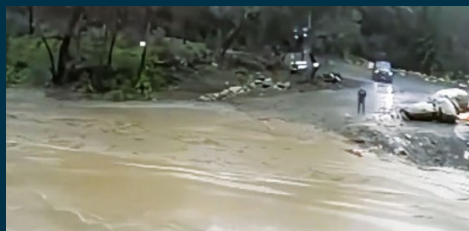
CASE STUDY: RALEIGH, NC

- Explore how Raleigh shifted mindsets and operations around storms from reactive to proactive
- Learn how the city used hydrological modeling to understand their risks and needs better
- See how radar rainfall data is enabling community leaders to make more informed decisions



CASE STUDY: CHARLOTTE-MECKLENBURG STORM WATER SERVICES

- See how Charlotte-Mecklenburg Storm Water scaled up their approach to water monitoring
- Discover how the city increased alignment for their flood and water quality teams
- Learn how the team is benefitting from comprehensive water and storm management software



CASE STUDY: SANTA BARBARA COUNTY, CA

- Learn how Santa Barbara is using visual intelligence from cameras to monitor their watershed
- See how the county has streamlined decision making for public leaders during a storm
- Discover how a community overcame communication and telemetry issues to provide real-time data

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