

## Briefly Noted

### US Government Launches Conservation.gov

Built on ArcGIS Hub, Conservation.gov is a public-facing website that connects visitors to tools and resources that support locally led conservation efforts across the United States. Launched by the Biden-Harris administration, the website is the first federally sponsored, interagency resource that directly supports the 30x30 Initiative, which seeks to conserve 30 percent of US land and water by 2030. The website also includes two apps created with ArcGIS Experience Builder that enable users to discover federal conservation grant opportunities and local conservation assistance programs. Additionally, the website has a custom JavaScript app that lets users explore a robust catalog of conservation-related, federally sponsored datasets and metrics, as well as an ArcGIS StoryMaps story that highlights federal restoration investments across the country.

### Esri YPN Establishes Regional Chapters

The Esri Young Professionals Network (YPN) now has seven regional chapters across the United States—in Redlands, California; Washington, DC; Denver, Colorado; Charlotte, North Carolina; Philadelphia, Pennsylvania; St. Louis, Missouri; and San Antonio, Texas. Each chapter hosts two in-person meetups per year in varying formats. YPN also recently started the YPN Ambassador program, which helps participants grow their professional networks, get noticed by peers and recruiters, and develop communication and leadership skills. Learn more at [esri.com/ypn](https://esri.com/ypn).

## Houston Examines Options for Low-Cost Housing Development with ArcGIS Urban

Across the United States, city planners are looking for ways to create more housing. This is particularly true in Houston, Texas. At 665 square miles (1,722 kilometers), Houston is the ninth-most expansive city in the United States. For land development, that's a lot of area to manage.

Houston has taken a different approach to land development from the traditional zoning ordinances that many other US cities use. Typically, cities divide their land into zones that dictate how each area can be developed. But Houston—the United States' fourth-most populous city, according to the 2020 census—relies on codes that address how property can be subdivided. This provides greater flexibility for managing housing and urban growth in this large, progressive city. It is also one of the reasons that the City of Houston became an avid user of geospatial technology in the early 1990s. In fact, Houston's Housing and Community Development Department (HCD) was one of the first departments at the city to implement it.



↑ A digital twin of Houston helps the Housing and Community Development Department's (HCD) GIS team communicate the details of complex projects to stakeholders.

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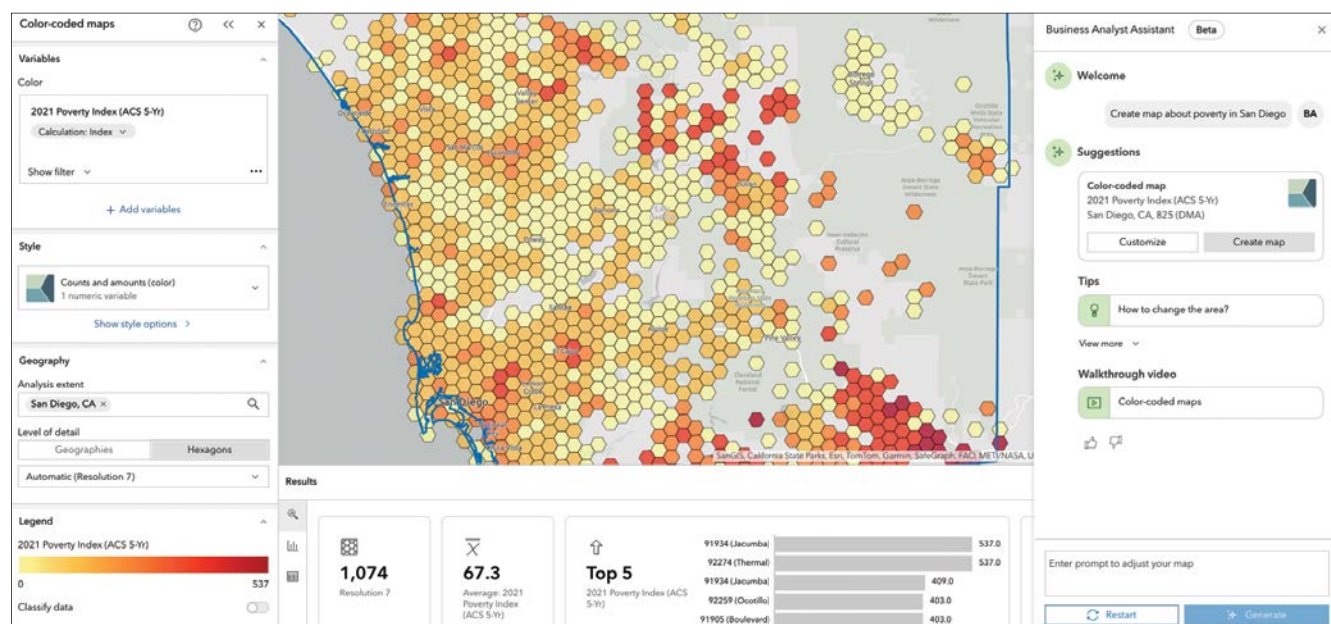
## Artificial Intelligence in GIS: Promise, Progress, and Possibilities

By Ismael Chivite, Esri

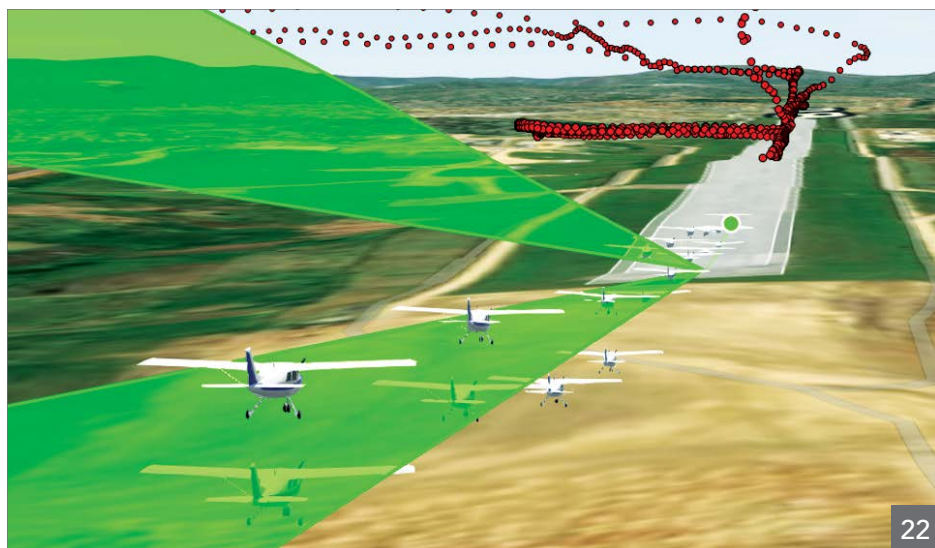
Imagine completing an ArcGIS project from start to finish without needing to click a user interface, open a tool, load a spreadsheet, or adjust symbols and colors. Rather than manually creating a map,

users would simply communicate their requirements in natural language inside the software. A few prompts later, the user would have a map with their desired appearance and specifications.

These are real possibilities being investigated and evaluated by research and development teams building generative AI capabilities into ArcGIS. continued on page 7



← An embedded assistant, in beta, in ArcGIS Business Analyst helps users create beautiful maps and interactive reports with a single prompt.



Mission Aviation Foundation (MAF) delivers humanitarian aid to some of the most remote places in the world. Safety and security are critical. The nonprofit organization's recent adoption of GIS technology—which helps show flight scenarios in great detail—has enhanced MAF's ability to protect its missionaries and pilots.

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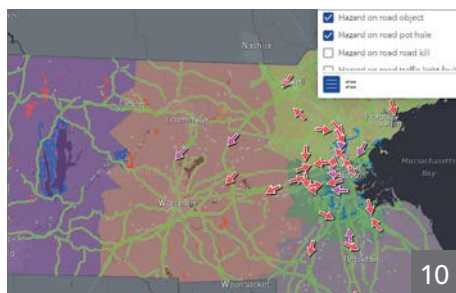
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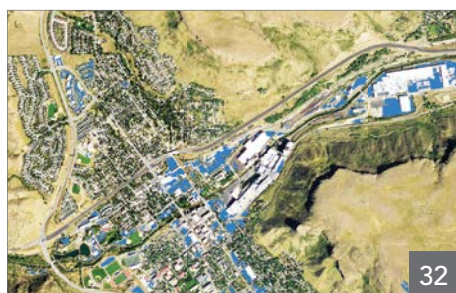
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Tell readers around the world how your organization saved money and time or acquired new capabilities through using GIS.

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# Esri DevSummit Highlights

## Powerful New ArcGIS Features and Tools

While showing developers and partners dozens of new ways to extend and build on GIS technology, Esri's annual developer-focused summit also provided attendees with myriad opportunities to collaborate and network.

Held in Palm Springs, California, March 12–15, the 19th annual Esri Developer Summit (DevSummit) represented the largest gathering of geospatial technology developers in the world, with nearly 4,000 in-person and virtual attendees from more than 50 countries. Developers were given the once-a-year opportunity to learn new techniques and where Esri technology is going, brush up on skills, and connect with fellow GIS developers and enthusiasts.

One event highlight was the introduction of new web components that are part of ArcGIS Maps SDK for JavaScript, which brings prebuilt ArcGIS experiences (encapsulated in web components) into apps. By writing just a few lines of code, users can now leverage many of the same capabilities as other Esri apps, such as creating charts, accessing attributes in vector tile layers, employing interactive editing constraints, and taking advantage of 3D tiles support.

"Web components are new to JavaScript Maps SDK, and they encapsulate both functionality and styling in a standards-based way," said David Cardella, product manager for the Esri developer technology group. He described web components as a set of building blocks for assembling solutions and apps across multiple platforms.

"They're native to the browser, so you don't need to worry about compatibility challenges," he said. "And they simplify your development experience by having you write less code."

The summit also showcased new features for ArcGIS Maps SDKs for Native Apps, including support for custom feeds to power real-time situational awareness experiences and smart forms to streamline attribute editing. Attendees were introduced to the new ArcGIS Maps SDK for Flutter (in beta), which provides developers with a new way to create cross-platform native mobile apps with ArcGIS capabilities. And according to Cardella, the Native

Maps SDKs continue to be built on a common C++ core, maximizing performance and consistency both online and offline; in 2D and 3D; and on mobile, desktop, and embedded devices.

Speakers also discussed Esri's initiatives to help developers easily incorporate Esri resources into open-source apps. For example, Esri developers regularly share open-source projects via GitHub to enable developers and partners to port Esri capabilities across the web. Another example is Esri Geoportal Server, a free, open-source, standards-based metadata catalog management app that enables users to discover and employ geospatial and nongeospatial resources.

Keynote presentations at DevSummit included the following:

- Liz Fulton, the digital and geospatial services director of vegetation management company Asplundh, described how the organization's field staff use tailored GIS apps to optimize their work.
- Justin Madex—spatial services manager for the Australian state of Victoria's Department of Environment, Land, Water and Planning—explained how the department empowers its planners with web-based 3D spatial analysis tools.
- Michael Healander, cofounder, president, and CEO of Esri partner Airspace Link, showed how the company uses location services in its drone flight management solutions.

Other summit highlights included presentations on how generative AI and ArcGIS can integrate to provide trustworthy, innovative functionality. Attendees also got a tour of the new ArcGIS Well-Architected Framework and Architecture Center, an online

resource to help organizations make informed decisions when implementing or using ArcGIS as an enterprise system.

Additionally, there were demonstrations on how ArcGIS Maps SDKs for Game Engines can help make scenes and data come to life, as well as on how integrating Calcite Design System components and React can help developers craft a superior user experience.

Attendees were introduced to new {arcgis} R bridge functions, such as an open-source package that facilitates interaction with ArcGIS location services from the R programming language. They also learned about the updated ArcGIS Basemaps styles service, which has new map styles such as ArcGIS Outdoor and ArcGIS Editor for OpenStreetMap navigation. In addition, there were sessions on how advances in ArcGIS Indoors and ArcGIS IPS can improve indoor asset and space management, safety, and security, as well as the occupant experience.

As DevSummit attendees learned more about client APIs, new developments in spatial analytics, and tools for extending and automating the entire ArcGIS system, they also shared their ideas, opinions, and projects with Esri employees. This is a reciprocal relationship that continually helps Esri refine and advance its own technological capabilities.

"I want you to share what you are doing so we learn from each other," advised Esri president Jack Dangermond.

For more information on the summit, including links to Plenary Session and presentation videos, visit the Esri Developer Summit web page at [links.esri.com/devsum](https://links.esri.com/devsum).



The 19th annual Esri Developer Summit featured keynote presentations, product announcements, technology demonstrations, networking opportunities, award ceremonies, seminars, a partner expo, and more.

```
<arcgis-map zoom="4" center="-118,34">  
  <arcgis-search position="top-right" />  
</arcgis-map>
```

# Simplifying How Users Access ArcGIS

New User Types Provide More ArcGIS Capabilities to Each Access Level

Organizations increasingly rely on GIS as a foundational IT system for mission-critical work. Esri continues to evolve ArcGIS as an enterprise-ready technology platform—available as an Esri-hosted software as a service, as well as a self-hosted geospatial infrastructure—that seamlessly integrates with other IT systems to bring the power of geospatial technology to the enterprise.

With the June 2024 update to ArcGIS Online, Esri updated ArcGIS user types—which provide the primary way to license and securely access the capabilities of ArcGIS—to offer expanded access to those capabilities across desktop, web, and mobile environments. This gives users the support and flexibility they need to work from anywhere, on any device. To simplify the administration process, Esri has included a set of most-used capabilities in each user type role.

Traditionally, users have accessed many ArcGIS capabilities through individual products, apps, and extensions—all with varying levels and forms of licensing, pricing, and entitlements. With Esri's updated model, users and their teams get more ArcGIS capabilities than ever before at each access level. Rather than licensing multiple products, extensions, and apps, role-based user types provide tailored access to the ArcGIS capabilities that different users across an organization need. This approach delivers roles attuned to every user level, from those needing the lightweight Viewer and Contributor user type capabilities to those who need the most advanced capabilities of the complete ArcGIS system in Professional Plus. This simplified access quickly enables broader collaboration across stakeholders.

Read on to find out more about the benefits of the updated user types, what they are, how to use them to collaborate among roles in an organization, and how to smoothly transition to them.

## Access ArcGIS Capabilities Anywhere

Esri's updated user types deliver secure, flexible, and expanded access to ArcGIS. Here are the key benefits:

- **Capabilities are aligned to team roles.** User types provide each team member with role-based access to the ArcGIS capabilities, apps, and content they need to do their work. For example, team members who create content can map, analyze, and

manage data to share with collaborators, who can then view it and make simple edits for accuracy.

- **Team members have more flexibility to choose the environment they work in.** Whether users are working in the office or in the field, they can seamlessly use and update ArcGIS content across desktop, web, and mobile devices.
- **User type administration is now streamlined.** Users can be confident that their organizations are equipped with the necessary tools for success. ArcGIS capabilities, apps, and content that were once purchased and provisioned separately are now included in user types.
- **Organizations can scale as their needs grow.** It is now easier to add user types to an ArcGIS organization. With the updated ArcGIS user types, organizations can progressively expand their capabilities when needed. Users simply move to the next level to obtain additional capabilities.

