GIS & DIGITAL WATER

The Foundational Role of GIS in Digital Water Transformation

A research collaboration with

bluefield RESEARCH

CONTENTS

THE *big* PICTURE

Defining GIS and Its Role in Digital Water Transformation

WHAT IS GIS?

WHAT DOES IT HAVE TO DO WITH WATER?

- Location is everything in the water industry. A utility's core function is to ensure the timely movement of water, wastewater, and stormwater from one location to another, flowing from the plant to the tap and back for treatment and discharge. Utility staff are highly mobile and responsible for operating and maintaining an extensive network of assets across diverse service areas. The data that utilities collect is fundamentally spatial. At the same time, various datasets are typically stored in separate systems or silos and used by different teams for different purposes; most of them are connected to specific locations such as customers, assets, or processes in identifiable areas.

WHERE DOES GIS FIT IN? WHAT IS GIS, *and* WHAT IS IT NOT?

- A geographic information system, or GIS, is a technology that originated in the 1960s for recording and analyzing geospatial or locational information.
- GIS is a tool for location intelligence, helping organizations of all types and sizes—including those in water, wastewater, and stormwater utilities—to make informed decisions based on locational data.
- GIS is a foundational element for digital transformation in the water industry. It facilitates the integration, coordination, and analysis of various hardware and software and the collaboration of workers, processes, departments, and datasets across space and time. This foundation paves the way for more advanced digital initiatives such as big data analytics, machine learning (ML), artificial intelligence (AI), and digital twins.
- GIS is *not* just a system for recording data about a utility's assets, such as the age or material type of a pipe segment or the maintenance history of a specific valve. It also functions as a system of engagement, enabling staff to access core asset data from any location or device. Furthermore, GIS operates as a system of insight, providing advanced analysis to support data-driven decision-making, optimize operations, and facilitate efficient resource planning.
- GIS is *not* limited to horizontal assets like distribution and collection system networks. Its capabilities have evolved and expanded, offering a comprehensive view of infrastructure that encompasses both vertical and horizontal assets. Utilities streamline facility management by leveraging GIS solutions to establish a robust system of record, expedite facility mapping, and enable 2D and 3D visualization.
- GIS is *not* only for experts. While GIS professionals are essential for building and maintaining a utility's GIS database, the system is also designed for use by nonspecialists. Field crews use mobile applications to view and collect data, customer service representatives easily access data, and leadership monitors work to ensure organizational goals are being met. GIS-based maps, apps, and solutions empower the entire organization.

{ DEFINITIONS }

Digital Water

An ecosystem of data and analytics solutions (e.g., hardware, software, and services) that supports informed decision-making across water, wastewater, and stormwater management.

Geographic Information System (GIS)

A framework for gathering, managing, and analyzing data, rooted in the science of geography, which analyzes spatial location and organizes layers of information into visualizations using maps and 3D scenes.

ArcGIS®

The market-leading GIS platform launched by US software company Esri in 1999 that is widely used in the water, wastewater, and stormwater industries.

Horizontal Assets

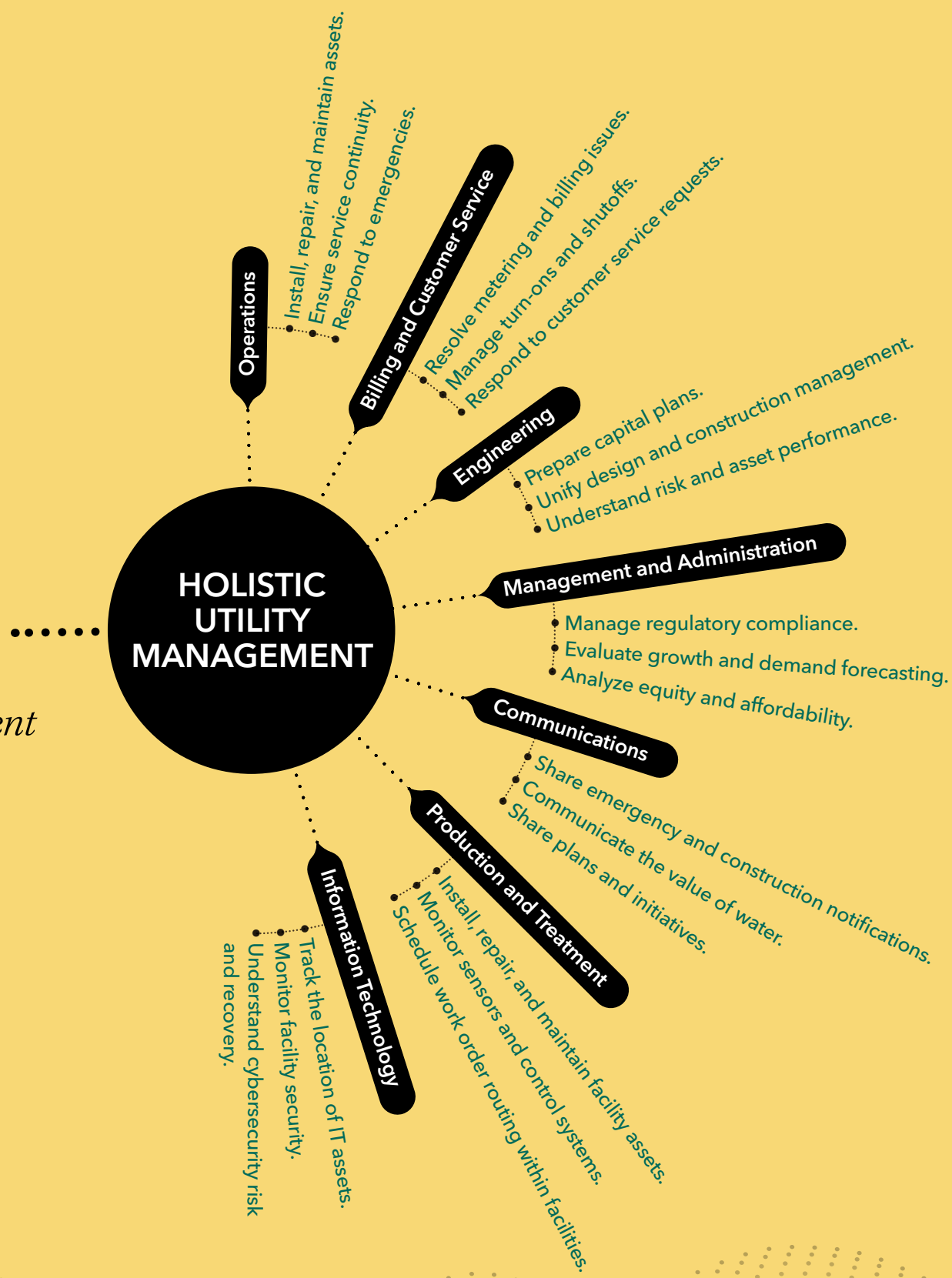
Network assets (e.g., system pipes and appurtenances) that are represented as points, lines, and polygons on a GIS map.

Vertical Assets

Buildings and facilities (e.g., treatment plants and pump stations) that are represented as lines, points, polygons, and 3D features on a GIS map.

Common Patterns of GIS Use

by Utility Department



SOURCE: *Esri, Bluefield Research*

WHY NOW?

Drivers for Digital Water Transformation

Today's water utility leaders must navigate unprecedented financial, demographic, environmental, regulatory, and technological challenges. Aging infrastructure is becoming increasingly costly to operate, maintain, and rehabilitate. Between 2019 and 2024, utility budgets faced significant strain due to price inflation. During this period, the average cost of pipes surged by 51 percent, while pumps and valves saw a 36 percent increase, and treatment chemicals experienced a rise of 26 percent. As water rates and utility revenues struggle to keep pace, utilities increasingly focus on optimizing their limited capital and operating budgets.

Moreover, the water workforce is aging, with approximately one-third of the industry's 1.7 million professionals expected to become eligible for retirement in the next decade, taking crucial institutional knowledge with them. Additionally, the evolving climate is resulting in heightened shocks and strains on utility infrastructure. In the US, there has been an average of 12 climate-related disasters annually over the past decade, each costing over a billion dollars. This marks a significant increase from the 1980s, when only three such events occurred per year. Savvy utility leaders recognize the opportunities inherent in these challenges—opportunities to implement technology that addresses these challenges while at the same time applying enhanced capabilities across the organization. These include the chance to tangibly improve customer communication and satisfaction, enhance community resilience, ensure worker safety, and maximize the efficiency of their personnel, processes, and technologies. Digital water solutions have enabled utilities to fully harness these opportunities by transforming their operations and infrastructure.

Tailwinds from federal funding and regulation are helping utilities adopt innovative digital water solutions. The Infrastructure Investment and Jobs Act (IIJA) of 2021 appropriated over US$50 billion for water infrastructure improvements through existing State Revolving Fund (SRF) programs. Utilities across the US have used this funding to invest in smart meters, digital sensors, supervisory control and data acquisition (SCADA) systems, and digitization initiatives. As of mid-2025, over half of the total funding remains to be distributed to SRFs, meaning that utilities will continue to have support for necessary improvements in the coming years.