From having access to more capabilities at each role level to streamlining licensing management, the updated user types offer a range of benefits to organizations of all sizes.

## Explore Esri's Updated User Types

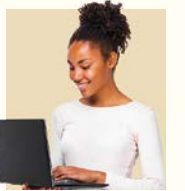
User types provide different levels of access to ArcGIS, ensuring that teams can employ the technology to collaborate efficiently and increase the reach of spatial capabilities across an organization. Some users need to map, analyze, and manage data. Other collaborators need to securely view, interact with, and perform basic reviews and editing of data.

Users who need to map, analyze, and manage data can choose from among the **Creator**, **Professional**, and **Professional Plus** user types. Each user type delivers access to a complete GIS, with more advanced capabilities available at each successive role level. These user types are a common place for users to get started, regardless of whether they're working in ArcGIS Online, ArcGIS Enterprise, or ArcGIS Pro. They offer flexibility as an organization's needs grow by allowing users to move up to the next level, add on apps and extensions, and incorporate additional user types.

- **Creator** serves as the entry point for accessing the essential capabilities of ArcGIS to produce dynamic maps and share content across an organization through a variety of prebuilt apps. Creator users can grant access and manage groups, members, and content, facilitating smooth collaboration. They can also enable an organization's mobile workforce by assigning tasks and managing work assignments. The updated Creator user type replaces the previous Creator and GIS Professional Basic user types and includes everything in the Mobile Worker user type except location sharing. Creator now provides access to ArcGIS Pro Basic, making Creator the foundational role for accessing ArcGIS capabilities in desktop and web environments.



- **Professional** provides access to advanced editing, analytics, and data management capabilities across ArcGIS. With Professional, users can create and configure utility networks and parcel fabrics to manage mission-critical systems of record. The Professional user type replaces the GIS Professional Standard user type. It includes access to ArcGIS Pro Standard and everything in Creator.



- **Professional Plus** enables users to create production-ready cartography, make GIS 3D, and perform comprehensive analysis that scales to big data. Professional Plus users can leverage machine learning and deep learning models to perform end-to-end AI workflows. The Professional Plus user type replaces the GIS Professional Advanced user type. It now includes access to ArcGIS Pro Advanced, the most popular ArcGIS Pro extensions, and everything in the Professional user type.



Organizations can extend the reach of their GIS by giving additional team members roles that allow them to collaborate with internal content. Additionally, organizations can continue to provide public access to maps and open data. The **Viewer**, **Contributor**,



## Discover GIS Innovators in ArcGIS Marketplace

Esri partners in the ArcGIS Marketplace extend ArcGIS® capabilities with products and services that fit unique customer business needs.



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and **Mobile Worker** user types support specific internal organizational needs.

- **Viewer** allows users to securely view their organization's maps, apps, and dashboards so that they can make better decisions and monitor internal key performance indicators (KPIs) and status updates.

- **Contributor** leverages enterprise integrations to ensure that organizations operate with the most up-to-date information. It empowers users to review data, make simple edits to it, and collaborate on projects using a variety of data. The Contributor user type includes everything in the Viewer user type.

- **Mobile Worker** allows organizations to streamline office-to-field connectivity with secure field apps that help users efficiently receive work assignments, update data, navigate routes both online and offline, and share their location. The Mobile Worker user type includes everything in the Contributor user type.

Everything in the Viewer, Contributor, and Mobile Worker user types is included in the Creator, Professional, and Professional Plus user types except location sharing. The Location Sharing user type extension is included with Mobile Worker and can be added onto Creator and higher.



## Boost Collaboration Across the Organization

Esri's updated user types enable more users within an organization to securely leverage the power of ArcGIS. The user types are designed to foster collaboration by enabling users to work together in one unified environment. Here are some examples of how an organization can apply user types to successfully complete tasks and workflows.

A content creator utilizing the Creator user type can design and share interactive maps. With Creator, this user has access to new web editing tools as well as ArcGIS Pro Basic, so they can not only build maps but also share them with stakeholders via ready-to-use apps as part of the company's decision-making processes. The content creator can share these maps and apps with any organizational stakeholders who have a Viewer user type, and those stakeholders can join a project and view and interact with any related maps.

A data editor leveraging the Contributor user type is responsible for reviewing and refining data on the web that was collected from the public. But this data editor relies on a cartographer to build interactive data visualizations. To produce these visualizations, the cartographer is assigned the Professional Plus user type, giving them access to ArcGIS Pro Advanced and its extensions. With Contributor, the data editor can view and update the public data entries while the cartographer, with their Professional Plus user type, can create high-end cartography. The organization can then share that map with the public.

A GIS specialist is assigned the Professional user type, which allows them to create complex data models using ArcGIS Pro Standard. The GIS specialist can then publish the data to ArcGIS

Online or ArcGIS Enterprise and create a web map for field technicians to use in focused field apps. Each technician is assigned a Mobile Worker user type, so they can sign in to the field app, find the web map, and add data collected in the field as needed.

These real-world examples demonstrate the versatility and effectiveness of the updated user types in ArcGIS. By assigning people to the appropriate user types, organizations can optimize their licensing investments, empower users with the right capabilities, and foster a collaborative work environment that drives success.

## Using the Updated User Types

Updated user types for ArcGIS Online and ArcGIS Enterprise are now available. But what does this mean for current subscriptions, and how can users get started?

### For ArcGIS Online Users

ArcGIS Online users can take advantage of the updated user types now. The updated user types became available with the June 2024 update of ArcGIS Online, delivering expanded capabilities and apps to each role.

### For ArcGIS Enterprise Users

Updated user type licenses for ArcGIS Enterprise became available to purchase with the June 2024 update of ArcGIS Online and will be available for use in ArcGIS Enterprise in November 2024 upon upgrading to version 11.4.

### For ArcGIS Pro Users

Since ArcGIS Pro can be administered through ArcGIS Online and ArcGIS Enterprise, the updates will be reflected in their respective releases.

## Learn More

To further explore the updated user types, head to [go.esri.com/usertypes2024](https://go.esri.com/usertypes2024) or contact your Esri representative.

# Updated User Types for ArcGIS

## Greater Capabilities for Each Role

Viewer	Contributor	Mobile Worker	Creator	Professional	Professional Plus
<p><b>Start viewing your data</b></p> <ul style="list-style-type: none"> <li>• Explore content.</li> <li>• Access dashboards.</li> </ul>	<p><b>Everything in Viewer, plus</b></p> <ul style="list-style-type: none"> <li>• Review and apply simple edits.</li> <li>• Collaborate with team members.</li> <li>• Leverage enterprise integrations.</li> </ul>	<p><b>Everything in Contributor, plus</b></p> <ul style="list-style-type: none"> <li>• Collect data from anywhere.</li> <li>• Receive work assignments.</li> <li>• Navigate routes online and offline.</li> <li>• Access and share current data.</li> </ul>	<p><b>Everything in Mobile Worker, plus</b></p> <ul style="list-style-type: none"> <li>• Create and share maps and apps.</li> <li>• Perform basic analysis.</li> <li>• Access ready-to-use data.</li> <li>• Grant access to and manage members.</li> <li>• Distribute work assignments.</li> <li>• <b>Access ArcGIS Pro Basic.</b></li> </ul>	<p><b>Everything in Creator, plus</b></p> <ul style="list-style-type: none"> <li>• Perform advanced data editing and management.</li> <li>• Configure utility networks and parcel fabrics.</li> <li>• Do additional analysis.</li> <li>• <b>Access ArcGIS Pro Standard.</b></li> </ul>	<p><b>Everything in Professional, plus</b></p> <ul style="list-style-type: none"> <li>• Conduct comprehensive analysis that scales to big data.</li> <li>• Perform end-to-end AI workflows.</li> <li>• Create production-ready cartography.</li> <li>• Build apps and extend ArcGIS.</li> <li>• Make your GIS 3D.</li> <li>• <b>Access ArcGIS Pro Advanced and multiple extensions.</b></li> </ul>

# GIS Helps Combat Racism as a Public Health Crisis in California

In a 1967 speech at Stanford University in California, the Black American minister, activist, and civil rights leader Dr. Martin Luther King Jr. said that America's promises of freedom and justice for Black Americans had not been met and that the United States' summer riots were a result of the country's winters of delay.

During this speech, King spoke of "genuine equality," an ideal that was indicated by US legislation such as the Fourteenth Amendment, which in 1868 extended "equal protection of the laws" to all US citizens.

More than 50 years later, King's call for accountability is being echoed in the Combating Racism as a Public Health Crisis dashboard, created by a group called Mapping Black California. The data arm of *Black Voice News*—the first Black American online news publication on the West Coast—Mapping Black California received help from Stanford University data integrity specialists and Esri user interface experts working with ArcGIS Online and ArcGIS Maps SDK for JavaScript.

## A US Public Health Crisis

Driven in part by a nationwide uproar over the 2020 murder of Black American George Floyd by a police officer in Minneapolis, Minnesota, racism has been officially declared a public health crisis, a public health emergency, or something similar hundreds of times across dozens of US states in recent years, according to the American Public Health Association. The association also says that California accounts for more of these declarations than any other state.

But what legal power do these declarations and resolutions have? Are they simply acknowledgements of systemic racism? Do they come with actual and measurable commitments? Or are they what King might have called empty promises of freedom and justice?

Whatever these declarations mean, staff at Mapping Black California want to make sure that government officials who express their commitment are also acting on it. As stated on its website, Mapping Black California equips California's population with data-driven knowledge of Black American issues, with the goal of eliminating regional and local systemic inequities.

"Whenever a racially motivated trauma occurs in Black communities, the government frequently makes declarations of empty promises," said Mapping Black California project director Candice Mays. "The intent behind the Combating Racism platform is to ensure that this is not the case with racism-as-a-public-health-crisis declarations in the State of California."

Mapping Black California project manager Alex Reed added that resolutions and declarations related to systemic racism "are an important first step to advancing racial equity and justice and must be followed by allocation of resources and strategic action."

## Keeping Promises, Literally and Figuratively

The Mapping Black California team began the first phase of its accountability effort by tracking public records and declarations of racial inequity. The second phase of the project, which was supported by a fellowship from Stanford University's Starling Lab for Data Integrity, integrated Web3 authentication technology to track, verify, and report on the progress of the commitments outlined in the declarations.

Starling Lab staff used decentralized tools and blockchain protocols to go beyond simple screenshot captures of web content. They employed Webrecorder to collect and authenticate the web pages' full context and used tools, platforms, and protocols that work with blockchain technology—such as InterPlanetary File System (IPFS), Filecoin, Avalanche, LikeCoin, and OpenTimestamps—to help ensure that saved web content is complete, accurate, and authentic. Pledges and promises, which can be deleted or hidden from social media and websites with the click of a button, are cryptographically sealed and stored—not only for posterity, but also for accountability.

Preserving the declarations and corresponding materials in this way enables concerned community members to determine a particular jurisdiction's declaration status, assess its progress, and identify local contacts to see if and how racial equity changes are proceeding.

## Visualizing Racial Equity Promises

The third phase of the project involved creating a fully integrated, content-aggregated platform. Published in November 2023, the platform preserves hundreds of web pages from California government sites and other online resources. It includes data to track whether actions followed promises, plus maps to help platform users focus on particular places.

To create the dashboard, accessible at [combatingracism.com](http://combatingracism.com), Mapping Black California researchers modeled an American Public Health Association map that tracked the creation of declarations across the US on state, county, and city levels. Mapping Black California then worked with Starling Lab and Esri experts to adapt the dashboard to show racially relevant federal and state data—along with local and regional changes to the declaration template in regard to funding, community engagement, and education—related to systemic racism. The Esri team used ArcGIS Online to host and publish the data and build the California map, and ArcGIS Maps SDK for JavaScript to integrate the map and data into Mapping Black California's website.

It's a novel approach to an old but ever-changing issue, according to Mays.

"As the tools used to inflict racism upon our communities continue to evolve, we must not just evolve with them but ahead of them," Mays said. This platform, she added, "is an exercise in that evolution."



**COMBATING RACISM AS A PUBLIC HEALTH CRISIS**

Track, Measure, Clarify & Report  
EXPLORE THE DASHBOARD

An accountability tool centralizing the oversight of monitoring, analysis, and reporting on the progression of commitments

This dashboard allows individuals to view cities, counties, and other governing organizations that have made a declaration about racism as a public health crisis.

**San Bernardino County**

- Data & Accountability 0 (of 5)
- Community Engagement 0 (of 5)
- Policies & Programs 0 (of 5)
- Funding 0 (of 5)
- Organizational capacity/training 0 (of 5)
- Economic Opportunities 0 (of 5)
- Education 0 (of 5)
- Housing, basic amenities, environment 0 (of 5)
- Public Safety/Policing 0 (of 5)

Contact  
Name: Lynn Monell  
Email: COB@county.gov  
Show State Data

**Declaration**

The San Bernardino County Board of Supervisors adopted Resolution No. 2020-013, addressing racism's impact on equity, health, education, employment, economic development, public safety, criminal justice, and housing.

**Web Archives**

Click on each link to view a webpage archive along with provenance data, registration of the records or blockchain, and to access archived copies of these records that were scattered across the web, at risk of being lost or taken down.

Mapping Black California worked with the Starling Lab for Data Integrity to capture and authenticate records of various websites with public declarations, social media posts, and other content related to the racism as a public health crisis research.

**Indicators**

In order to measure the community conditions that impact well-being, we have combined 25 community characteristics, like access to healthcare, affordable housing, and more, into our sub-indices and a single overall comparative rank. The higher the rank, the less vulnerable the community.

**Related News**

San Bernardino County News 1  
Learn about data, to meet community organizing efforts. President in our democratic state supports research...

New Item 1  
Learn about data, to meet community organizing efforts. President in our democratic state supports research...

New Item 2  
Learn about data, to meet community organizing efforts. President in our democratic state supports research...

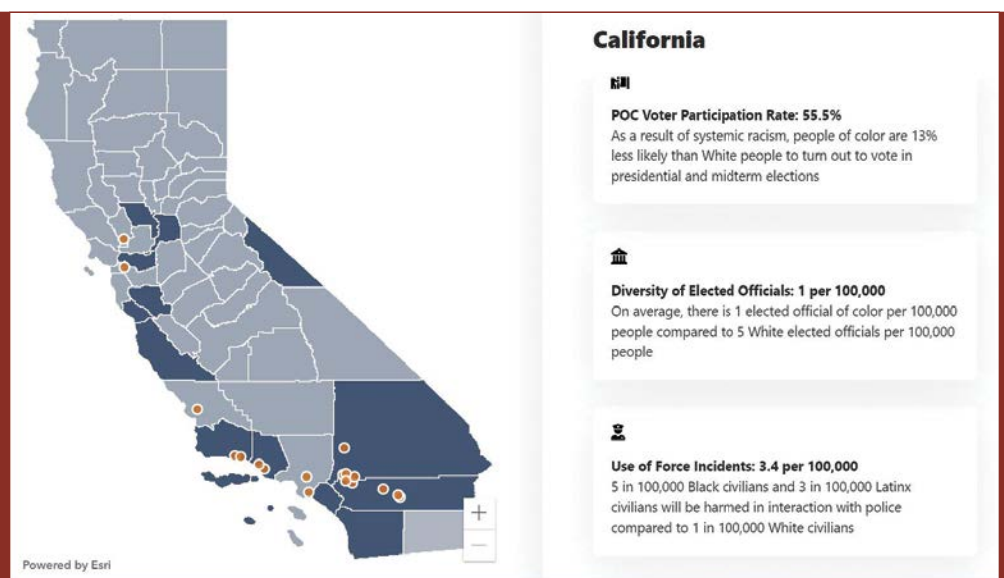
New Item 2  
Learn about data.

Mapping Black California  
MBC helps the state's population with data-driven knowledge on all things Black and data in California to eliminate regional and local systemic inequities.

Navigation  
MBC Home  
About  
Projects  
In The News  
BOD Directory  
Team Bios  
Partners & Sponsors  
Contact Us  
MBC Newsletter

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For more information on *Black Voice News*, go to [blackvoicenews.com](http://blackvoicenews.com). To learn more about Mapping Black California, visit [mappingblackca.com](http://mappingblackca.com). For more information about Stanford University's Starling Lab for Data Integrity, visit [starlinglab.org](http://starlinglab.org).



↑ The Combating Racism as a Public Health Crisis dashboard shows how governing bodies across California have acted to address systemic racism after making declarations or resolutions related to racism.

Early prototypes have shown promise in making this vision a reality.

In GIS, AI assistants offer a compelling opportunity to democratize what is already a powerful technology. They stand to make geospatial understanding more accessible to a wider audience and empower users of all skill levels to tackle complex challenges.

A different type of AI is already in use in ArcGIS.

Geospatial artificial intelligence, or GeoAI, accelerates GIS outcomes by leveraging AI subfields like pattern recognition, computer vision, and machine and deep learning methods. GIS professionals use it to automate feature extraction and similar repetitive tasks and to perform advanced analyses.

The development of AI assistants and GeoAI demands careful navigation, given the sensitive nature of GIS work and the important decisions that follow from it.

Esri is embracing the power of AI and the promise it brings. While it is tempting to move quickly, doing things right is more important than doing them fast.

### GeoAI Transforms How GIS Work Is Done

With GeoAI, artificial intelligence is already delivering on its promise to dramatically improve how organizations solve spatial problems. It enables ArcGIS users to automate tasks that once required extensive manual efforts.

GeoAI tools are especially good at extracting meaningful geospatial features from a variety of data sources, including text documents and images. ArcGIS—with any of the 70-plus ready-to-use pretrained deep learning packages from Esri—can help users automate the extraction of features such as buildings, land-use polygons, swimming pools, solar panels, or trees from imagery or 3D point clouds.

Many different types of organizations use GeoAI capabilities to enhance their geographic approach.

A highway maintenance department can use GeoAI to identify cracks in roads based on drone imagery. Then staff can integrate this with data on traffic patterns to prioritize repair work.

Aid organizations can use GeoAI to make quick damage assessments. Using ArcGIS and a deep learning model, they can compare before-and-after satellite images and identify damaged buildings on a map.

In regions of the world where people live in informal settlements, local governments can use GeoAI to take a more accurate census. The process involves capturing aerial imagery and then, with a deep learning model, extracting building footprints to estimate population.

Each of these scenarios would have required tedious digitization that, in the past, was done manually. Now, users can apply out-of-the-box deep learning models to accelerate the job.

GeoAI also enables predictive analysis of vector data through machine learning algorithms. For example, a machine learning model can be used to estimate flash flood risk in an area based on factors related to precipitation, topography, hydrology, policies, and population demographics.

All this allows for better decision-making and planning by incorporating data-driven insight into GIS workflows.

### The Importance of Trustworthy AI for GIS

As everyone knows, the GIS community does important work that informs impactful decisions. It is, therefore, imperative that the data involved is accurate and up-to-date.

This is a fundamental GIS concept that has been true for decades. AI raises the stakes—especially where decisions from AI models affect people and communities.

GeoAI in ArcGIS is built by following the highest standards for trustworthy AI, including well-documented models and instrumentation to help users measure accuracy and bias in analysis.

As has always been the case, GIS professionals must ask the right questions of the data.

### Development of AI Assistants Shows Promise

Recent advancements in language models have opened exciting new possibilities for building generative AI capabilities into the ArcGIS user experience. These assistants are still in early development, but several prototypes have shown promising potential.

Broadly, two types of AI assistants are being evaluated inside ArcGIS.

The first type, embedded assistants, are designed to boost productivity on everyday tasks. They provide suggestions and automate repetitive actions inside regularly used ArcGIS tools.

Furthest along in development is a beta feature in ArcGIS Survey123. This assistant simplifies the survey design process by providing a conversational approach to building surveys. Prompting the assistant just as they might with ChatGPT, users can quickly create a survey draft without needing to navigate menus or interfaces in the tool.

Other embedded AI assistants are in the early stages of research and development at Esri.

One of these AI assistants aims to help ArcGIS users author SQL, Python, Cypher, and Arcade expressions in ArcGIS Pro. Another is the ArcGIS help system chatbot trained on volumes

Create a survey to report hazardous trees in the city.

Sure! Here's a sample survey to report hazardous trees in the city:

Title: Hazardous Trees Reporting Survey

Introduction:  
Thank you for helping us identify and report hazardous trees in our city. Your input is valuable in ensuring the safety of our community. Please take a few minutes to complete this survey. Your responses will be kept confidential.

1. Location of the hazardous tree:  
Please provide the location of the hazardous tree. You can either enter the full address or use the map to mark the exact location.
2. Description of the hazardous tree:  
Please describe the hazardous tree in detail. Include information such as the size, type of tree, visible signs of decay, or any other relevant details.
3. Severity of the hazard:  
On a scale of 1 to 5, please rate the severity of the hazard posed by the tree. 1 indicates a low risk, while 5 indicates an immediate danger.
4. Attach a photo (optional):  
If you have a photo of the hazardous tree, you can attach it here. This will help us assess the situation more accurately.
5. Your contact information (optional):  
If you would like to be contacted regarding the hazardous tree you reported, please provide your name and contact details.

Thank you for taking the time to report a hazardous tree. Your contribution is crucial in maintaining the safety of our city. If you have any additional comments or concerns, please feel free to share them below.

Additional Comments: [Text Box]

That's it! This survey will allow residents to easily report hazardous trees in the city, providing important

Replace the description of the tree question with a tree species list including common tree species in California

↑ A beta embedded assistant in ArcGIS Survey123 provides a conversational approach to building surveys.

of ArcGIS documentation that can quickly answer how-to questions. A third assistant would help users conduct market planning and site selection inside ArcGIS Business Analyst.

Apart from the embedded assistants, the second type of assistant being evaluated for use in ArcGIS technology is a broader general AI assistant that might someday encompass the entire ArcGIS experience. Think of this as a sophisticated chatbot that understands GIS data and tools and can answer geospatial questions.

As a simple example, a municipality using ArcGIS Hub could build a site with a public-facing AI assistant that interprets a query about trash pickups. The assistant would reference authoritative open data about the pickup schedule from within the public works department's hub site and use a geocoding service to discern the user's location.

Accuracy is paramount in the design. This assistant would invite the user to confirm their location by creating a map showing the geocoded address. For transparency, the assistant would cite its source—a public works database.

### Progressing with Deliberate Caution

The development of AI technology is moving at an astounding pace. We have only scratched the surface of what AI can do in GIS.

Users are already doing the foundational work. They are publishing data as services and adding metadata. High-quality data forms the backbone of how AI systems learn and reason.

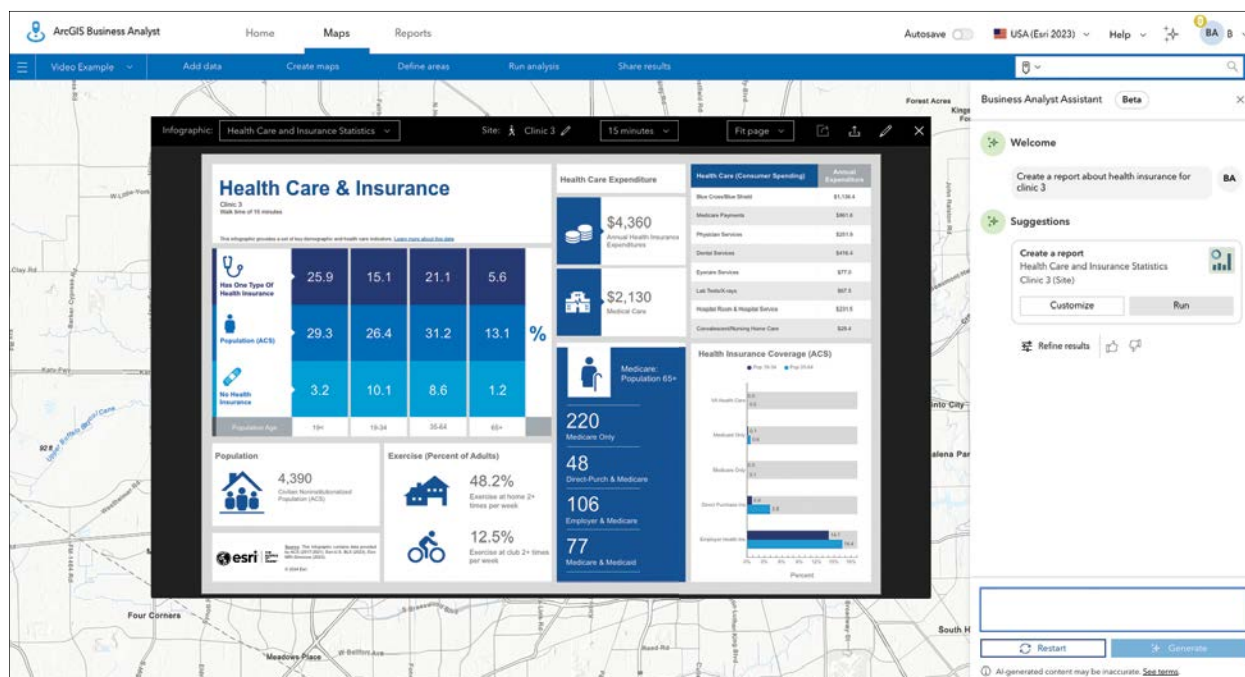
In developing the AI tools for ArcGIS, much of the work involves mitigating risks. This means constraining inputs to authoritative sources and building configurable guardrails.

The development process demands responsible implementation. An Esri AI advisory board—a cross-functional team of technology, product, legal, security, and privacy officers—provides guidelines for responsibly implementing AI in ArcGIS.

Through a commitment to responsible implementation and continuous learning, Esri is helping organizations apply the promise of geography and AI to solve the most challenging problems.

### About the Author

Ismael Chivite is Esri's senior principal product manager for AI assistants in ArcGIS. He has been with Esri since 2002 and is always looking for ideas to create and enhance Esri products.



↑ The AI assistant in ArcGIS Business Analyst that's currently in beta can help users conduct market planning.

## Houston Examines Options for Low-Cost Housing Development with ArcGIS Urban

Now, city staff members, residents, and other stakeholders are demanding more immersive experiences related to urban planning and development. Moving from 2D GIS to 3D GIS is one way to accomplish this. So the HCD GIS team has implemented ArcGIS Urban—3D scenario-planning software that merges a digital copy of the built environment with web-based interactive zoning analysis and planning tools—to create models and scenarios where large-tract developments are proposed.

### Analyzing the Potential Impacts of Proposed Developments

In 2017, the City of Houston created the Houston Complete Communities program, which focuses on uplifting 10 historically underserved and underresourced neighborhoods. The program

promotes and facilitates community-identified projects that address service needs for residents and businesses.

HCD's role in this initiative is to record any new housing being constructed and any community development activities that are being implemented, according to HCD's former GIS supervisor Arturo Tovar, who worked on the project.

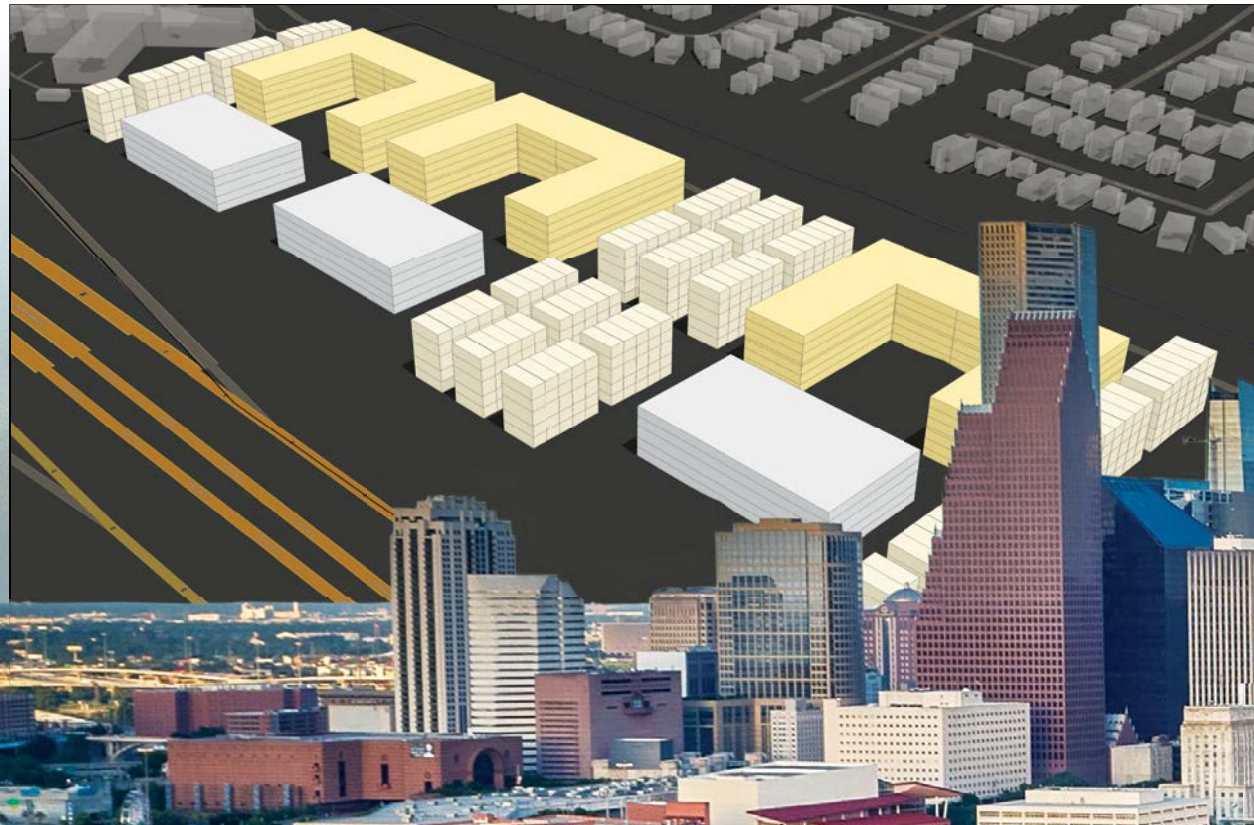
"[HCD uses] ArcGIS Urban to help the city analyze and visualize the housing scenarios that are under consideration," Tovar said.