Regulatory changes are increasingly incentivizing modernization efforts in utilities. Across the board, tighter regulations regarding water quality, leakage, and water supply management drive the adoption of real-time data collection and management technologies. Consider the US Environmental Protection Agency's (EPA) 2021 Lead and Copper Rule Revisions, which set an October 2024 deadline for utilities to inventory their lead service lines (LSLs) and share the findings with customers and state regulators. To accomplish this, utilities had to manage massive amounts of data collected on inventoried pipes, including details such as pipe materials, locations, asset ages, ownership, and classification methods. The October 2024 deadline was more representative of a starting line than a finish line. Utilities are now focused on how the transition from the Lead and Copper

Rule Revisions to the 2024 Lead and Copper Rule Improvements (LCRI) will impact their work. Although the LCRI has similar requirements, differences impact utilities by requiring

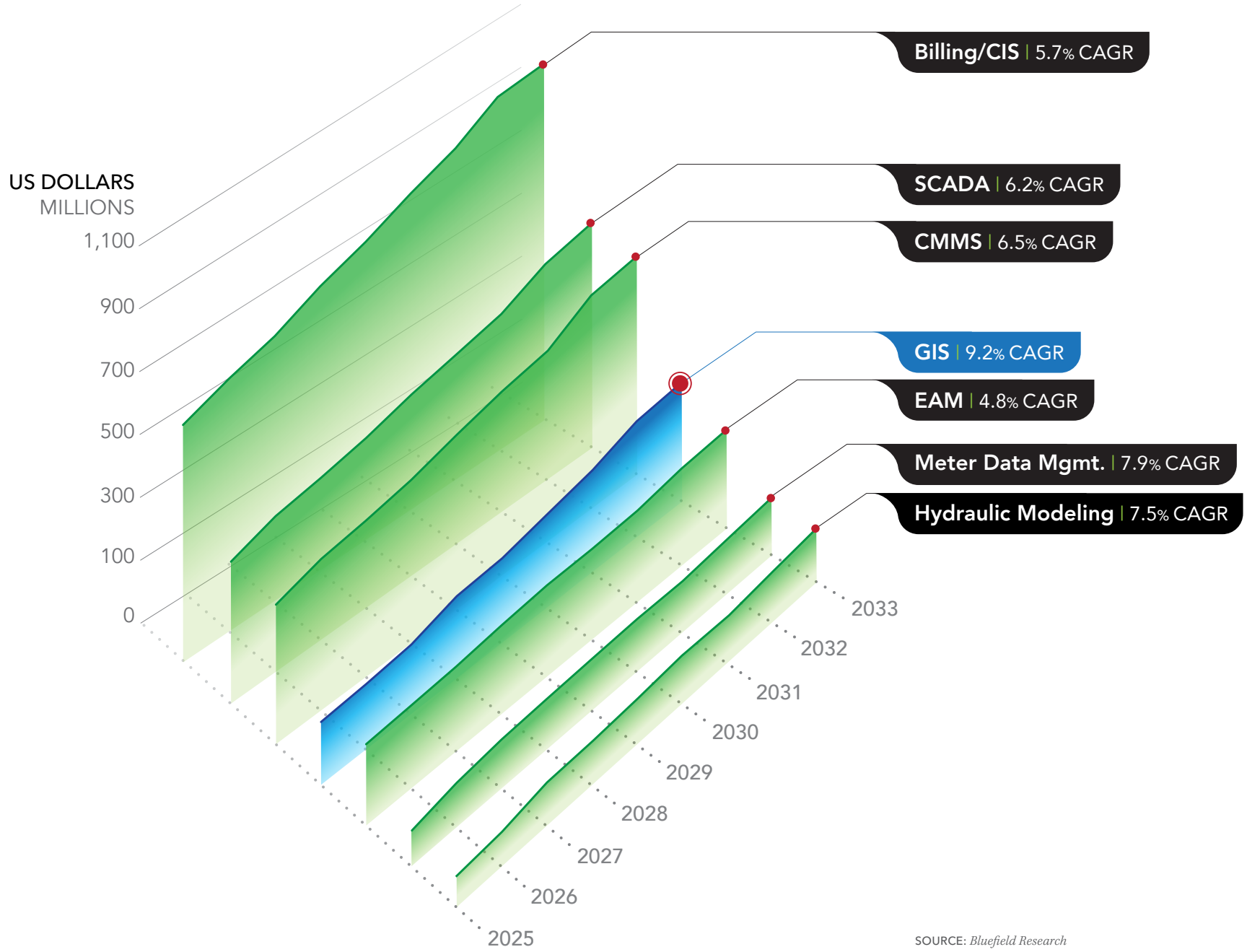
- The replacement of lead service lines by 2037.
- Service line inventory updates.
- A change in tap sampling protocol.
- A response to a lower lead action level.
- Increased public outreach and transparency.

Water utilities are working to include ongoing identification of unknown pipes, maintain and update public-facing pipe inventories, sample water at sites with LSLs, and entirely replace lead service lines. GIS mapping can aid utilities in these initiatives by providing an updated, location-based record of pipe data, maintenance history, replacement plans, and more.

Water leakage is another compelling factor driving digital transformation efforts in the water sector. It is estimated that 18 percent of treated water in the US is lost due to leakage, equating to nearly seven

US UTILITIES' PROJECTED DIGITAL WATER SOFTWARE INVESTMENTS BY PRODUCT TYPE

2021–2030

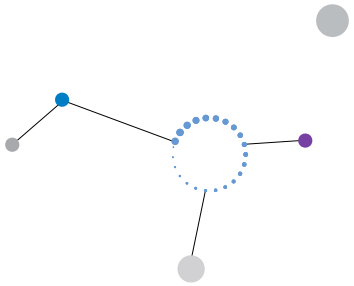


SOURCE: *Bluefield Research*

billion gallons of treated water per day—over 10,000 Olympic-sized swimming pools worth of water! Beyond the energy and chemical resources wasted in this loss, utilities face direct financial costs; the lost water translates to over US$17 million in lost revenue daily. While there is no federal regulation regarding water leakage, states like California and Georgia require utilities to track and address these losses. Utilities are adopting various solutions to identify and reduce leakage to comply with these regulations. These include GIS mapping, satellite leak detection, pipe replacements, network pressure monitoring, and smart water meters.

GIS is uniquely suited to serve as the foundation for digital transformation in the water sector for several reasons. It is designed to be accessible to users across a utility organization from anywhere, on any device. GIS can intake, display, and analyze data from various digital hardware and software, including flow meters, water quality monitors, billing systems, and work order management systems. Furthermore, GIS is already used by most water, wastewater, and stormwater utilities worldwide, making it an ideal starting point for new digital water investments and initiatives. Whether you work for a large urban utility serving millions or a small rural or suburban provider serving thousands, GIS can support your digital transformation journey at every stage.

Water industry analysts at Bluefield Research consider GIS one of the most promising growth areas for digital water investments, on par with other key segments like SCADA, enterprise asset management, and hydraulic modeling. Investments by water utilities in GIS software are projected to see nearly double-digit growth annually over the next decade as utilities worldwide harness GIS as the bedrock of their digital transformation initiatives.



{ DEFINITIONS }

Customer Information System (CIS)

A software platform for managing key customer data, including account and billing information.

Computerized Maintenance Management System (CMMS)

A software platform for managing maintenance programs, with functionality related to scheduling maintenance tasks, managing work orders and inventory, and facilitating communication around maintenance activities.

Enterprise Asset Management (EAM) Software

A more advanced software for managing enterprise assets that often includes CMMS modules and draws from CMMS data but extends into predictive maintenance, asset life cycle planning, and financial analysis.

Supervisory Control and Data Acquisition (SCADA)

A system of software and hardware used in water and wastewater treatment to monitor and control processes remotely, improving efficiency and safety.

MAPPING THE POINTS OF OPPORTUNITY

The following sections outline several ways a robust, well-configured GIS serves as the cornerstone for innovative digital transformation initiatives. By examining pioneering water, wastewater, and stormwater utilities in the US, you will discover how to utilize GIS for five key digital water initiatives:

- **Network Management:**
  Updating and integrating network data to model and manage network performance, behavior, and asset relationships. Network management also includes creating and integrating digital twins—real-time, dynamic digital replicas of infrastructure assets that enable improved operation and management.
- **Coordinated Operations**
  Ensuring that all utility data is accessible to all staff members—from field crews and customer service representatives to engineers and financial planners—so that every member of the organization has access to up-to-date information when and where they need it.

A COURSE FOR THE DIGITAL WATER JOURNEY WITH GIS

- **Customer Care**
  Creating transparency inside and outside of the organization. GIS maps and applications provide easy access to information about utility services and projects, resulting in more informed, knowledgeable, and satisfied internal stakeholders and customers.
- **Location Intelligence & Analytics**
  Leveraging embedded, industry-specific analytics to support data-driven decision-making and improve operational efficiency, transparency, and sustainability practices. ArcGIS offers decision support tools that enable water utilities to make informed decisions based on spatial data analysis, scenario planning, and risk assessment.
- **Facilities & Vertical Assets**
  Improving operational effectiveness with GIS mapping, modeling, and location intelligence capabilities. Applying proven asset management strategies to facilities and vertical infrastructure leverages GIS solutions that empower organizations to make data-driven decisions, enhance operational efficiency, and ensure longevity and optimal performance of assets.

{ DEFINITIONS }

Digital Twin

A virtual representation of the real world, including physical objects, processes, relationships, and behaviors. GIS creates digital twins of natural and built environments, integrating many types of digital models in a unique way.

US WATER AND WASTEWATER *Asset Base*

225,488
pump and lift stations

52,400
water storage tanks and towers

23,990
wastewater treatment plants

2.2 MILLION
miles of water pipe

17.6 MILLION
fire hydrants

20.5 MILLION
maintenance holes

51,300
water treatment plants

1.8 MILLION
miles of wastewater pipe

$1.46 TRILLION*
worth of assets

*US DOLLARS

SOURCE: *Bluefield Research*

NETWORK MANAGEMENT

US utilities collectively manage nearly US$1.5 trillion of water, wastewater, and stormwater assets. These assets encompass an estimated four million miles of distribution and collection pipes, 77.5 million network assets (such as valves, hydrants, and maintenance holes), and over 350,000 vertical assets (such as treatment plants, storage tanks, and pump and lift stations). Mapping these assets and recording key attributes (such as size, age, and material type) are foundational functions of a GIS platform.

Effective infrastructure management requires utilities to adopt a holistic approach to their networks rather than viewing them as individual assets. It is crucial to have a clear understanding of the location of critical assets, as well as their interconnections and relationships within the network. For example, in the event of a water main break, understanding which valves should be closed helps to quickly minimize service disruptions for customers and businesses. In the case of a power outage at a wastewater lift station, it's important to know which maintenance holes are at greatest risk for sanitary sewer overflows. Additionally, when catastrophic weather impacts a water treatment plant, having awareness about the relationships between power, communications, heating, and water will help prevent cascading failures.

/ **PERSPECTIVES** /

"EPCOR migrated to [ArcGIS] Utility Network and modernized our geospatial platform. The implementation streamlined editing practices, set better quality control measures, and put in place a richer data model with more advanced tracing and system analysis capabilities. Our geospatial program is well positioned for future success."

— ***Jamie Patterson***
GIS Manager | EPCOR

This is where Esri's advanced network management and modeling tools come into play. Utilities leverage ArcGIS Utility Network for sophisticated, real-world water network modeling. It employs industry-standard and utility-specific logic to comprehensively model, visualize, and analyze the network's performance. These tools extend to complex infrastructure with multiple subcomponents, such as pump stations, which contain interrelated equipment that must be operated and managed in tandem. ArcGIS Utility Network is designed to work on a field supervisor's mobile device and a GIS professional's desktop computer, providing access to all users within the organization, regardless of their location.

[CASE STUDY]

Metropolitan Utilities District

The Metropolitan Utilities District (M.U.D.) made the decision to modernize their GIS by implementing Esri's ArcGIS Enterprise and migrating to ArcGIS Utility Network. The GIS team began laying the foundation for transitioning from ArcMap and the geometric network to ArcGIS Pro and ArcGIS Utility Network. This began with a thorough data review to identify data gaps and errors, and a strategy to improve data quality. The result is an accurate, real-world data model with full network connectivity.

Utilizing capabilities in ArcGIS Pro and ArcGIS Utility Network empowered M.U.D. to implement modern solutions. The integration of hydraulic modeling and advanced analytics has enabled M.U.D. to strategically plan capital improvements, prioritizing risk reduction and enhancing sustainability. Maps and apps were configured to share capital improvement projects with stakeholders. Staff built an outage

M.U.D. developed an outage application that leverages ArcGIS Utility Network in real time to show field personnel how to isolate water mains during emergencies.

management application supported by trace capabilities in ArcGIS Utility Network, integration with SAP, and ArcGIS Enterprise. This application has improved communication and response times during emergencies. M.U.D. is addressing lead service line replacements in compliance with EPA regulations, utilizing high-quality data to inform decision-making. In response to the American Gas Association rule for responding to a gas-filled structure, M.U.D. configured a new application that creates situational awareness for field crews, fire departments, and first responders. Future plans include GIS-based solutions to improve various workflows, including corrosion control, cathodic protection, and the as-built process.

ArcGIS Enterprise and ArcGIS Utility Network empower staff with a central GIS hub, powerful desktop capabilities, and GIS-based mobile applications.

/ **PERSPECTIVES** /

"Using data from the UN [ArcGIS Utility Network] has resulted in less time fixing connectivity issues in the hydraulic model. The built-in connectivity rules ensure good data, which is very important when modeling flow through our system, knowing what's connected to what and how the system flows together."

— Evan Martin

Director, Infrastructure Integrity | Metropolitan Utilities District

COORDINATED OPERATIONS

Roughly 75 percent of the 1.7 million employees in US water utilities serve in on-site or field-based roles, while only a quarter hold office-based positions. This mobile and distributed workforce presents significant challenges for communication and coordination. How can utility managers ensure that all staff members have equal access to accurate, up-to-date, and authoritative organizational information—such as as-builts, maintenance records, and open work orders—regardless of whether they are in the office or on a jobsite?

GIS is an ideal solution, serving as a system of engagement that facilitates coordination, collaboration, and data sharing in real time across all teams and departments—from field crews and plant operators to customer service representatives and financial planners. Esri's synchronized mobile and desktop applications open a two-way channel of communication between the field and the office. Field staff quickly and easily collect or update data while they work via a mobile device, with changes immediately reflected in maps and operational dashboards. Meanwhile, office-based dispatchers and customer service representatives push assignments out to field teams with the click of a button, leveraging either Esri's internal task management tools or its deep integrations with third-party work order management software platforms (e.g., EAM, CMMS, CIS), many of which are built directly on top of ArcGIS.

The benefits of better coordination and data sharing across functional areas are clear. With data at their fingertips, field crews eliminate frequent trips back to the office to review paper maps and files, saving significant time, labor, and fuel costs. Functioning as a single source of truth, GIS empowers utility staff, contractors, and other external stakeholders to make data-driven decisions in the field and avoid costly or even dangerous mistakes resulting from inaccurate or out-of-date information.

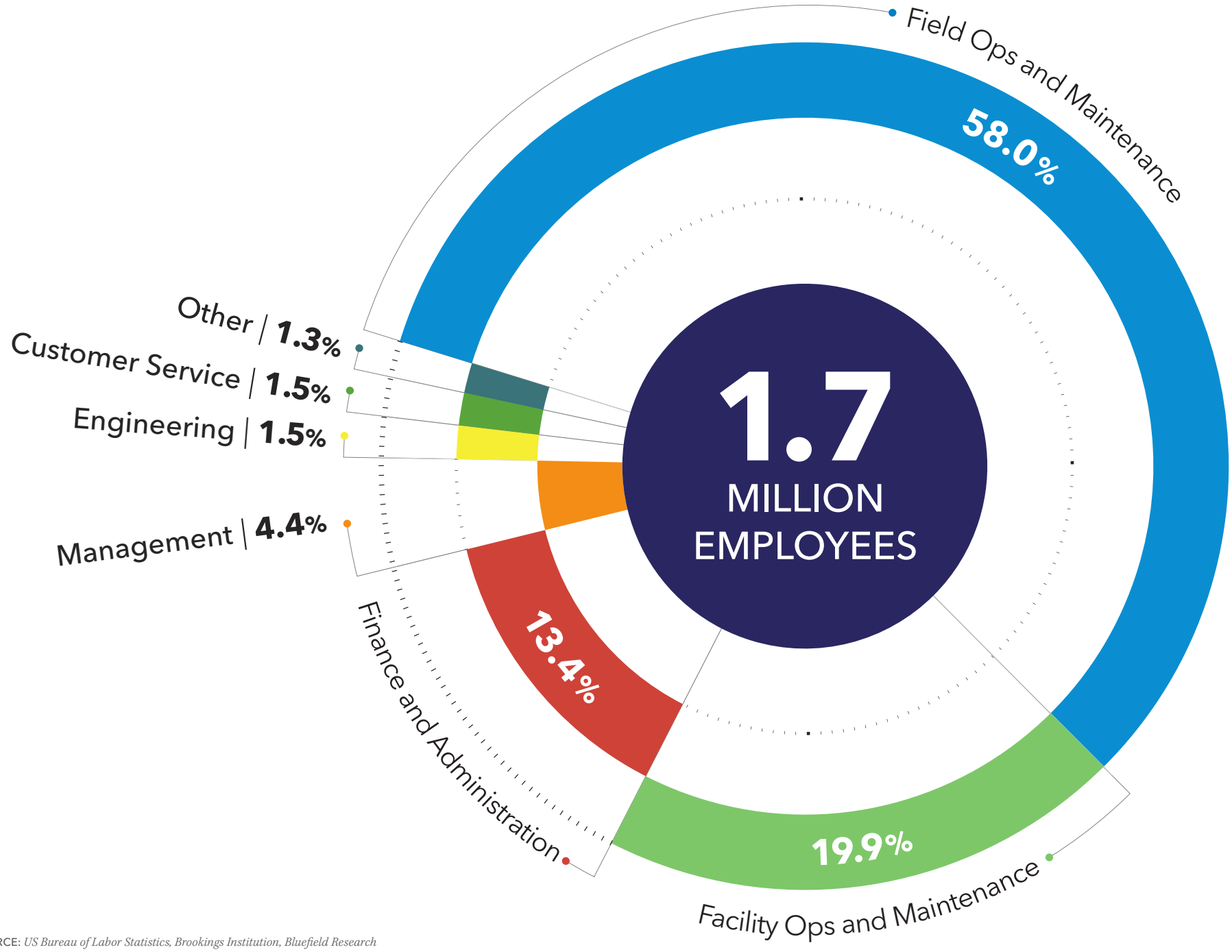
ArcGIS also serves as a valuable repository for preserving the expertise of experienced operators, storing detailed insights on the status and functionality of network assets. This ensures that details regarding asset conditions are easily accessible to future utility personnel, facilitating seamless knowledge transfer across generations.

Esri's powerful location platform optimizes operations and enables integrated data visualization and analytics, giving utility managers greater visibility and transparency into staff performance. This empowers them to monitor the progress of organizational objectives, goals, and key performance indicators (KPIs).

Continued on page 18

US WATER AND WASTEWATER WORKFORCE

by Functional Area



SOURCE: *US Bureau of Labor Statistics, Brookings Institution, Bluefield Research*

/ **PERSPECTIVES** /

"Assessment, operations, and management of an entire sewer collection system can be a daunting task. GIS-based applications and solutions enabled staff to acquire, organize, distribute, and track data. Using ArcGIS, the Water and Sewer Department has achieved unprecedented success."