Using Urban, HCD GIS staff help inform decision-makers at the City of Houston about how proposed tract housing will impact nearby communities and other parts of the city. For example, Houston's Affordable Home Development Program employs the data to analyze the social and financial effects of proposed developments. By using the Housing Affordability Index layer, analysts

can identify where housing is most or least affordable in Houston, based on US Census Bureau data. This helps HCD because, for eligible projects, the initiative can provide funding to developers to make it possible for them to sell homes at relatively low prices.

"ArcGIS Urban is used to examine viable options for low-cost housing development by applying different housing types and urban design principles to proposed locations," Tovar said. "[The team] first [performs] a suitability analysis using ArcGIS Pro to identify the best locations for a large-tract development. Once these areas are identified, AutoCAD is used for the site plan design based on the city's ordinances and regulations, such as flood management and planning and design."

Next, the team designs different housing scenarios and related landscapes, such as various mixes of single-family townhouses,



← The HCD GIS team designs different housing scenarios and related landscapes, such as various mixes of single-family townhouses, commercial buildings, and multifamily apartment complexes.



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commercial buildings, and multifamily apartment complexes. Staff then export these design scenarios to ArcGIS Pro and a 3D visualization rendering engine that uses SketchUp and V-Ray. Attributes are identified in the resultant GIS layers, which are then published to ArcGIS Online.

“Finally, the scenarios are evaluated with ArcGIS Urban using different metrics, including a demographic analysis, to select the one that best fits the city’s criteria for community engagement and economic viability,” Tovar said.

Once a housing location and scenario have been selected, the city can acquire the land if it hasn’t already been purchased. Then the city begins accepting applications from developers that meet Houston’s Affordable Home Development Program requirements.

### More ArcGIS Projects in Houston

The HCD GIS team plans to increase the number of housing metrics in Urban so that the department can perform more detailed feasibility analyses. The team also plans to expand the use of Urban to other city departments, such as planning.

→ ArcGIS Urban helps the HCD GIS team inform decision-makers about how proposed housing will impact nearby communities and other parts of the city.

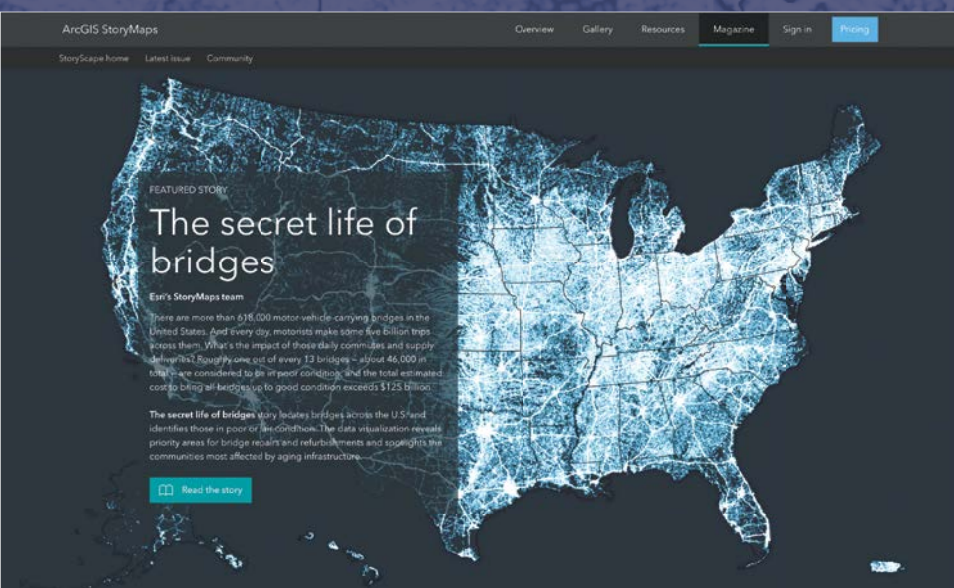
Additionally, HCD has developed a digital twin of Houston. This has helped the GIS team communicate the details of complex projects to those who are unfamiliar with GIS and have difficulty visualizing specific scenarios.

“As soon as our projects were introduced in the context of the city’s digital twin, the nontechnical audience’s perspective

and engagement changed dramatically from previous presentations,” Tovar said. “They were more involved with what was being presented, and they had greater clarity on the project’s location, scope, and impact. The digital twin and ArcGIS Urban are huge milestones in [HCD’s] portfolio.”



## Spotlight on StoryScape: A Celebration of Storytelling with Maps



↑ Each issue highlights a story on a relevant topic.

featured story; a storyteller profile; additional theme-related stories; and bonus materials such as blog posts, 3D scenes, and dashboards.

Recent themes featured in *StoryScape* include the following:

- **Charting the Heavens**, in a space-focused issue
- **Community-Based Conservation**, highlighted in conservation success stories driven by local and Indigenous communities
- **Follow the Flow**, in an issue that looks at the Colorado River through changing landscapes and provides a local lens through which to see global water challenges
- **The Science of Storytelling**, in an issue that focuses on ArcGIS StoryMaps stories that communicate scientific issues effectively
- **Building Stronger Communities**, highlighted in an issue centered on the architecture, engineering, and construction (AEC) industry

For over a decade, scientists, students, GIS professionals, and organizations of all sizes have created more than 2.9 million stories with Esri’s storytelling products. Storytellers from around the world—representing organizations including the National Geographic Society, the National Oceanic and Atmospheric Administration, and the Smithsonian Institution—are producing impactful, place-based stories that communicate important causes, share instructional materials, underscore successes, and more.

To celebrate these exceptional stories and the remarkable storytellers behind them, last year Esri launched *StoryScape*, a monthly digital magazine that highlights excellence in storytelling using dynamic ArcGIS content. Built into the ArcGIS StoryMaps website, the *StoryScape* home page, [esri.com/StoryScape](https://esri.com/StoryScape), features the month’s current themed issue and includes the month’s current themed issue and includes the month’s current themed issue and includes the month’s current themed issue and includes the month’s current themed issue.

One goal of *StoryScape* is to motivate people to create their own stories or, if they’re already using ArcGIS StoryMaps, to experiment with new storytelling techniques and narrative devices. To get inspired, visit [esri.com/StoryScape](https://esri.com/StoryScape) and subscribe to the ArcGIS StoryMaps newsletter at [links.esri.com/ASMnews](https://links.esri.com/ASMnews).

# State Transportation Department Boosts Emergency Response with ArcGIS Velocity

Each day, up to 5 million vehicles travel more than 154 million miles (248 million kilometers) on roads in the state of Massachusetts. The Massachusetts Department of Transportation (MassDOT) builds and maintains infrastructure such as roads, bridges, and tunnels across the state, directed by the department's Highway Division.

As MassDOT's around-the-clock traffic management center, the Highway Division's Highway Operations Center (HOC) in south Boston monitors state roadways and facilities, with on-site staff managing calls and dispatching personnel to emergency events such as auto crashes.

Recently, the HOC wanted to improve emergency response times and handle even more event information, including incident mapping. So the center turned to the GIS team under MassDOT's Office of Transportation Planning for assistance.

The GIS team deployed ArcGIS Velocity to ingest, analyze, and visualize real-time data. It also integrated data from Waze, a free GPS navigation app that provides traffic updates in real time. This has enabled staff at the HOC to see the most up-to-date information on state roadways across Massachusetts so that they can improve safety and better dispatch emergency personnel when needed.

## Identifying Emergency Events

Prior to the Waze-based project, HOC staff identified emergency events by monitoring traffic cameras, local news reports, and X (formerly known as Twitter) and taking phone calls from drivers and state police officers. To get more prompt notifications of roadway emergencies,

the HOC wanted to add real-time data to its system. This would allow staff members to dispatch help faster and improve response times.

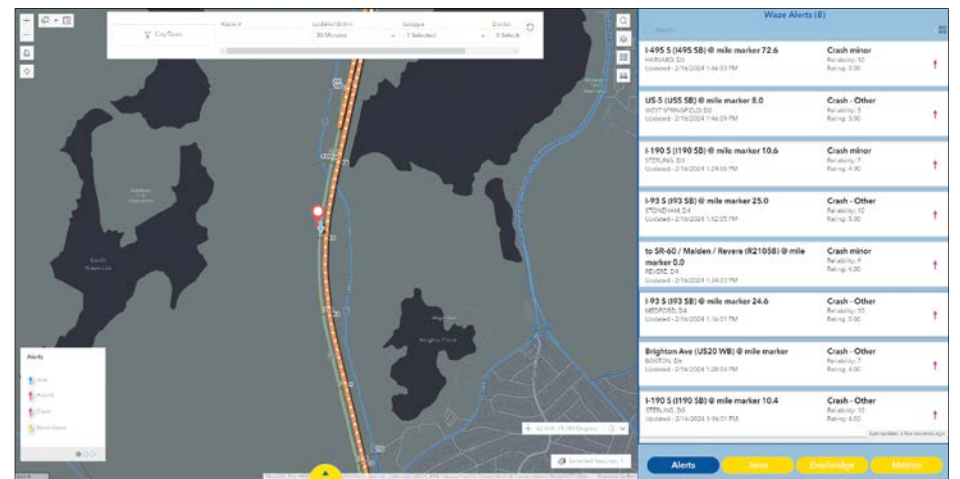
"A key challenge to any operations center, including the HOC, is to decrease incident detection time," said Michael Fitzpatrick, superintendent of systems management for the Highway Division. "Incident management begins with detection, and HOC aims to supplement our traditional means with information in an ever more connected world."

The MassDOT GIS team began incorporating a feed from Waze, which uses a combination of user-generated reports and real-time data from other Waze users to identify traffic hot spots and accidents. But use of the Waze viewer for operational maps and traffic alerts required a specific email account service, and MassDOT wanted staff to be able to access this data without signing in to a proprietary portal. In addition, the HOC wanted to associate the Waze traffic alerts and data feed with information from ArcGIS Roads and Highways, a location reference system solution for departments of transportation to manage route and event data.

MassDOT lead GIS developer Carl Hughes said that HOC staff primarily wanted to be able to see the route ID and the closest mile marker for each emergency event. These details, which were previously unavailable in Waze, would support faster emergency response.

## Real-Time Analysis

To help MassDOT achieve its goals, staff from Esri recommended ArcGIS Velocity—a software as a



↑ The dashboard shows a zoomed-in view of traffic incidents. Clicking on an arrow (alert) or traffic jam (line) highlights the location and triggers a pop-up window with related information.

service offering designed to help users ingest, process, visualize, and analyze real-time data feeds—because of its performance and scalability. The GIS team already used Esri technology, and Hughes said he liked that Velocity was cloud hosted, so the GIS team wouldn't have to maintain a database. He also liked that there was seamless integration with JavaScript Object Notation (JSON), a data format that is supported by Velocity and is one of the Waze feed formats. Hughes chose Velocity because of other features as well, including the ability to control refresh rates, easily view feed-related metrics, and see the number of events coming in.

"You could filter the events quite easily and modify *[them]* without it breaking or without much downtime," Hughes said.

The Velocity output—specifically the hosted feature layer generated by Velocity—proved

reliable and robust for real-time data, according to Hughes. Additionally, he liked that installation and setup required minimal effort, with little to no coding.

Since the Waze traffic feed updates every two minutes, Hughes wrote a Python script that continuously appends values such as the ArcGIS Roads and Highway fields. The script takes the latitude and longitude of each Velocity feature, identifies it on the HOC location reference system network, and performs a quality assurance and quality control check to see if the feature is a good match.

Velocity also makes it easy to filter out information that HOC staff don't need from Waze, since the focus for them is only MassDOT-owned roads. Hughes explained that the script helps find the closest mile marker and route

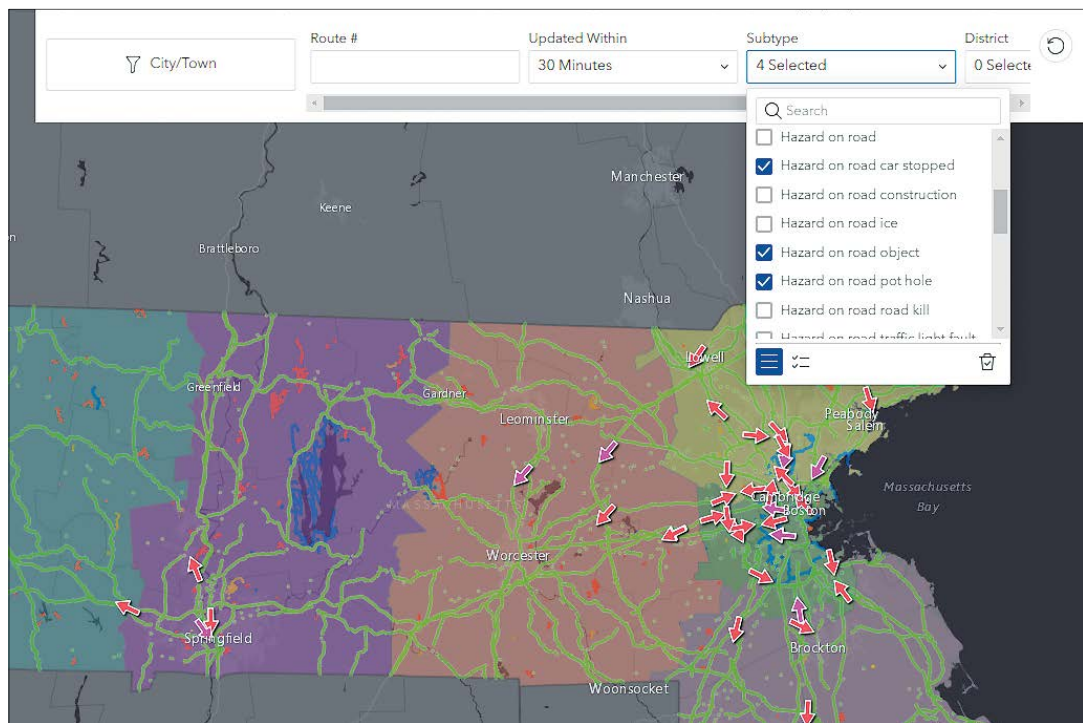
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↑ On-site staff at the Highway Operations Center (HOC) monitor state roadways and facilities, manage calls, and dispatch personnel to emergency events.

← The ArcGIS Velocity output proved reliable and robust for real-time data about incidents on state highways across Massachusetts.

measurements through the location reference system and appends that to the Velocity feature. Then, depending on the route ID found, it links to a specific event and hides or deletes other data based on set criteria.