— ***Marc Courville***
GISP, Strategic Asset Management | Athens Utilities

[CASE STUDY]

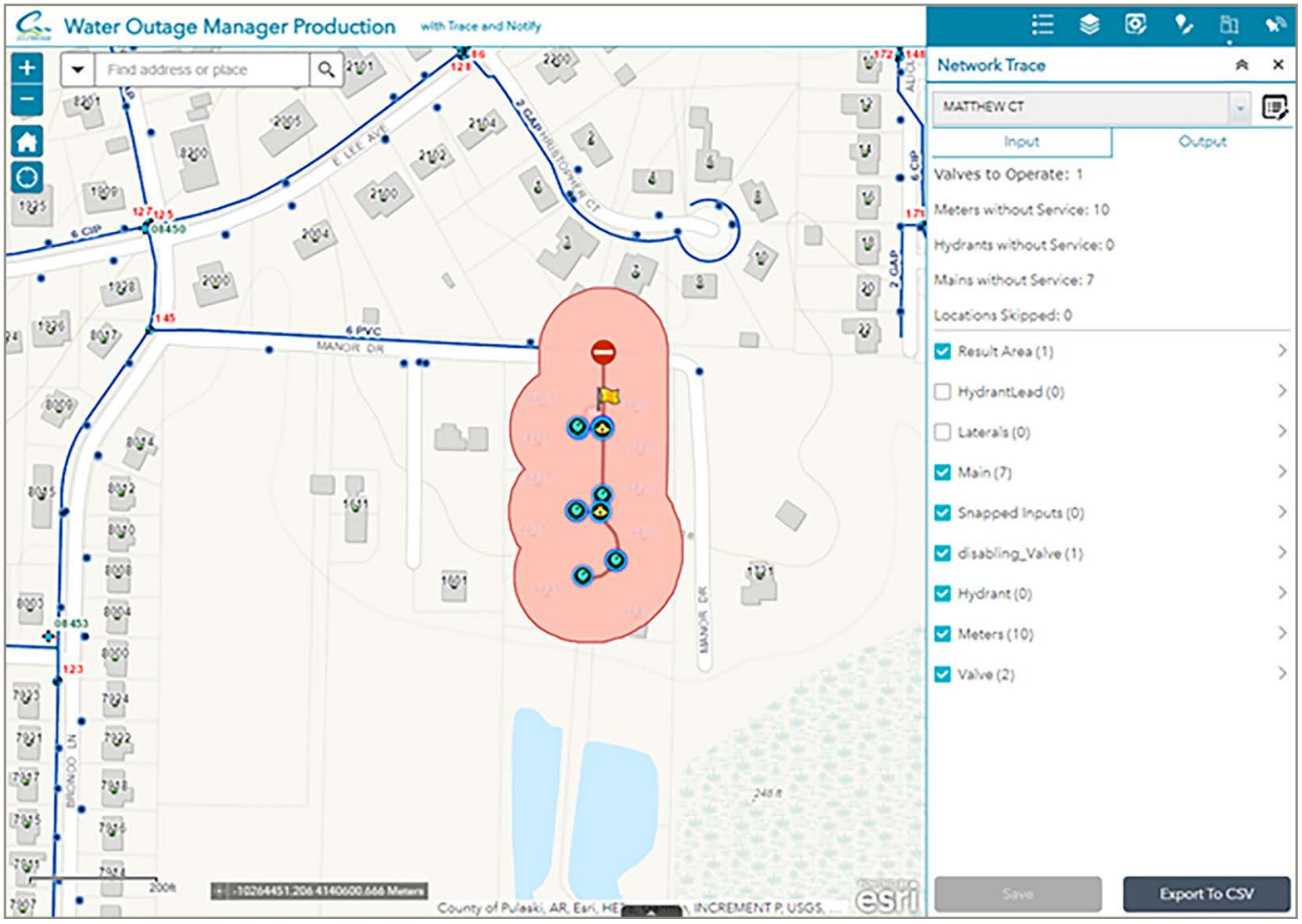
Central Arkansas Water

Central Arkansas Water (CAW) serves nearly 500,000 individuals while managing over 2,600 miles of pipeline infrastructure. Esri technology has transformed how they work. CAW has transitioned from ArcMap to ArcGIS Pro for enhanced functionality and streamlined workflows across the organization, providing a lifeline for workers in the field to access critical information. Access to system data and mobile solutions provides a foundation for maintenance and inspection activities. Distribution staff can view a digital map, access information, and quickly determine inspection needs. Performing inspections in-house saves CAW more than $1 million every five years.

Integrating GIS with CIS and CMMS allows field crews to generate work orders that are automatically routed and assigned. Service locations are displayed on a map, providing distribution staff with a better understanding of work assignments. CAW also uses GIS-based solutions to immediately respond to main breaks and outages. Using a mobile device, field crews can trace an outage, select meters, and quickly identify customers that are impacted. The meters are linked to customer contact information from the CIS and notified by email, SMS, or voice calls.

ArcGIS is being used across the organization, supporting many workflows. In addition to those shared above, it supports watershed, facility, and fleet management. It is also critical for Lead and Copper Rule Improvement compliance. GIS serves as a centralized source of truth, empowering utility personnel, contractors, and external stakeholders to make informed, data-backed decisions and prevent costly errors stemming from outdated or inaccurate information.

Below is a screenshot of Central Arkansas Water (CAW) Water Outage Manager deployed as part of Esri's Water Outage solution.



/ PERSPECTIVES /

"GIS provides a lifeline from the workers in the field to critical information to help them on a daily basis, whether it's being able to quickly locate a valve, isolate a main break, or to find a meter to assist a customer. GIS enables us to have this information literally at our fingertips."

— Blake Weindorf
Director of Distribution | Central Arkansas Water

CUSTOMER CARE

/ **PERSPECTIVES** /

"It's all about customer service. Having high-accuracy location of our assets, combined with easily accessible information, allows for greater response, reaction, and repair—which translates to greater customer experience."

— ***Ryan Key***
GIS Manager | Evansville Water and Sewer Utility

Water utility customers have increasingly high expectations, driven by technological advancements that offer more convenient engagement methods. To meet customer demand, utilities must prioritize understanding needs and preferences for information sharing. Effective and timely communication is crucial to ensure customers are well-informed and satisfied.

Coordinating workflows across different departments is challenging, as each department may have conflicting priorities and communication methods. Various business systems across departments can be a barrier, leading to data silos and poor collaboration. This lack of integration can result in slower response times and a decline in customer satisfaction.

Esri's ArcGIS offers out-of-the-box solutions that promote information sharing and collaboration. User-friendly applications streamline workflows, improving alignment across departments and creating a customer-centric focus. By embedding maps and applications on websites, customers gain self-service options, enhancing their experience. Improved communication among all stakeholders contributes to increased internal and external satisfaction levels.

[CASE STUDY]

Aqua

For Aqua, GIS technology has been instrumental in better serving over three million customers across eight states. In the wake of aging infrastructure and climate change, the importance of communicating service disruptions to customers has never been more apparent. Severe weather impacts system territories more often now than ever before—heavy storms bring detrimental flooding, frigid temperatures result in damaged pipes, and power outages shut down critical facilities.

Using ArcGIS, Aqua transitioned its customer-facing disruption tracking website to a GIS-based solution. The Aqua Disruption Map solution includes six applications, each serving a specific stakeholder group and purpose. Stakeholders include utility leadership, field staff, customer representatives, customers, and the public. A key component of the solution allows customers to view disruptions on a public web app, including no-water and reduced-pressure events, boil-water and system pressure advisories, and even planned work. Customers can

review details about these disruptions and check the app for status updates in real time.

Another key component of the solution is the Disruption Creator Field app, which was designed for field staff to quickly and efficiently create or update a disruption event. The app enables certain fields to be pre-populated, identifies required fields, and provides workflow guidance. As a result, field staff can create a disruption event in approximately 30 seconds, allowing them ample time to focus on other critical tasks like making repairs and restoring service.

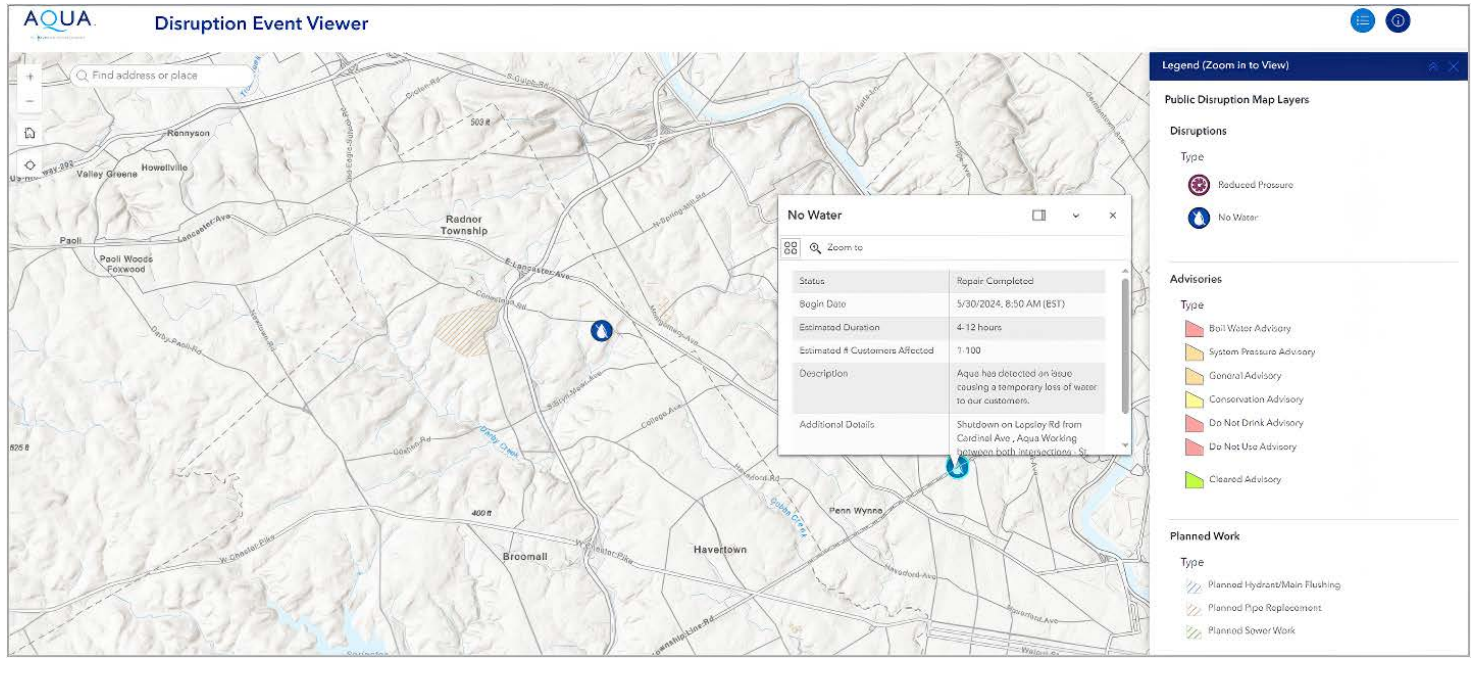
By keeping people informed and improving field workflow efficiency, Aqua has built trust and increased customer satisfaction.