“The Python script complements the Velocity feed, so when it’s packaged all together it [makes] it easy to filter out the stuff that we don’t need,” said Hughes.

#### New System Benefits

MassDOT has been employing the Waze and Velocity integration for more than a year, and the team has benefited from increased reliability, minimal maintenance, and improved access to real-time data. The HOC now receives Waze data around 2–4 minutes faster than other methods, such as emergency calls from motorists, according to Fitzpatrick. In addition, Waze features, including clustered alerts and alert

scoring, indicate visually when an incident is occurring, which helps the HOC deploy assets to the correct locations.

“The new tool provides new efficiencies,” said Fitzpatrick. “Waze users’ data comes from a much broader coverage area—and more quickly than other means. The tool is customizable, provides filtering (white noise), and allows other at-a-glance graphic summaries.”

To help staff in the HOC swiftly view real-time data and alerts, the GIS team developed a comprehensive dashboard using ArcGIS Experience Builder. The GIS team set the dashboard to refresh every two minutes, which is how often Waze updates and Velocity pulls the data, so the HOC receives the most current information.

“The new dashboard provides a real-time means of ingesting and displaying mapped alert data from Waze,” Fitzpatrick said. “Operators can quickly look at alerts right on a map and

find anomalies, incidents, and nonrecurring congestion. Our traditional methods of detection—phone, radio, CCTV, and field personnel—are supplemented with this new tool in the toolbox.”

Ron Vitale, HOC superintendent of operations management, added, “I’ve seen the dashboard evolve into a very user-friendly tool. Operators have reported that the notifications on the Waze dashboard are accurate and timely.”

Velocity generates an output that, according to Hughes, has streamlined work for the GIS team and increased reliability for the HOC. He explained that the previous solution involved more steps, which included making the schema—publishing, connecting, and registering it—and hoping for a favorable result.

“I don’t have to generate the output and then sort of rely on Velocity to write to it,” Hughes

said. “Velocity handles that. I can tell Velocity, ‘OK, generate an output from what I’ve already told you.’”

Hughes also likes that the feature layer hosted by Velocity works well with ArcGIS API for Python, which provides a consistent programmatic experience for scripting across the ArcGIS product suite. Updating with the location reference system wouldn’t be possible without this integration, he said.

#### Plans to Leverage Velocity Further

MassDOT’s GIS team plans to expand its use of Velocity by using it to get a real-time view of the locations of buses, trains, and subways. In addition, the MassDOT safety team is interested in using real-time Waze data and Velocity to complement its own research and look at historical data to help prevent accidents. With Velocity, the team can retain a customizable archive of historical data for operations, which helps the HOC answer inquiries about recent events.

“As an in-house tool, adjustments and improvements are tested and implemented in a timely manner,” Fitzpatrick said. “The tool appears to be a promising template for the inclusion of additional sources of information, like weather or other data streams, as we move forward.”

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# THE LAND IN BETWEEN

When considering how land records are managed in the United States, the local tax assessor's office may come to mind. Responsible for collecting taxes in their communities, assessors are stewards of important land information and property characteristics and often maintain maps of the parcels that make up their jurisdictions.

But what about the strips of land that lie in between taxable parcels? Often void of information or even nonexistent on tax maps, this land contains some of the United States' most critical infrastructure, from transportation, water distribution, and sanitary sewer systems to electrical and communication networks. Sometimes hidden in plain sight, these ribbons of land are called right-of-ways, and they contain resources that help keep people throughout the United States connected.

With such important services at stake, many transportation agencies and utility companies are turning to GIS to manage right-of-ways. This is helping them boost efficiency, improve operator safety, inform design decisions, ensure compliance with standards and regulations, and be more resilient in the face of mounting weather extremes due to climate change.

## Aging US Infrastructure Gets a Boost

In its 2021 *Report Card for America's Infrastructure*, the American Society of Civil Engineers gave US infrastructure a below-average grade of C-. Thus, the United States needs to take swift action to avoid additional deterioration of its infrastructure and meet the growing needs of society.

It seems that the United States is heading in the right direction. With the passage of the bipartisan Infrastructure Investment and Jobs Act in 2021, the US government authorized spending \$1.2 trillion to improve transportation and infrastructure throughout the United States. The White House then released the Biden-Harris Permitting Action Plan in May 2022, which aims to accelerate federal environmental review and permitting processes, and the Biden-Harris Action Plan for Accelerating Infrastructure in October 2022, which provides provisions to accelerate infrastructure construction. Both plans seek to leverage technology and innovation such as GIS to achieve their goals.

Moreover, as of October 2023, the US Department of Energy is investing nearly \$3.5 billion in the country's electrical infrastructure. This funding package, which aims to strengthen the resilience and reliability of America's power grid, identifies 58 projects across 44 states that strive to improve systems and make energy more reliable and affordable.

Now more than ever, it is crucial to have readily accessible right-of-way information to plan transportation, electrical, and other types of infrastructure projects. For instance, by leveraging ArcGIS Parcel Fabric, which is supported by a flexible data model and scalable architecture, organizations can easily maintain and share accurate, up-to-date, and

authoritative right-of-way parcel data. They can also significantly reduce the time it takes to plan new infrastructure projects by incorporating data layers from ArcGIS Living Atlas of the World and deploying extensions such as ArcGIS 3D Analyst and ArcGIS Spatial Analyst.

## Digitizing and Georeferencing Documents

According to the Federal Highway Administration, a division of the US Department of Transportation, the United States has approximately 4.19 million miles of highway. Decades—and in some instances, even centuries—of land transactions carved out the right-of-ways for these highways.

Likely, the real estate division of every organization responsible for managing these right-of-ways has a records room filled with documents that define where critical infrastructure can be placed. However, these records—which are vital yet often difficult to access—are vulnerable to loss due to fires, floods, deterioration, and more. Additionally, doing research with these documents is often burdensome for agency personnel and adds costs to every infrastructure project because accessing them is usually a manual process.

At the Nevada Department of Transportation (NDOT), for example, right-of-way survey services manager Gregorio Torres faced a challenge like this. NDOT had a huge number of documents dispersed among many different folders, boxes, and filing systems.

"Information wasn't consistent or reliable," said Torres. "It hadn't been brought together in a way that addressed all of the issues that the digitization process highlighted. We needed to change."

So the department embarked on an ambitious project to digitize and map NDOT's right-of-way documents in GIS. Now, teams across the organization have ready access to right-of-way information, which has greatly improved efficiency.

The Maryland Department of Transportation (MDOT) is also employing GIS to digitize its existing right-of-way plats. These maps show official land transactions and provide the historical records needed to plan and design Maryland State Highway Administration projects. Now, right-of-way data in Maryland is presented uniformly within MDOT's ArcGIS Online environment as authoritative feature layers. This allows both internal MDOT users and members of the public to access right-of-way and associated plat information in a single location on the web.

## Planning with Purpose

Once existing right-of-way records are mapped and accessible in GIS, officials can better plan expansion and reconstruction projects and build or rebuild more efficiently.

In the United States, there are about 5.5 million miles of electrical distribution lines and 600,000 miles of transmission lines, according to the National Academies of Engineering. By understanding where existing right-of-ways are located, agencies that manage this infrastructure can more easily identify environmental sensitivities,

prohibitive construction conditions, and access issues that could affect a project. This can accelerate project timelines and save organizations money.

The Chugach Electric Association in Alaska, for example, uses GIS to keep projects on track during the utility's very short, five-month construction window. ArcGIS Enterprise and Cityworks PLL—a solution from Esri partner Cityworks (a Trimble company) that's built exclusively on ArcGIS technology—now contain all of the utility's land permitting and right-of-way data. When staff members need to request right-of-way information, the process is automated. And it's easy to share land records across the organization, which enables staff to plan construction projects more efficiently.

## Staying Safe and Compliant

Not only is it imperative for organizations to know where their right-of-ways are, but it is also important for them to understand what lies within each right-of-way.

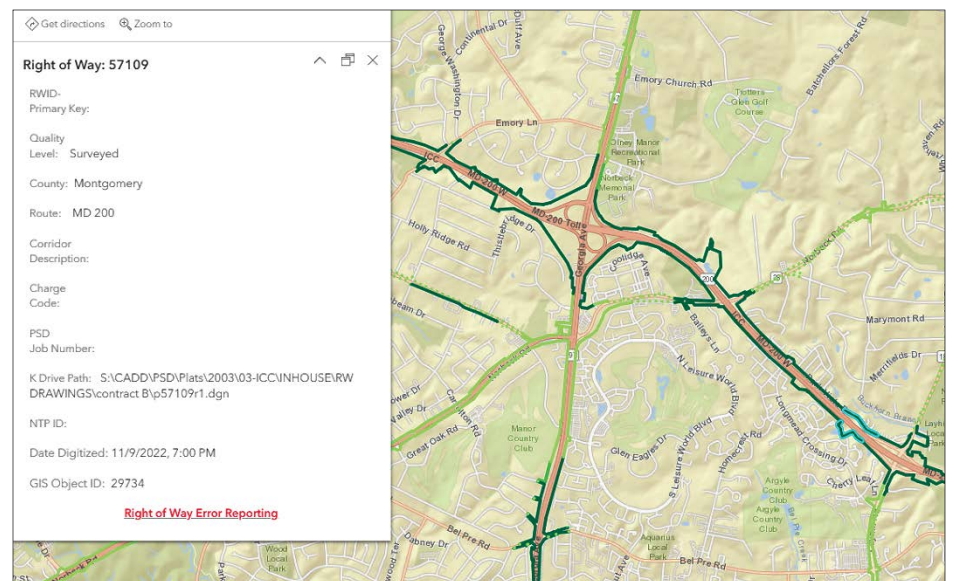
In the United States, there is currently a focus on colocating utilities—especially by putting broadband infrastructure within transportation corridors. This means there is an increased need to understand the exact location of assets and encroachments.

Given that the United States has more than 2.2 million miles of underground water infrastructure, an estimated 1.2 million miles of underground sewer lines, more than 2.6 million miles of natural gas and liquid petroleum pipelines, and millions of miles of electrical infrastructure, there's plenty of opportunity for conflict. If utilities and transportation organizations map these assets in ArcGIS Pro and maintain them using tools such as ArcGIS Field Maps and ArcGIS QuickCapture, then staff members can quickly, easily, and securely share this data with key stakeholders via ArcGIS Dashboards or ArcGIS Online. That reduces the likelihood that conflicts will arise during a construction project.

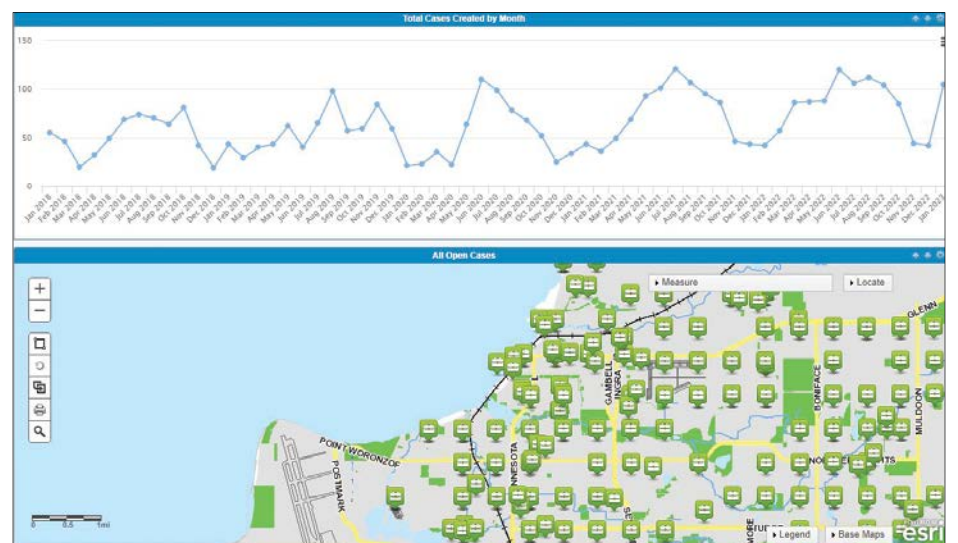
## Having a Lasting Impact

Overhauling the United States' aging infrastructure is a daunting task, yet one that is essential for keeping the country connected and its infrastructure resilient. Using GIS to manage right-of-way records and their associated projects gives transportation organizations, utilities, and other companies a huge boost toward achieving this goal. And moving to location-intelligent, digital records will have a lasting impact for generations to come.

To learn more about managing right-of-ways with GIS, visit [go.esri.com/rightofway](https://go.esri.com/rightofway).



↑ The Maryland Department of Transportation (MDOT) has digitized right-of-way plats and presents this data uniformly in a feature layer.



↑ Using GIS, staff at the Chugach Electric Association can easily see right-of-way and easement applications over time.

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# Web Editing: An Alternative Way to Edit Data

Easier, faster, better—that's the promise of Esri's new focused app for data editing, ArcGIS Web Editor. Users can edit and maintain data more easily, get data changes into the system more quickly, and do all that with fewer errors and higher precision.

Web Editor is included with ArcGIS Online and ArcGIS Enterprise, and its purpose is to simplify data editing activities and scale them within an organization. Although the web editing capability

is not new to ArcGIS, it hasn't had the completeness, robustness, or performance that ArcGIS Web Editor brings. Additionally, this new app is a leading feature of a larger strategy at Esri to advance web editing capabilities across the ArcGIS system.