Aqua's Public-Facing Disruption Map

/ PERSPECTIVES /

"Our GIS-based solution allows customers to view disruptions on a public web app, including no-water and reduced-pressure events, boil-water and system pressure advisories, and even planned work. They can review details about these disruptions and check the app for status updates in real time. By keeping people informed, we build trust and boost customer satisfaction."

— Kimberly Tanz
Business Analyst | Aqua



LOCATION INTELLIGENCE AND ANALYTICS

The advancement of digital water technology has provided utilities with vast amounts of data on customer needs, asset conditions, operational challenges, and system performance. Putting that data in the context of location is key to turning it into actionable information. Location is the common thread connecting disparate data sources and breaking down silos.

Water utilities use ArcGIS to unlock the value of data by making it easily accessible, comprehensible, and actionable. They integrate utility datasets and use advanced analytics to uncover relationships and reveal spatial and temporal trends. This often results in valuable insights essential for making well-informed operational, planning, and investment decisions that benefit both customers and communities.

Today's industry leaders have realized the value of ArcGIS. They are moving past traditional static maps and embracing real-time mapping and data sharing. By incorporating business systems and organizational data, they leverage location intelligence to optimize efficiency and effectiveness throughout their organizations.

/ PERSPECTIVES /

"When shared with the management team, water usage data helps to plan both short-term leak detection/repair work and long-term line replacement priorities. Overall, our GIS-aided process helps to streamline and solidify decision-making. Data and analytics have saved millions of gallons of the precious resource of water."

— April Winklmann

Executive Director | Hampton Shaler Water Authority

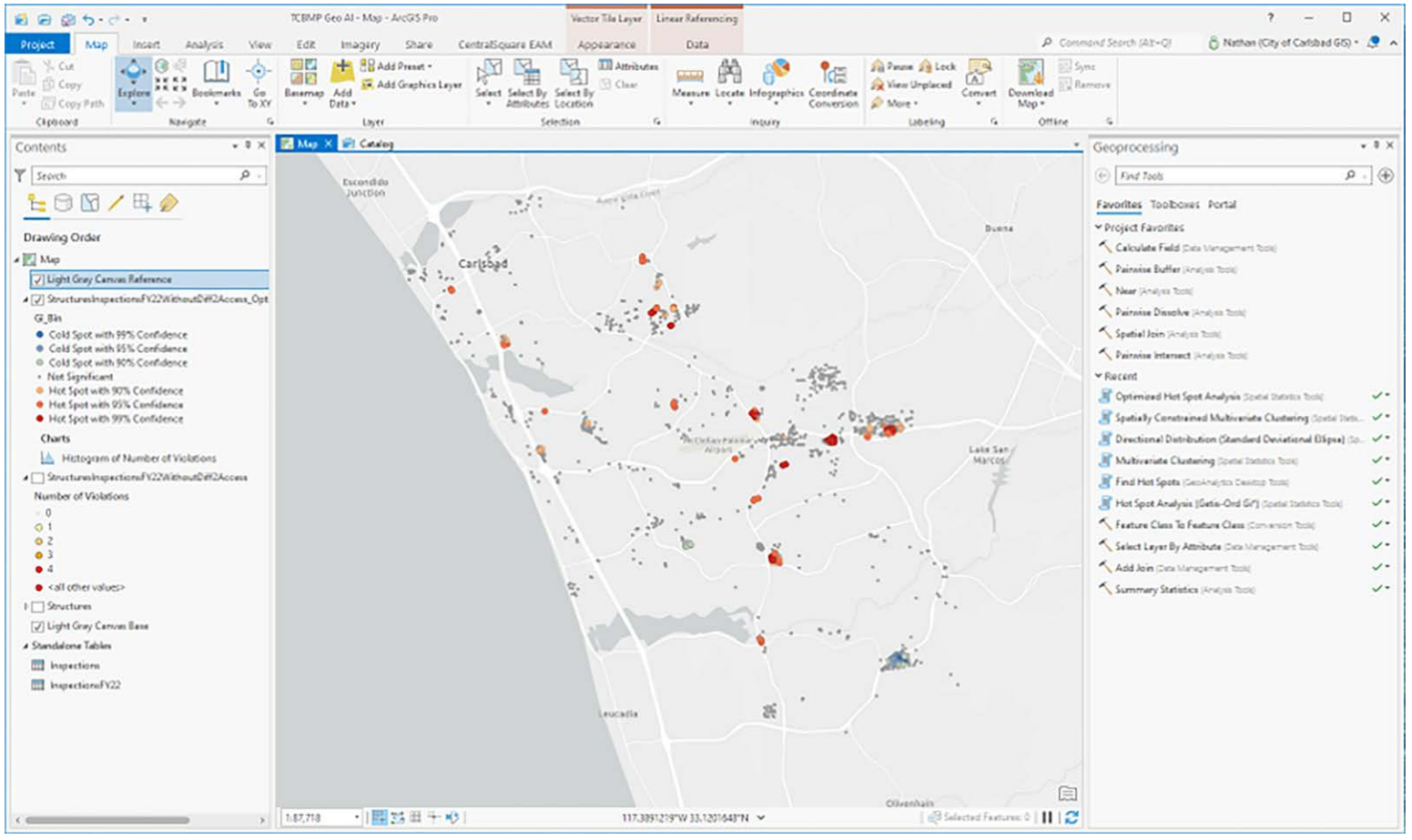
[CASE STUDY]

City of Carlsbad

Carlsbad, a coastal community in San Diego County, California, prioritizes environmental sustainability despite urban growth challenges. The city's stormwater permit mandates treatment control best management practices (TCBMPs) to prevent pollutants from entering waterways. Managing the growing TCBMP inventory became increasingly difficult due to outdated processes and conflicting data. To address this, Carlsbad developed the Automation, Compliance, Tracking, Inspection, and Owner Notification (ACTION) System. This ArcGIS software-based platform enhances data tracking, public engagement, compliance, and efficiency while cutting paper use and staff time. Integrating software applications and creating a cohesive digital platform, the city transformed its asset management approach. The use of geospatial AI and machine learning further optimized inspection scheduling, data collection, and identification of hot spots for targeted actions. Implementing the ACTION System led to cost reductions, less paper use, time savings, and improved community involvement.

The long-term benefit of the ACTION System lies in its operational efficiencies; this has had an overall positive

Hot spot analysis with ArcGIS Pro helps the city focus outreach to and engagement with TCBMP owners/ operators who may need additional inspections, information, or escalated enforcement.



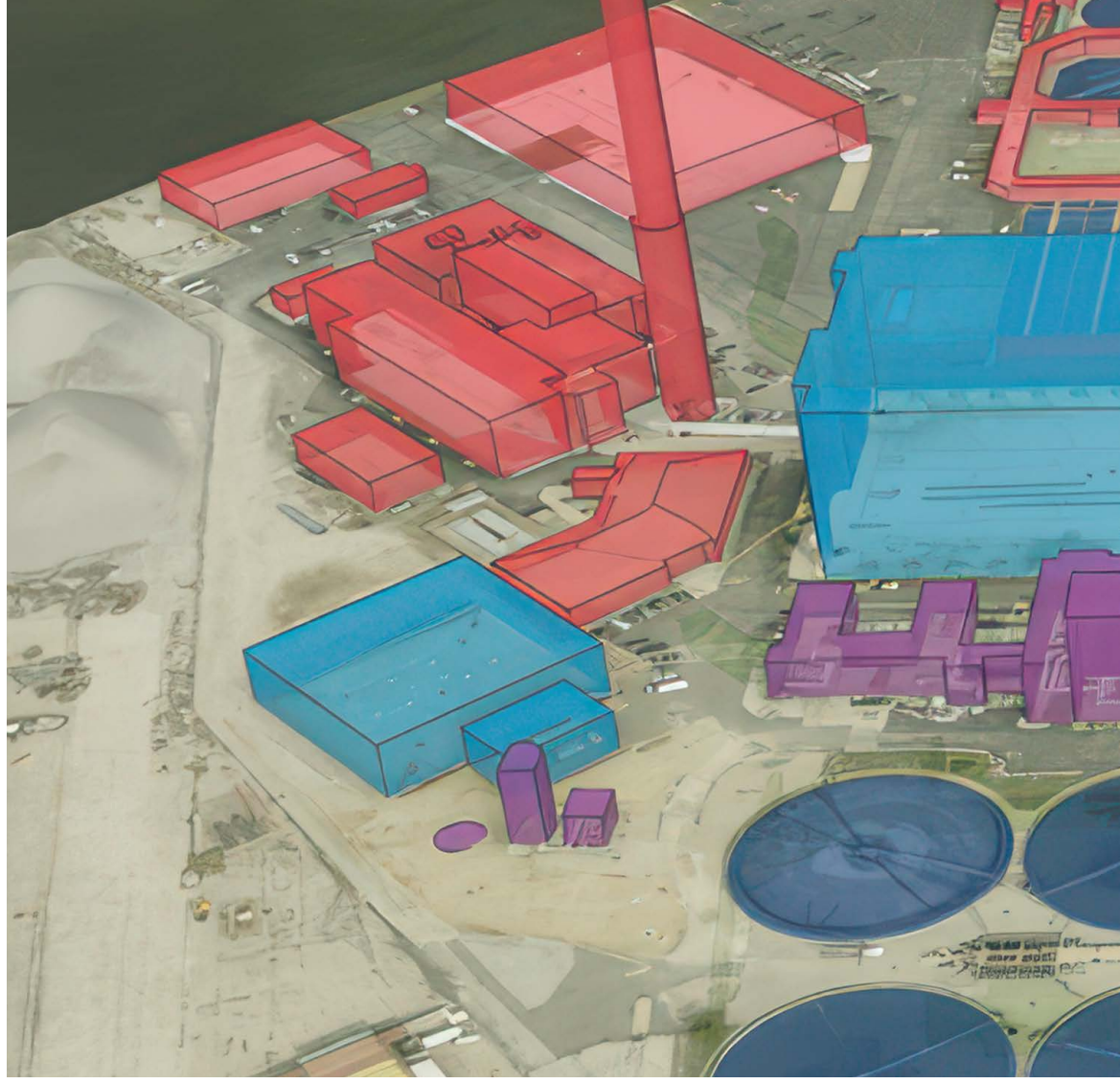
impact on not only the TCBMP community but also Carlsbad as a whole. Feedback has been amazing, primarily focused on system innovations, real-time experiences, access to interactive maps, and improved responsiveness. Carlsbad's innovative environmental asset management showcases how technology, data-driven decisions, and community engagement drive sustainable practices. Carlsbad has utilized ArcGIS to grow location awareness, perform advanced analytics, and boost operational efficiency, transparency, and environmental stewardship.