## Benefits for All Types of GIS Users

In recent years, data editing in the desktop and mobile environments has advanced considerably,

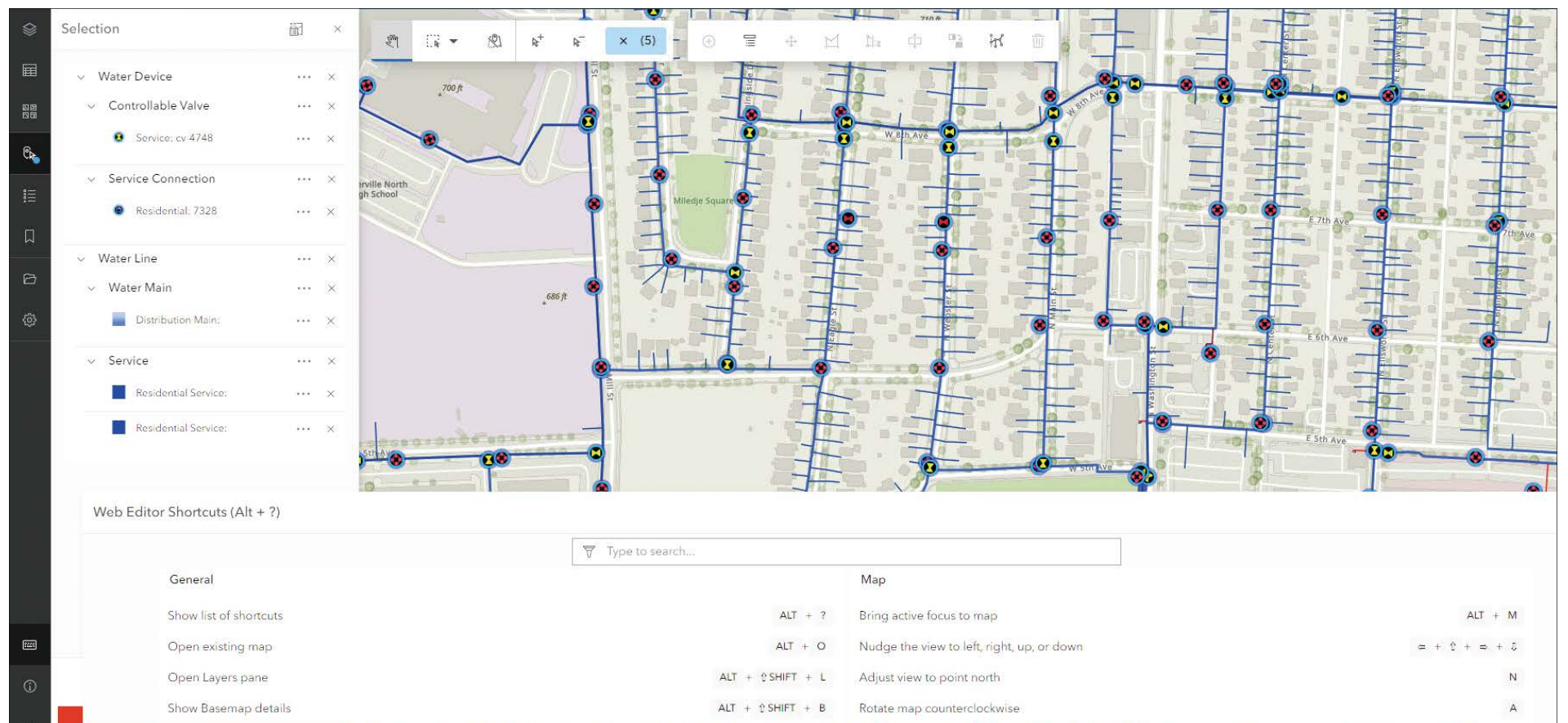
yet many organizations have not taken full advantage of the web pattern of data editing. This is especially true for complex features such as networks, fabrics, topology, dimensions, and versioning. Using Web Editor can change that.

ArcGIS Web Editor is a self-service spatial data editing app that brings common tools for editing into one browser-based interface and guides users through the editing process.

It modernizes data maintenance operations, reduces data errors, ensures a more accurate system of record, and enforces organizational data standards.

For GIS administrators and IT managers, installing and upgrading software on each user's machine is largely becoming a thing of the past.

Keyboard shortcuts in ArcGIS Web Editor help data editors quickly access the tools they need.



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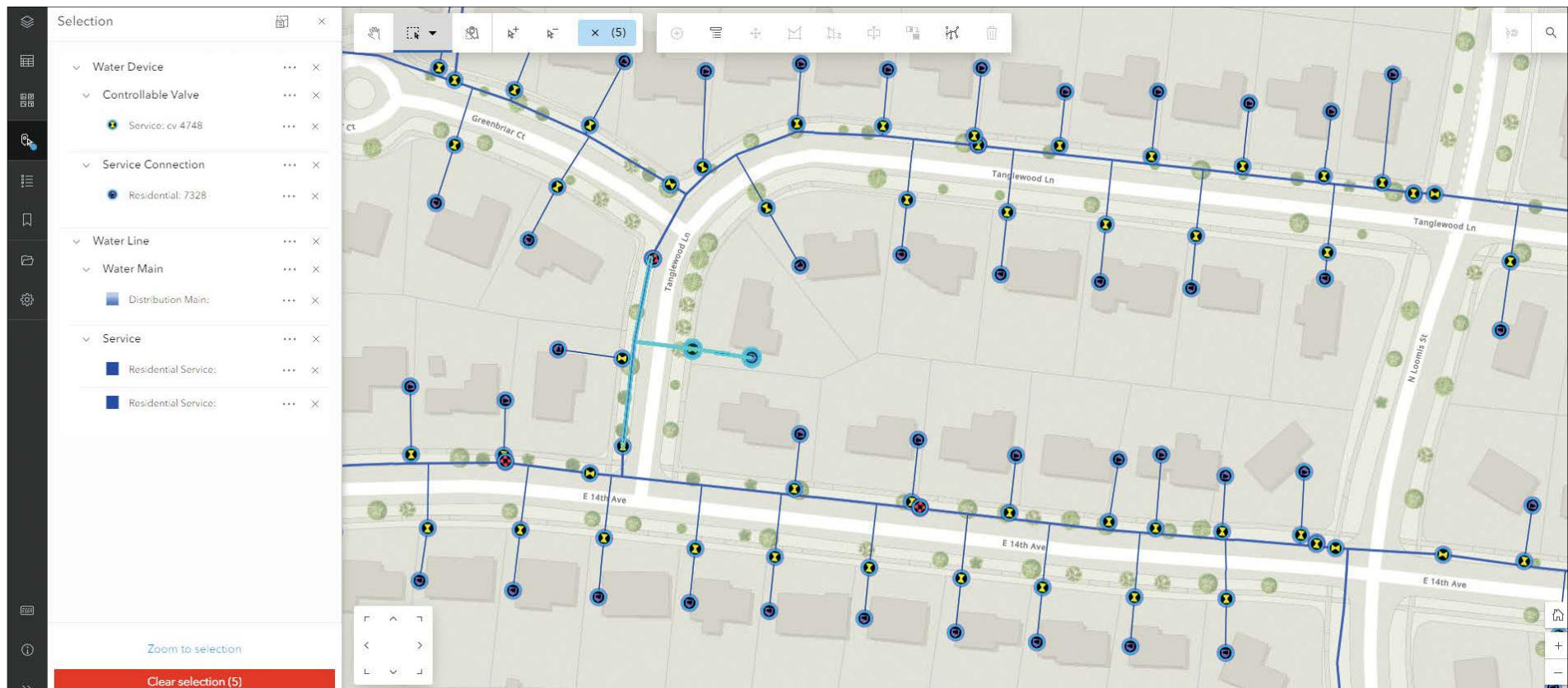
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↑ Tools and toolbars are context sensitive, so when a point feature is selected, only point feature editing tools are made available.

Web Editor is deployed once in ArcGIS Online or ArcGIS Enterprise, and then all users can immediately access the most current software and app configurations on their computers from various work locations, whether they're in the office or out in the field.

Many asset owners aren't very technical, and they shouldn't have to know GIS at a professional level to be able to do their jobs. Some biologists, for example, just need to delineate wetland boundaries, and many surveyors just need to enter parcel boundaries. These users expect simplicity from their apps, and that's what Web Editor provides. For asset owners, it has a simple, focused, and targeted user experience with built-in context, onboarding, and user guidance. This makes it quick and easy for biologists, surveyors, and others to make the types of data edits they need.

For GIS analysts who correct data and perform quality control on it, these processes typically take a lot of time. Using data constraints and feature forms at the point that data is captured—rather than during post-capture validation processes—can cut down on much of this data correction work. And that's where ArcGIS Web Editor comes in. It enables the autopopulation of values, enforces attribute rules, constrains values to ranges or lists, and maintains feature connectivity and coincidence. Through Web Editor, GIS analysts can also configure and expose these capabilities for the entire organization, saving everyone time; improving accuracy; and, when applicable, increasing safety for users in industries such as utilities.

### Editing Data with Confidence—and Fewer Errors

ArcGIS Web Editor allows users to be more self-sufficient by enabling them to enter their data on their own, directly in the app. It adds contextual information needed during the editing process, such as related overlay data layers, and

will soon include predefined tasks for following workflows, as well as descriptions of what to consider during the editing process. This all provides users with a guided experience so they can add and edit their data with confidence. The app also minimizes the editing options that are available, which prevents confusion.

GIS administrators can make their work lives easier by spending a little extra time defining and configuring Web Editor and its data rules. They can optimize the structure, timeliness, completeness, and consistency of the data contained within the app. These guardrails are then kept in place with attribute rules, feature forms, topology, and more. This staves off potential mistakes and reduces users' reliance on the GIS team to correct data errors. It also gives GIS professionals more time to focus on other mission-critical activities.

### Putting Data Editing at the Forefront of the User Experience

In its first release in ArcGIS Online and ArcGIS Enterprise, the Web Editor app provides users with a better editing experience overall. It comes with basic, out-of-the-box editing tools, including a better data selection experience to curate specific features, plus some foundational geometry drawing tools such as Freehand, Right Angle Line, Move, and Reshape. The app also leverages attribute rules and feature forms—platform-based approaches that are already established across ArcGIS apps and services.

The Web Editor app helps organizations leverage data editing and management capabilities by providing a consistent editing experience whether these capabilities are exposed through focused apps, widgets, or custom apps. And this is part of a larger, system-wide approach to elevating web editing across ArcGIS technology.

Although ArcGIS Web Editor is the premier app for editing data on the web and has the

most capabilities for editing data, Esri is also delivering these same updated data editing tools throughout ArcGIS and at the developer tier—in low-code configurable apps, such as ArcGIS Experience Builder, as well as in ready-to-use apps like Map Viewer. All ArcGIS web apps have the same underlying web editing components, so they all benefit from these updates and improvements.

Enhancements like these bring consistency to the ArcGIS experience, meaning that editing tools work the same when used in different apps. The iconography, tool names, terms, and keyboard shortcuts are all the same. This enables users to stay comfortable and edit their data confidently, even when transitioning among different apps.

### The ArcGIS Web Editor Road Map

As with many Esri products, ArcGIS Web Editor will gain more functionality over the coming months and years. The goal of the first two releases is to set a fundamental framework for the many releases and tools to come, so right now, Web Editor gives users access to core editing tools and feature forms. Once that framework is established, users will be able to create and deploy app configurations, edit utility network and parcel fabric data, assign tasks, work with client-side topology, and more.

ArcGIS Web Editor is available as part of ArcGIS Online and ArcGIS Enterprise (version 11.3). To use Web Editor, users need to have a Creator user type or higher. To leverage advanced features such as utility network or parcel fabric data editing, users will need to have a Professional user type or higher.

So go try ArcGIS Web Editor. And if you're so inclined, please submit feedback about the app at [links.esri.com/WebEditorCommunity](https://links.esri.com/WebEditorCommunity).

# Data Quality Across the Digital Landscape

According to consulting firm Gartner, bad data costs organizations an average of \$12.9 million per year. Other reports show similarly staggering figures. The McKinsey Global Institute, for example, found that poor-quality data can lead to a 20 percent decrease in productivity and a 30 percent increase in costs.

The consequences of working with bad data are serious, ranging from diminished customer loyalty, lost revenue, and wasted resources to uninformed decision-making and missed opportunities. Data quality management should be a priority for all businesses. And as data volumes grow, being able to effectively manage data is indispensable. Organizations need to ensure that their data is high quality, meaning it is accurate, complete, consistent, and timely.

To address the risks that poor-quality data poses to organizations, Esri provides capabilities across the ArcGIS system that support general data quality requirements, as well as focused extensions for comprehensive data quality management. ArcGIS Data Reviewer, in particular, enables organizations in myriad industries to implement comprehensive quality reviews of their data based on their own unique requirements. This allows organizations to better analyze their data; identify patterns; and, ultimately, make data-driven decisions.

## Defining Data Quality

One of the challenges facing data producers and consumers alike is defining what constitutes good-quality data. What works for one organization may not be acceptable at another, since quality is defined in the context of how the data will be used in problem-solving. Furthermore, data that is of good quality today may not measure up in the future as business processes and best practices change.

↓ ArcGIS Data Reviewer enables organizations to do quality reviews on their data based on their own unique requirements.

Sophisticated apps rely on high-quality data inputs to generate accurate insight and predictions. And while cutting-edge technology like AI and machine learning models can yield advanced analytics, poor-quality data can lead to biased models, erroneous predictions, and unreliable recommendations. This undermines the effectiveness of AI-driven decision-making.

For many organizations, data quality requirements are based on industry standards, input from subject matter experts, and experience. While these approaches differ from organization to organization, there are standards in place to create a common language when defining quality.

The International Organization for Standardization's ISO-19157 provides this framework for geographic data. ISO-19157 presents guidelines for how to manage geospatial data quality, focusing on how to assess and improve the quality of geospatial data throughout its life cycle. The standard, which demonstrates how to evaluate and document geospatial data quality, defines various elements that contribute to data quality, such as completeness, positional accuracy, logical consistency, and temporal precision.

## Raising Data Quality Standards

Given that many industries have undergone digital transformations, the volume and variety of available data have grown. This increased reliance on data has significantly raised data quality standards, since only high-quality data can be mined to generate insight.

Users of ArcGIS technology can use Data Reviewer to automatically and holistically manage the quality of their spatial data through configurable data checks. The workflows in Data Reviewer support the data quality requirements found across multiple industries. The extension automatically detects poor-quality data, makes it easier to get qualitative feedback from subject matter experts, and includes a

framework for tracking corrective actions that improve data quality. The library of ready-to-use data checks provided with Data Reviewer can help identify errors in feature integrity, spatial relationships, attributes, events, polylines, polygons, and z-values.

All kinds of organizations—from local governments and public works departments to utilities and water and sanitation districts—use Data Reviewer to improve the quality and reliability of their GIS data. This helps them streamline resources, reduce costs, and enhance productivity and transparency.

## Overcoming Data Quality Challenges

One area that industries and governments around the globe are grappling with—and one that relies heavily on high-quality spatial data—is infrastructure improvement. Transportation networks, energy grids, communication channels, and water and wastewater systems the world over are aging. And the challenging operating conditions presented by improving these critical facilities are straining governments and citizens alike.

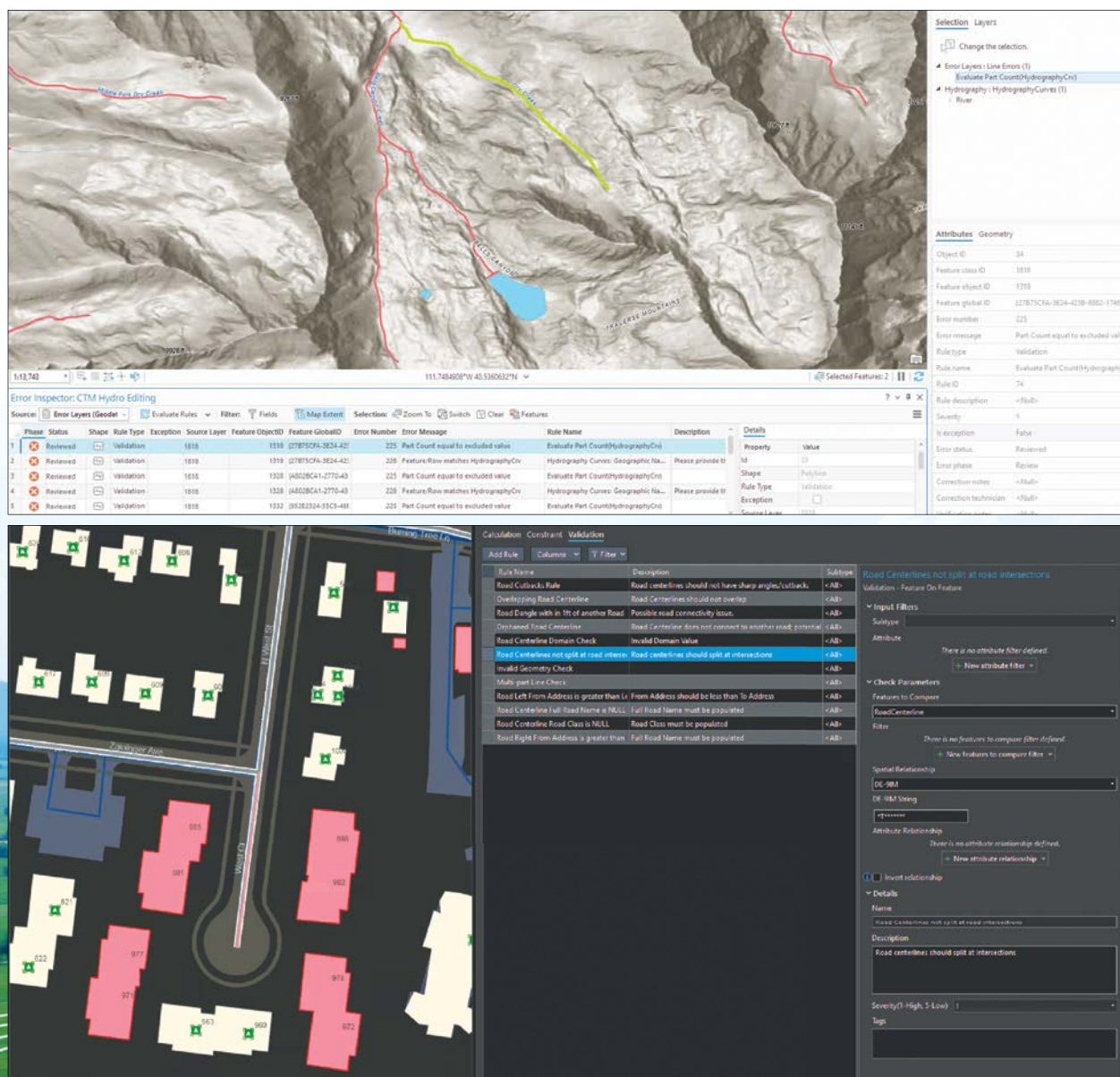
Many organizations involved in infrastructure improvement are trying to take advantage of technological advancements such as digitization, automation, and AI to fast-track modernization projects. This often requires them to upgrade their legacy systems to the latest solutions that follow newer architecture patterns. System upgrades like these are most often accompanied by data migration and consolidation efforts. These are substantial undertakings, and they need to be done right so that organizations can reap the full benefits of a system overhaul. This means that organizations need to let go of archaic data structures and workflows, which can cause gaps in data that compound over time.

Usually, modernization projects include adopting industry-specific solutions, such as ArcGIS Parcel Fabric or ArcGIS Utility Network, along with their associated data models. In preparation, organizations will often conduct a comprehensive review of their data holdings to determine their fitness for use in these solutions and the workflows they are intended to support. Many organizations employ Data Reviewer during these reviews to identify and document data that does not meet the requirements of their modernized systems.

## Investing in Data Quality Management

In today's competitive environment—with advanced technologies such as AI and machine learning changing the way that so many industries operate—investing in data quality management is essential. By ensuring that their data is accurate, complete, consistent, and timely, businesses can make well-informed decisions, avoid costly mistakes, and improve operational efficiency. And if they adhere to industry-backed data standards and regulations, they can mitigate the risks associated with having incomplete or inconsistent data.

Data Reviewer automates and simplifies the data quality management process for geospatial data. Learn more about it at [go.esri.com/datareviewer](http://go.esri.com/datareviewer).



← Data Reviewer automatically detects poor-quality data based on standards from specific industries.



# When Developing Governance for GIS, Account for Its Distinct Characteristics

By Nathan Heazlewood, Eagle Technology Group

As with other IT systems, GIS relies on good data management, systems integration, and cybersecurity. These shared elements underscore the importance of leveraging IT governance frameworks and best practices when developing GIS governance strategies. Aligning GIS practices with established IT standards ensures coherence in overall IT management and helps organizations seamlessly achieve their objectives.

However, GIS governance must also account for the distinct characteristics of GIS. For example, GIS deals with spatial data, adding a layer of complexity. The spatial components of GIS mean that practitioners must make considerations related to geographic coordinates, map projections, and ways to interpret data in relation to physical locations.

For anyone involved in developing GIS governance, it is critical to understand and address these and other distinctions. Here are some additional key differences between IT and GIS that those who focus on GIS governance need to consider.

## External Data Sources

GIS often relies on information from external geographic databases, satellite imagery, or other specialized datasets. This introduces challenges related to data provenance and accuracy as well as compliance with data-sharing agreements. Understanding and managing the intricacies of external data use are critical aspects of GIS governance.

## Rapid Technology Evolution

GIS involves rapid advances in data collection, analysis, and visualization tools and techniques. This requires governance practices that are agile and responsive. Staying updated on trends and incorporating flexible governance frameworks ensures that organizations can harness the full potential of evolving GIS capabilities.

## Big Data

GIS datasets, especially those involving specialized raster or lidar data, are often larger than those in other IT systems. This necessitates careful deliberation on data storage solutions and system performance techniques to ensure efficiency and optimal functionality.

## Variety of Geospatial Data

GIS data is more varied than data that's in many other IT systems. It is therefore important to understand and record dataset characteristics, since different datasets may require tailored management throughout their life cycles. This adaptability ensures that GIS data is handled in the way that best suits its unique attributes.

## A System of Systems

GIS can simultaneously be a system of record, a system of insight, a system of engagement, a system of analysis, and a system of design. This versatility sets GIS apart, as many other IT systems encompass just one or two of these. Governance strategies that are overly focused on one or two systems risk overlooking the full potential of GIS.

## Specialized Geospatial Concepts

Concepts such as geodesy, map projections, requirements for topological accuracy, and cartographic licensing and generalization are crucial in GIS. It's important that individuals involved in GIS governance are adequately trained and familiar with these concepts.

## GIS People

GIS professionals are often technically savvy and have overlapping skills with other IT personnel—and they are also frequently interested in environmental, social, and governance initiatives. Recognizing and leveraging these traits can make GIS governance more effective.

## Risks, Including Bureaucracy and Opportunity Costs

Different uses of GIS data and tools have varying risk profiles. Failure to address these risks can have severe consequences, while an overly risk-averse approach may lead to unnecessary bureaucracy, inefficiency, or missed opportunities.

## Integration

GIS can be used as an integrator or a common framework for diverse datasets. The geographic elements in GIS facilitate the easy association of data from multiple sources, enhancing the interoperability and utility of GIS in various organizational contexts. When multiple projects or systems are involved, it's important for different teams to be able to interact without facing conflicts or misunderstandings, which requires good governance.

## Data Sharing

Data sharing is more common in GIS than in many other IT systems. Governance responsibilities include ensuring that data sharing is appropriate, efficient, and secure. This involves establishing protocols and mechanisms for responsible and secure data sharing inside and outside an organization.

## Unique Data Characteristics

Given that GIS has multiple transferable and storable formats, each with its own advantages and disadvantages, GIS governance strategies should evaluate a wide variety of web service types for different scenarios. This helps ensure that GIS data remains accessible, usable, and interoperable across diverse applications.

## Learn More About GIS Governance

For anyone involved in GIS governance, one good way to better understand the similarities and differences between GIS and IT governance is to attend the Urban and Regional Information Systems Association's (URISA) GIS Leadership Academy. The educational and networking opportunities at these events can help attendees build knowledge of these and other critical topics.

### About the Author

Nathan Heazlewood is a GIS principal consultant at Eagle Technology Group, Esri's official distributor for New Zealand and the South Pacific. He writes a popular LinkedIn blog about the worldwide geospatial technology industry and project management. Heazlewood also advises the New Zealand Emerging Spatial Professionals Group, which provides early career guidance to geospatial technology professionals.

### Managing GIS

A column from members of the Urban and Regional Information Systems Association



# Land-Cover Mapping with Deep Learning in ArcGIS Living Atlas of the World

What do you get when you combine big data, satellite imagery, and AI? There are lots of answers to this question—and one of them is the ever-expanding collection of high-quality land-cover models available in ArcGIS Living Atlas of the World.

The land-cover maps generated by these models can be used for environmental monitoring, resource management, urban planning, and more. ArcGIS Living Atlas users don't need extensive training, computational resources, or AI expertise to employ these models. And they can produce high-quality land-cover maps that classify building footprints, evaluate damage, and determine an otherwise bewildering array of land-cover types in a variety of spatial resolutions and revisit periods.

## A Range of Resolutions

The Land Cover Classification (Landsat 8) model is an important lower-resolution resource for producing land-cover maps. Based on Landsat 8 imagery at 30-meter resolution, such maps are ideal for conducting long-term analysis on land-cover

change to study things like climate change and help manage resources such as forests, water bodies, and agricultural areas. The maps can be used to quantify changes in carbon storage, surface-light reflection, and land-surface temperatures.

For medium-resolution imagery, the Land Cover Classification (Sentinel-2) model provides 10-meter resolution. Images created with this model are useful for environmental monitoring such as tracking vegetation, examining water bodies, detecting hazards for disaster management, and aiding land-use planning by offering insight into land-cover changes and urban expansion.

Several models, including High Resolution Land Cover Classification – USA and Land Cover Classification (Aerial Imagery), are tailored for high-resolution data. These models can be used to create maps for monitoring crop types and health, planning infrastructure, identifying tree species, assessing vegetation conditions, and monitoring natural resources.

Choosing the most suitable satellite imagery sources and pretrained deep-learning models



↑ Satellite imagery can help indicate surface characteristics such as water permeability.

can help align specific land-cover mapping apps with an organization's requirements. In this way, land-cover maps, complemented by additional data layers available in ArcGIS Living Atlas, can provide a holistic picture of human and natural footprints across the planet.

Called Prithvi - Crop Classification, it was developed by IBM and the National Aeronautics and Space Administration (NASA) to assist with tasks such as crop monitoring and water irrigation management.

## Next Steps

Discover these and other pretrained deep learning models at [links.esri.com/pdlm](https://links.esri.com/pdlm). Go to [links.esri.com/i-pm](https://links.esri.com/i-pm) to learn how to use them in ArcGIS.

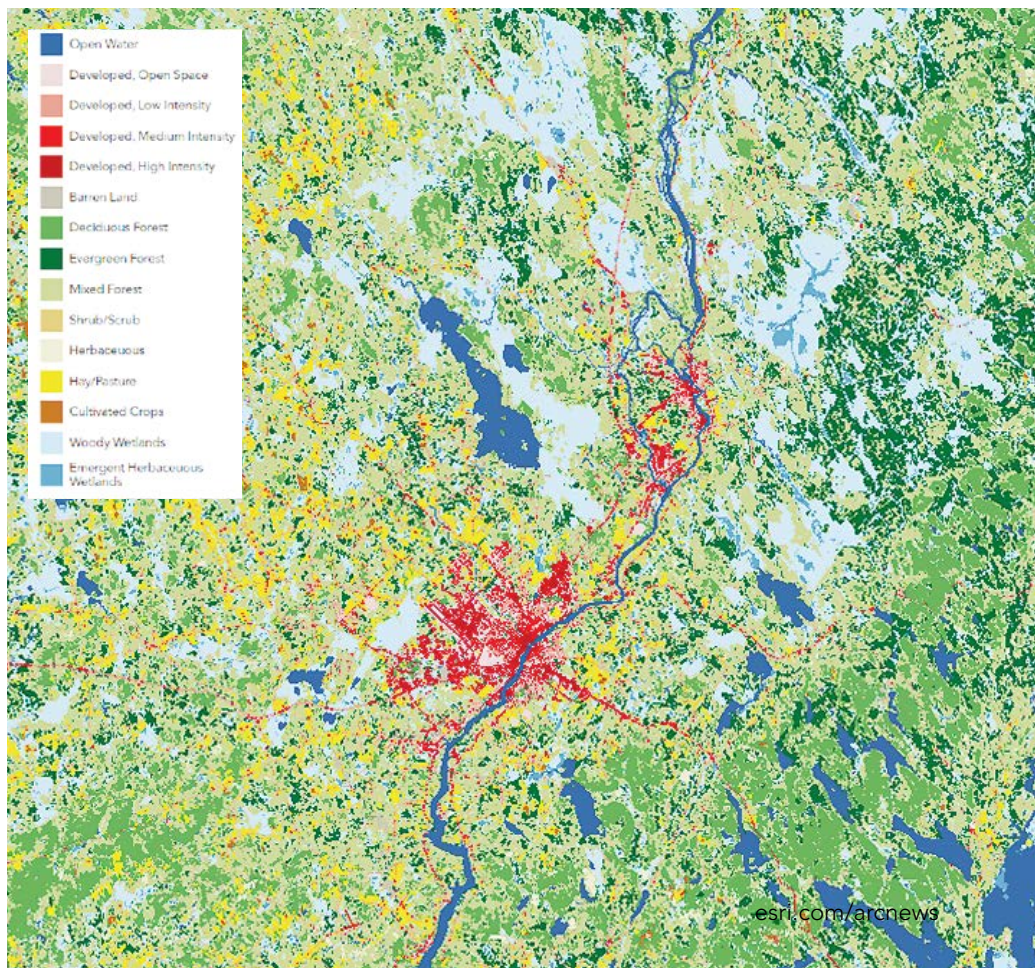
To ask questions or gain more insight into what these models do—or to contribute ideas for additional AI-powered feature extraction tasks—join the conversation on Esri Community at [community.esri.com](https://community.esri.com).

## Recent Additions to the Collection

One of the models recently added to ArcGIS Living Atlas is called Text SAM. Created in February, Text SAM is an open-source sample model that enables users to employ free-form text prompts to get the model to indicate surface features such as automobiles, swimming pools, ships, airplanes, and solar panels.

Another new pretrained model in ArcGIS Living Atlas, created in January, can be used to classify crops via multispectral satellite imagery.

↓ The Land Cover Classification (Landsat 8) model can be used for low-resolution time-series change analysis.