/ **PERSPECTIVES** /

"Esri's ArcGIS platform empowered us to connect people, places, and purpose in ways we couldn't have imagined. For me, location intelligence and analytics were the threads that wove it all together. It helped us go from fragmented paper records and files to a transformative, digital experience that created a true partnership with the community. What I'm most proud of is that we didn't just build a system, we built trust, transparency, and ownership."

— ***Shawnetta Grandberry***
Senior Program Manager, NPDES and Green Infrastructure Compliance | City of Carlsbad

OPTIMIZING FACILITY AND VERTICAL ASSET MANAGEMENT



Challenges related to a changing workforce, aging infrastructure, extreme weather, regulatory requirements, and lack of resources are pushing utilities to be more innovative. Utilities that are already using ArcGIS technology understand its powerful capabilities and are applying what they know to advance their asset management strategy. Modern network management solutions have enabled them to digitally transform how they manage their horizontal assets and transition to more holistic asset management that includes vertical assets. This often incorporates a shift from hierarchical asset management strategies previously used for vertical assets, to comprehensive mapping of real-world physical assets in GIS. Technological capabilities provided by GIS-based solutions include the ability to map asset groups and asset types, resulting in a strong foundation for vertical asset management.

ArcGIS includes a suite of tools for mapping, modeling, and managing three-dimensional vertical assets like treatment facilities and pump stations. By integrating design and engineering models (e.g., CAD, BIM) with real-time sensor and control system data, GIS provides easy access to maintenance records and indoor navigation guides. It also delivers realistic visualizations of facilities and their interconnected assets. This enables a better understanding of complex systems, structures, and assemblies throughout the entire life cycle of vertical assets, from design and construction to operations and maintenance.

Esri's ArcGIS technology enables organizations to gain a comprehensive view of all assets, empowering them to make informed, data-driven decisions, enhance operational efficiency, and guarantee the longevity and optimal performance of their facilities.

/ PERSPECTIVES /

"ArcGIS Indoors provides a solution that allows us to standardize how we manage the assets throughout our organization and provides real-time insights into the status of our operational and maintenance activities within our facilities."

— Andrew Hayes

Technology Supervisor | Raleigh Water

{ DEFINITIONS }

Computer-Aided Design (CAD)

A computer-based system for the design, drafting, and display of graphical information to support engineering, planning, and illustrating activities.

Building Information Modeling (BIM)

Software for creating and managing 3D representations of physical structures (e.g., buildings, infrastructure) and their functional characteristics.

[CASE STUDY]

Milwaukee Metropolitan Sewerage District

The Milwaukee Metropolitan Sewerage District (MMSD) implemented scalable and maintainable solutions for Water Reclamation Facility vertical asset management using ArcGIS and building information modeling (BIM).

MMSD is a regional government agency that provides water reclamation and flood management services to the Greater Milwaukee area. Twenty-nine different municipal systems convey wastewater to MMSD's two Water Reclamation Facilities (WRFs). To support management of these facilities, MMSD developed a WRF Building Information Modeling Vision: *Create a scalable and maintainable solution for sharing Water Reclamation Facilities data that integrates with other systems.*

Although MMSD has a comprehensive ArcGIS Enterprise system for horizontal assets (e.g., sewer system), the organization relied on 2D drawings and paper-based document workflows to support over 14,000 vertical assets in 120 buildings and structures at its WRF locations. Staff identified the need to establish accessible WRF data, improve digitally based workflows, and create mobile-friendly web solutions to reduce operating costs, avoid data silos, and facilitate underground and aboveground vertical asset life cycle management.

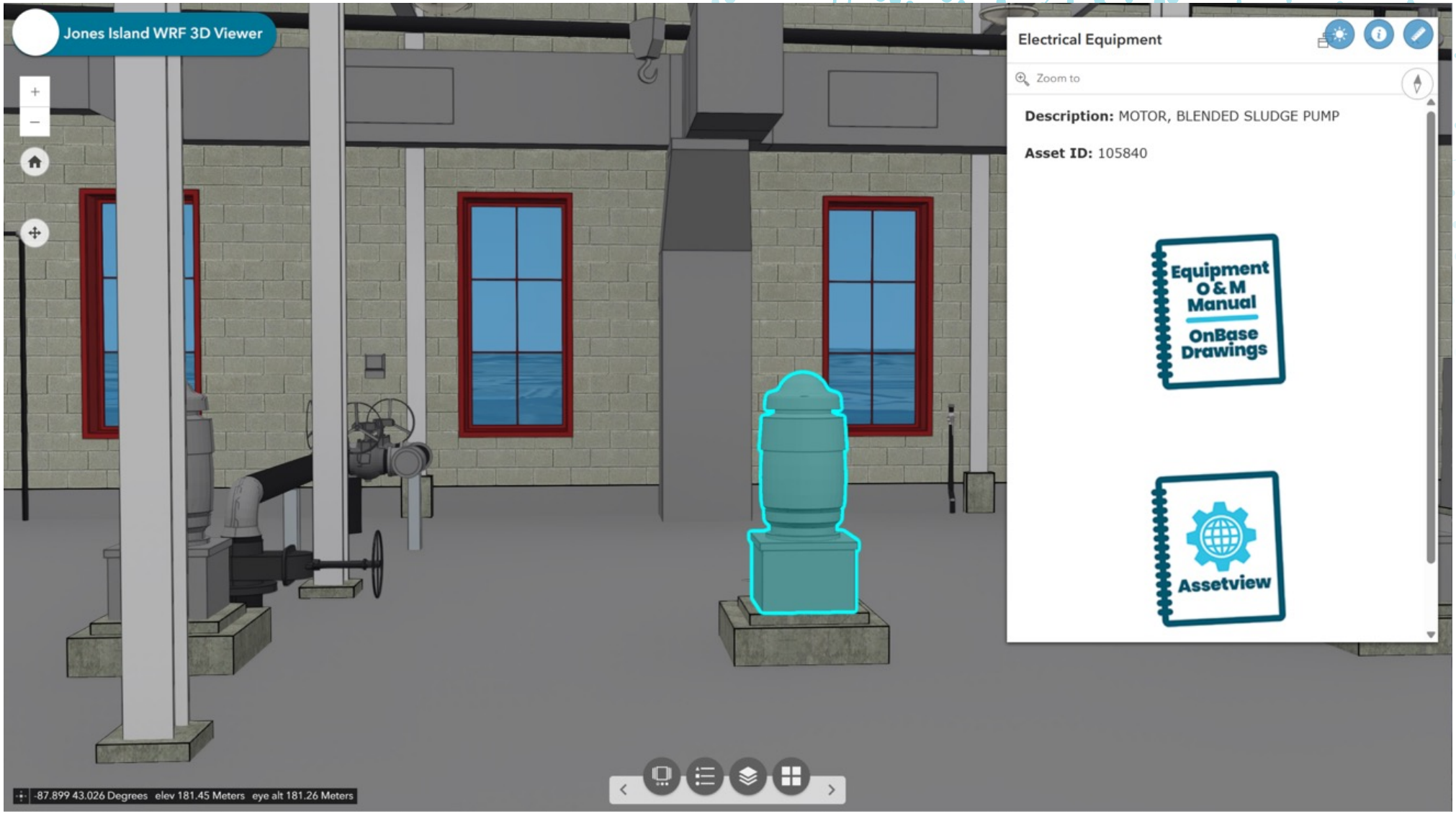
MMSD utilized Autodesk Revit software to create 3D models for BIM projects that follow MMSD's BIM Standards. GIS staff use ArcGIS Pro geoprocessing tools to import Autodesk Revit 3D models into GIS format and output populated feature datasets based on MMSD's primary disciplines (e.g., mechanical, piping, electrical, architectural, structural). Using Autodesk and Esri technology, MMSD has created a web-based interactive experience that provides staff with a single source of truth and has improved efficiency, communication, and access to important information.

/ PERSPECTIVES /

"Esri's easy-to-use and familiar application templates make the switch between 2D maps and 3D scenes intuitive for MMSD. 3D scene applications are a key factor in our successful BIM implementation for vertical assets at our Water Reclamation Facilities. Pop-up elements enhanced by Arcade expressions are a powerful tool linking MMSD's multiple related systems of record to individual 3D GIS features. Using ArcGIS Pro's BIM geoprocessing toolsets, we've reduced the need for custom programming or third-party conversion software to maintain our BIM scene viewers."

— Emily Champagne
Geospatial Manager | Milwaukee Metropolitan Sewerage District (MMSD)

MMSD 3D Scene Viewer Application Displaying Motor Equipment with Links to Related System Information



TAKING THE *next steps*

ON THE DIGITAL WATER JOURNEY

YOU ARE HERE:

Getting Started on the Path to Transformation

Recent industry surveys suggest that time, rather than cost, is the most significant barrier to digital transformation in the water utility sector. Utility managers fear getting entangled in long, arduous digital initiatives that could monopolize their team's time, attention, and budget for months or even years before delivering tangible benefits for customers and staff.

However, it doesn't have to be this way. Many of the most successful digital innovators in the water industry have learned one crucial lesson: The best place to start is where you already are. Most utilities have significantly invested in data and digital systems across various departments and functional areas. Starting from scratch or tackling everything at once is unwise and unnecessary. The key is to maximize the value of existing investments first and then build incrementally from there, learning, adjusting, and improving as you go.

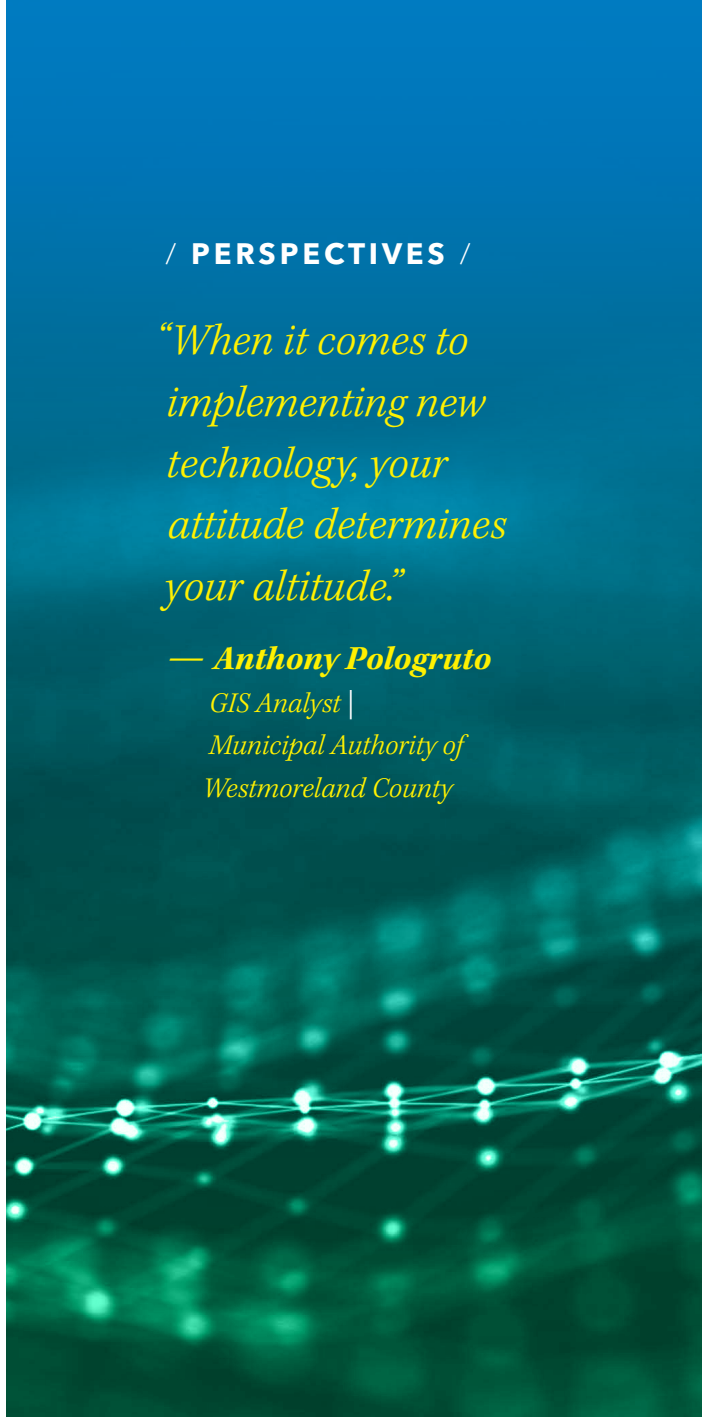
GIS plays a vital role in this process. Esri's ArcGIS is uniquely designed to integrate with various devices, business systems, and data feeds throughout the water industry. It provides a crucial locational context that gives value and meaning to otherwise dark and disparate data. Furthermore, ArcGIS is user-friendly, allowing anyone in the organization to access the tools and information needed to make better operational and planning decisions, communicate and collaborate more effectively, and resolve issues more efficiently for their customers, coworkers, and communities.

So, get out there, identify your first challenge, and discover what GIS can achieve as the foundation for digital transformation in your organization.

/ PERSPECTIVES /

"When it comes to implementing new technology, your attitude determines your altitude."

— Anthony Pologruto
GIS Analyst | Municipal Authority of Westmoreland County



RECOMMENDATIONS AND BEST PRACTICES FROM UTILITY PIONEERS

STILL NOT SURE WHERE TO BEGIN?

Here are some valuable insights from leading Esri water, wastewater, and stormwater utility clients. Following these recommendations can help ensure the successful implementation and acceptance of GIS within your organization:

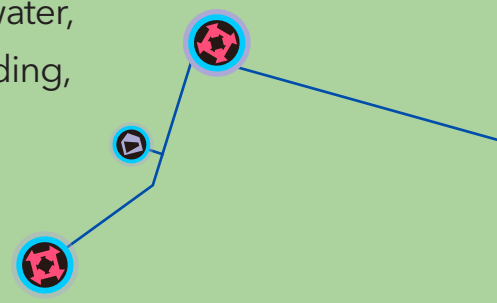
- Define your goals: Clearly articulate your goals and vision for your GIS program. Focus on understanding the "why" before moving on to the "what" or "how." Ensure your objectives align with your organization's core values and strategic priorities.
- Empathize with your team: Put yourself in each team member's shoes. Understand their key objectives, workflows, and pain points, and explore how GIS and other technologies can improve their work experience.
- Start with quick wins: Identify quick wins and low-hanging fruit to showcase the value of GIS to your team effectively. Remember, while a picture is worth a thousand words, a functional application can be worth a million.
- Find department champions: Encourage each department to select a leader to promote GIS and demonstrate its value to colleagues.
- Invest in training and resources: Ensure your GIS staff can access the necessary resources and training to maximize the value of your GIS and other digital investments.
- Democratize data access: Allow team members to access their data and provide them with the tools to update and maintain it over time.
- Maintain patience and positivity: Communicating the value of new technology takes time and a positive attitude. Emphasize the benefits as you introduce changes.
- Start with a pilot project: You will learn a lot and be better prepared for organization-wide transformation.

WHO IS

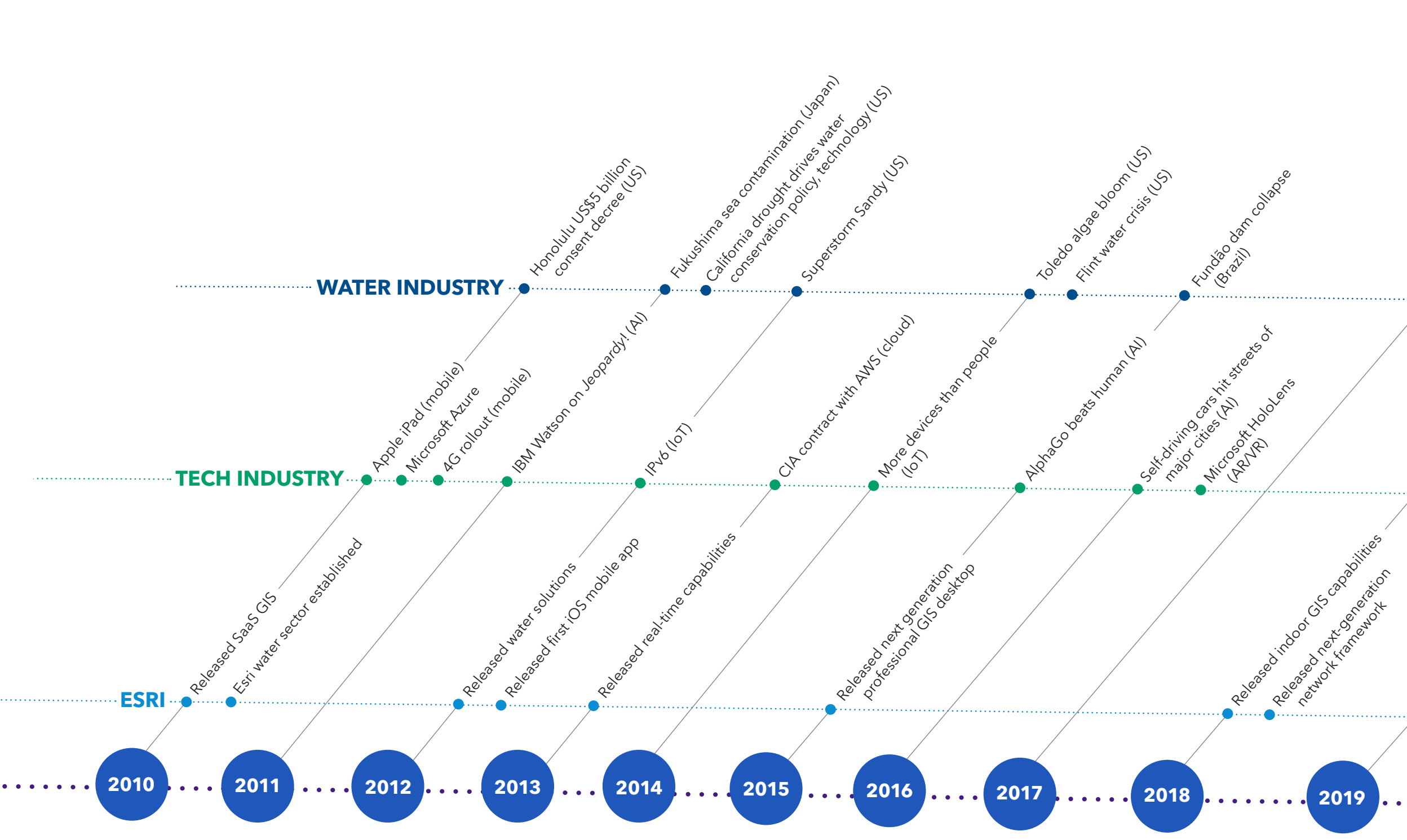
Esri

IN THE WORLD OF DIGITAL WATER?

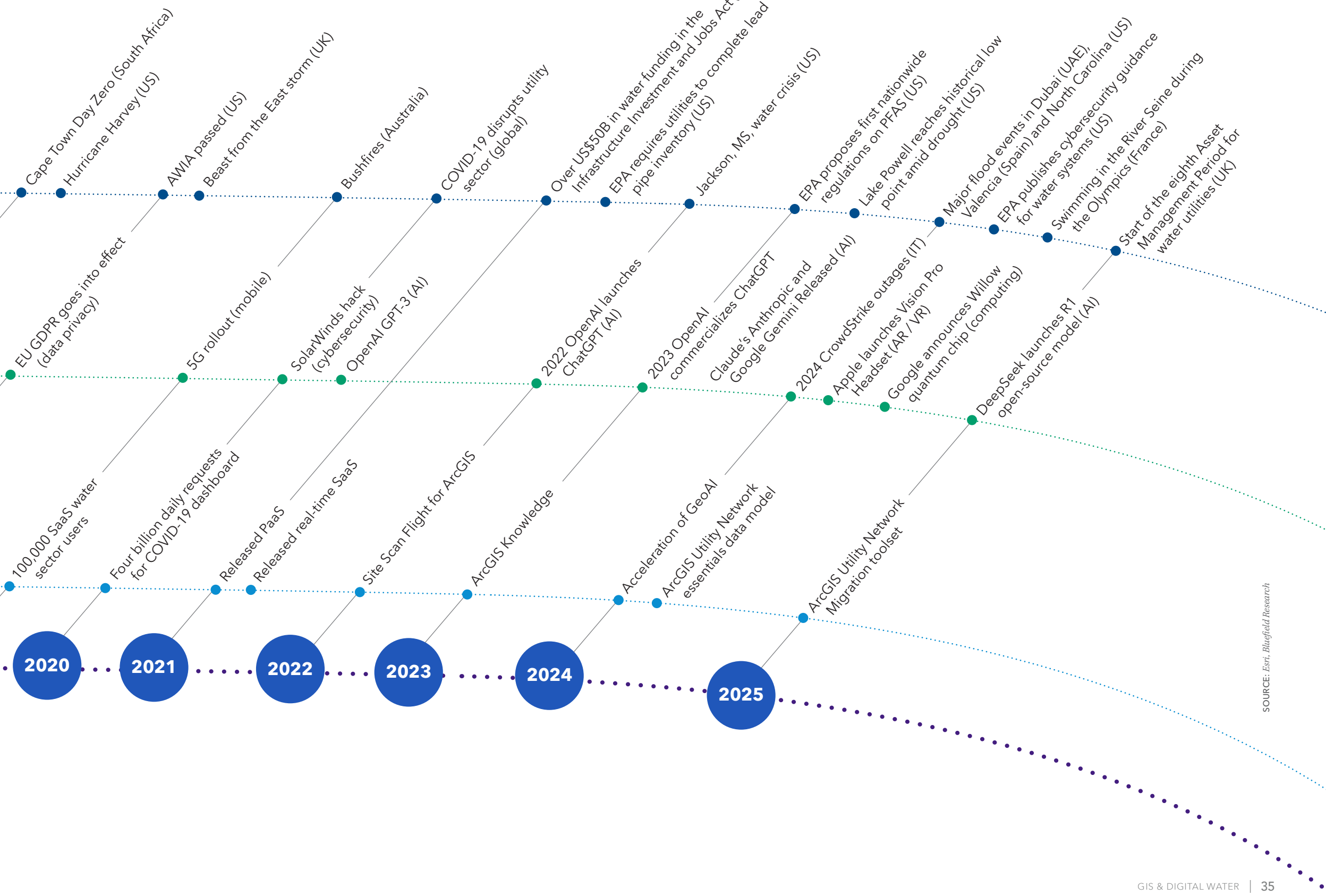
You may not be familiar with Esri, but you have probably encountered their software. Esri's ArcGIS is the leading GIS platform used by water utilities worldwide. Over 90 percent of the 500 largest utilities in the US utilize ArcGIS to manage their water, wastewater, and stormwater infrastructure—including, most likely, your local utility!



Based in Redlands, California, Esri was founded in 1969 as a land use consultancy and launched the first commercial GIS software program 12 years later. Since then, Esri has continued evolving alongside the tech industry, advancing GIS to new heights with each technological revolution.



Timeline *of Key Events in Esri, Tech, and Water History*



SOURCE: *Esri, Bluefield Research*

In the past decade, the world has witnessed the mass adoption of cloud computing, machine learning, artificial intelligence, and the Internet of Things. The water industry has also experienced major changes during this time, highlighting the importance of digital water technology. The US Environmental Protection Agency required all community water systems to inventory their pipe networks by October 2024, prompting many utilities to use GIS to manage pipe data and communicate with their customers. In recent years, there have been significant instances of destructive flooding, with major disasters occurring in Dubai, UAE; Valencia, Spain; North Carolina, US; and Kentucky, US. When Hurricane Helene struck North Carolina, GIS technology played a crucial role in positioning emergency management teams, ensuring the public had access to real-time information about emergency services, and effectively allocating recovery resources afterward.

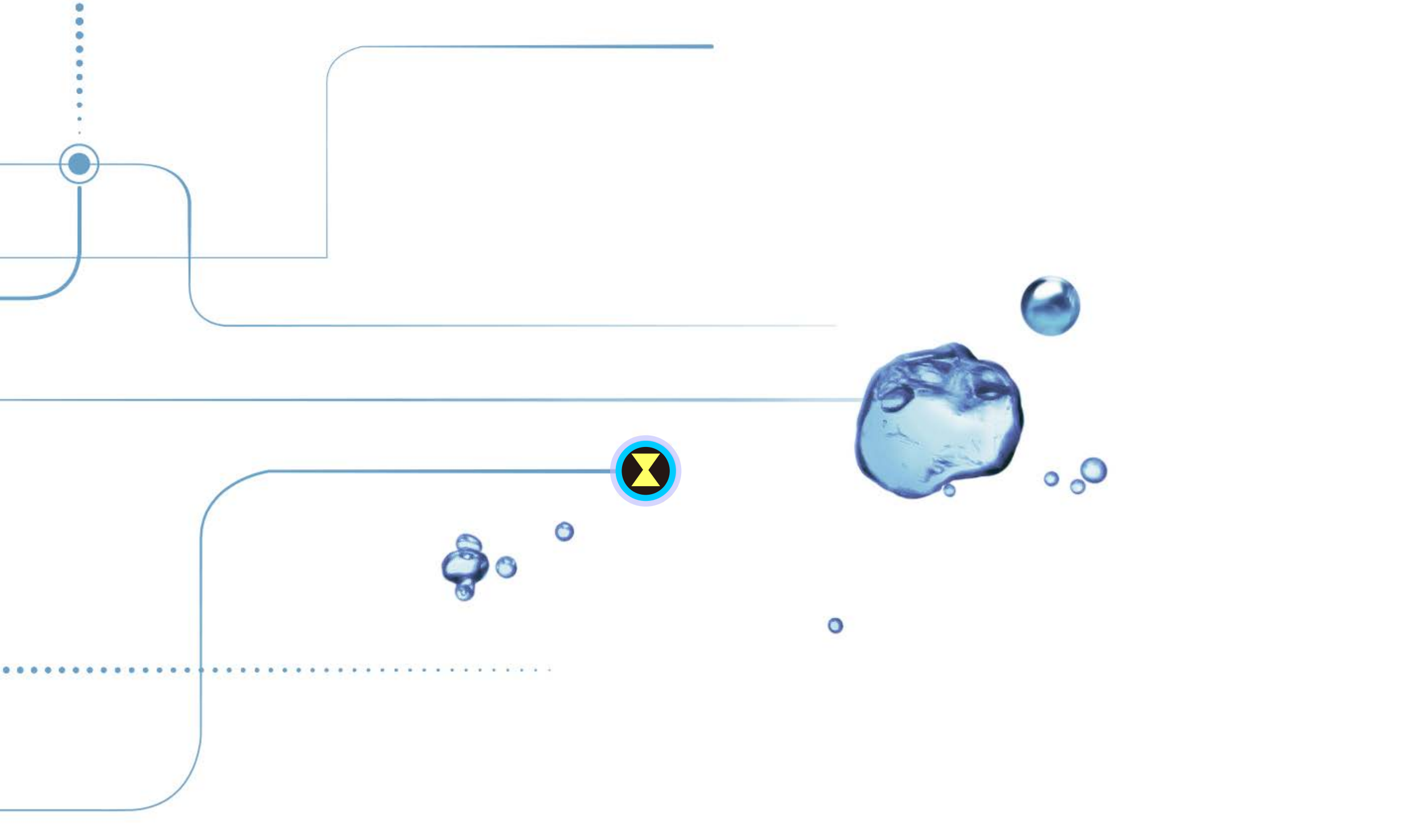
Additionally, following a massive investment of US$1.5 billion to upgrade its sewer and stormwater systems, the city of Paris, France, allowed Olympic triathletes and swimmers to compete in the Seine. Digital water sensors provided real-time information about the water's bacteria levels during the events.

Esri has been there every step of the way, consistently adapting the ArcGIS platform to meet the water industry's evolving needs. Since launching a dedicated water team in 2010, Esri introduced its first suite of water-specific solutions in 2012. The company continues to leverage the latest technological advances to deliver GIS solutions that meet the requirements of water professionals, whether on-site, on the web, in the cloud, or on mobile devices.

Throughout this journey, Esri has built a robust ecosystem of third-party digital water hardware, software, and service providers that integrate with or are built upon ArcGIS. Esri partners with leading technology firms in the water industry to empower utilities to leverage location intelligence for essential applications. These applications include mobile workforce management, regulatory and compliance management, asset condition inspection, and system optimization. Esri's service partners—comprising leading global engineering firms and specialized GIS consultants—offer utilities the technical support needed to integrate their systems and data, streamline their workflows and processes, and maximize the value of their GIS and other digital water investments.

The ArcGIS platform, which your utility has likely already invested in for mapping water, wastewater, and stormwater infrastructure, offers much more value for your organization. It can enhance coordination and collaboration between field and office staff, visualize

and analyze real-time data across your service area, and create more accurate, granular models of the performance and behavior of your critical facilities and network assets. With strategic planning and configuration, your GIS platform will become the cornerstone of your digital transformation initiatives. It helps you maximize the benefits of new and existing digital water investments across various departments and domains, whether related to smart metering rollouts, SCADA modernization projects, or business systems integrations.



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