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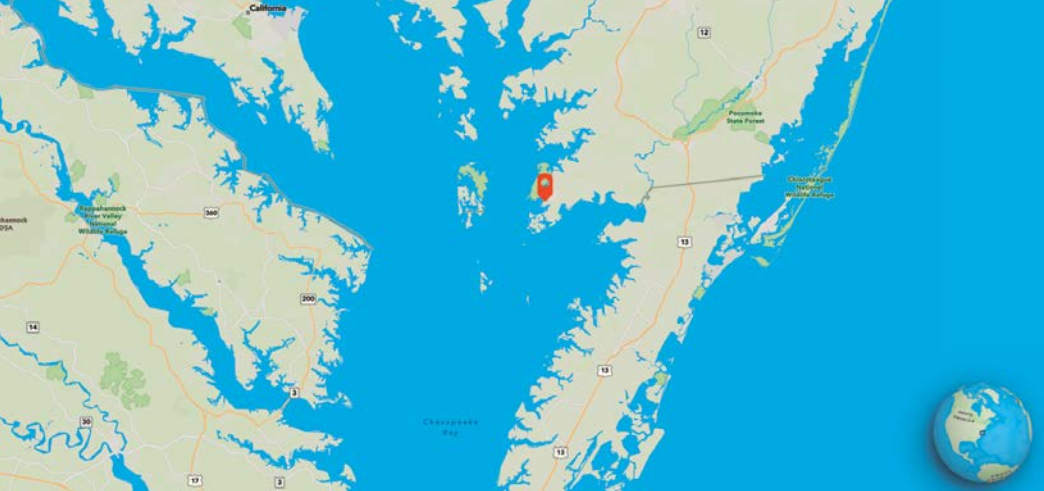
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↑ Crisfield lies on the eastern shore of the Chesapeake Bay, the largest estuary in the United States.

# Digital Twin Shows Climate Vulnerability in Chesapeake Bay City

The Chesapeake Bay area, located on the East Coast of the United States, is one of the country's regions that's most vulnerable to climate change, according to the Chesapeake Bay Program, a regional partnership that has conducted wide-ranging bay restoration projects for more than 40 years.

According to the National Oceanic and Atmospheric Administration (NOAA), the bay will likely undergo sea level rise of 1.3–5.2 feet (0.4–1.6 meters) during the next century—more than the global average—due to climate change, groundwater removal, and land subsidence. This would intensify the already-intensifying impact of storm surges generated by hurricanes and other weather-related events. With more extreme weather due to climate change, NOAA expects increases in coastal flooding and shoreline erosion, as well as changes in local wildlife abundance and migration patterns.

Located on the Chesapeake Bay's eastern shore and with an average elevation of only about three feet (0.9 meters) above sea level, the city of Crisfield, Maryland, has high flooding risk. In 2012, a storm surge from Hurricane Sandy flooded most of the city, highlighting issues that are being tracked by Chesapeake Bay Program partners such as the US Geological Survey and NOAA. Using ArcGIS Pro, ArcGIS Online, and 3D landscape visualization, Chesapeake Bay Program partners created a digital twin of Crisfield to help the flood mitigation team develop a flood adaptation assessment to enhance community resilience.

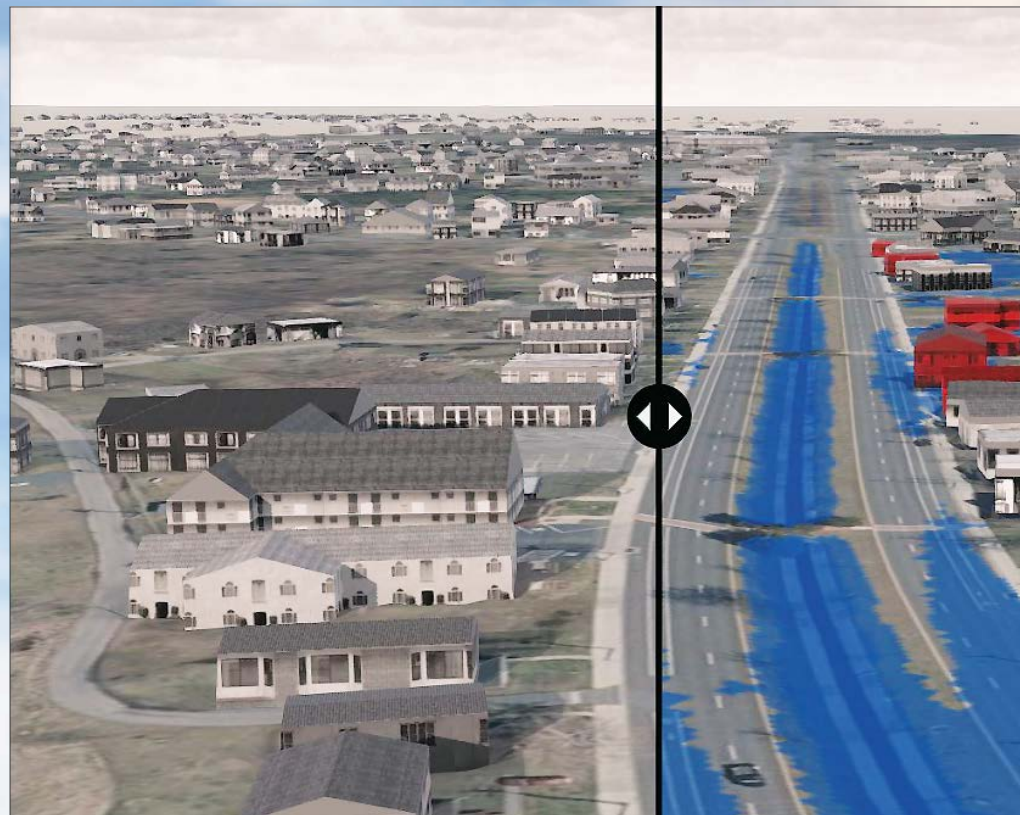
## Digital Twin Shows Flooding Scenarios

The Chesapeake Bay Program team used 3D Basemaps to create the digital twin and employed ArcGIS Pro to generate the 3D terrain, buildings, and vegetation from lidar data and digital building footprints. Dr. André de Souza de Lima and his colleagues at George Mason University's Flood Hazards Research Lab developed flood scenarios based on NOAA's coastal high-tide flooding mapping methodology.

"Crisfield's digital twin enables users to see the extent of flooding under different hazard and adaptation scenarios," said John Wolf, a US Geological Survey geographer and the GIS team leader for the Chesapeake Bay Program. Wolf's team oversees landscape monitoring and modeling while leading the development of related data communication and visualization products.

To help show potential flooding impacts to buildings and other important local assets in the digital twin, the team downloaded building footprints and lidar data from the MD iMAP Portal ([imap.maryland.gov](http://imap.maryland.gov)), Maryland's enterprise GIS resource. The team also used property data from iMAP to add parcel-scale valuation data to the basemap.

"The building footprints were enhanced with additional attributes originating from parcel data through spatial joins," Wolf said. "As a result, we were able to approximate the total assessed value of buildings that could be impacted under various flooding scenarios."



↑ A swipe app shows the area around Crisfield's Main Street—unflooded (on the left) and under a 2.5-foot (0.8-meter) water-level hazard (on the right), with impacted structures shown in red.

## Optimizing 3D Visualizations

The team published 3D visualizations to ArcGIS Online, with animated water and atmospheric effects added in Scene Viewer. Because the team members also wished to show historical context for the city, which was incorporated in 1872, they used maps from 1897 that had been created for the fire insurance industry to exhibit streets, buildings, and other details.

To help with community resilience planning, the City of Crisfield flood mitigation team and others can use several interactive 3D visualizations that Wolf's team developed based on insight from scientists from The Nature Conservancy, the University of Maryland Environmental Finance Center, George Mason University, and the US Environmental Protection Agency. As examples, one visualization shows the extent of flooding and impacted buildings from a 1.5-foot (0.46-meter) water-level hazard while another illustrates the effects that would be expected if the city faced a storm comparable to Hurricane Isabel,

which flooded large sections of Maryland's eastern shore in 2003.

Using ArcGIS Pro and Site Scan for ArcGIS, the Chesapeake Bay Program team is also collaborating with the Chesapeake Conservancy to develop an integrated mesh dataset to further improve realism. "The current version of the Crisfield scenes uses 3D building and vegetation models that approximate the vertical landscape structure," said Wolf. "But an imagery-based integrated mesh version will present a more authentic depiction of the city."

While this digital twin approach to studying coastal flooding is relatively new, it could be applied to communities all around the bay and its tributaries—an area that represents 11,684 miles (18,804 kilometers) of shoreline and 4,480 square miles (7,210 square kilometers) of surface area. In fact, a similar project is underway in Norfolk, Virginia.

"I hope these examples will serve as prototypes for other communities along the Chesapeake Bay coastline at risk of sea level rise," said Wolf.

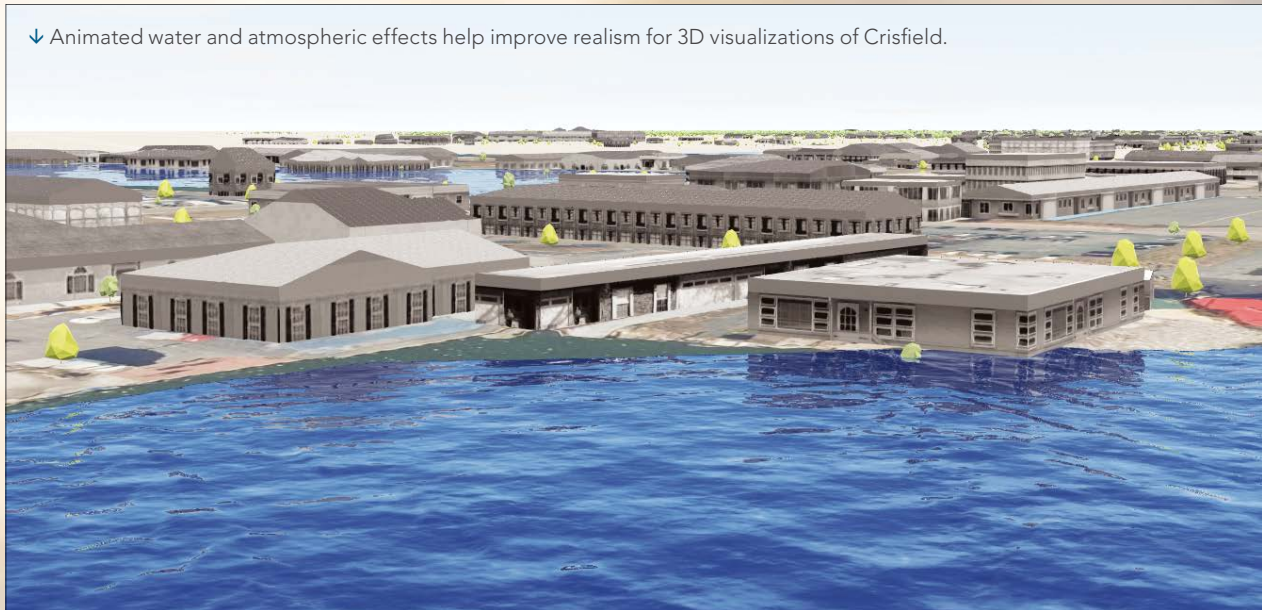
See an ArcGIS StoryMaps story about Crisfield's digital twin at [links.esri.com/crisfield\\_twin](https://links.esri.com/crisfield_twin).



→ A 3D visualization shows flooding and impacted buildings in a scenario based on Hurricane Isabel conditions from 2003.



↓ Animated water and atmospheric effects help improve realism for 3D visualizations of Crisfield.



↓ A digital twin illustrates a minor flooding scenario near the Crisfield waterfront, with affected buildings shown in red.



# 3D GIS Helps MAF Deliver Aid to Isolated Communities

Following the end of World War II, a group of veteran pilots shared a dream of using their flying skills to reach isolated communities and better serve people in times of need. To turn this dream into reality, they banded together to create Mission Aviation Fellowship (MAF).

For nearly 80 years, MAF's goal has been to deliver medical supplies, personnel, food, and hope to communities in isolated areas, from Mozambique and Lesotho in southern Africa to islands in Indonesia and the Caribbean. The organization's work has spanned 12 countries,

and in 2023 alone, MAF conducted 16,207 flights covering more than 1.1 million miles (1.7 million kilometers) to safely transport more than 48,300 passengers to their destinations.

Safety and security are critical for MAF. With its recent adoption of GIS technology, MAF has

enhanced its ability to protect its missionaries and pilots, helping them deliver humanitarian aid to some of the most remote areas in the world.

## A GIS Vision Takes Shape

In 2022, MAF rolled out an enterprise-wide GIS, revitalizing the way its flight missions are planned and executed.

"I've known [about] and used GIS for 30 years," said MAF global data architect and GIS manager Frank Roberts. "But being at MAF makes me excited with the newness of GIS in the organization. In just a year, we've used GIS to visualize airstrips, to support disaster response efforts, and to even create a digital twin."

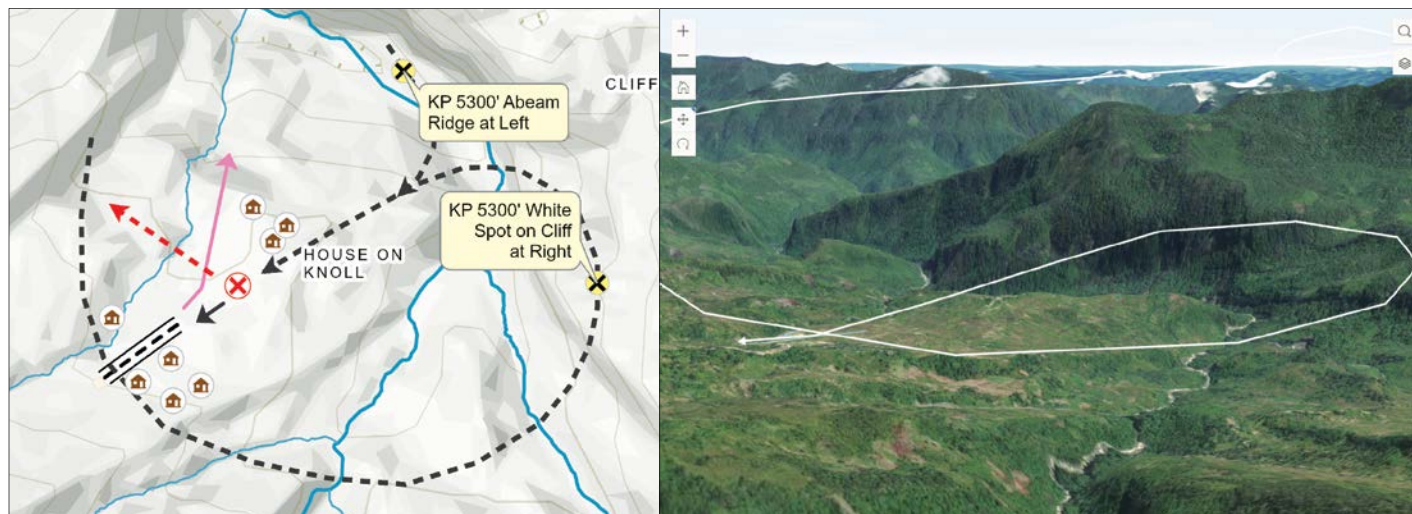
MAF's GIS initiative started by having staff inventory data needs and the data they already had available to support the organization's various activities. MAF staff also gathered input on organizational challenges and began to outline where GIS could make the biggest impact. With this in mind, staff asked a key question: How can we effectively use GIS to visualize our data, make more informed decisions, and communicate the important work that MAF is doing?

Obtaining answers to questions like this one revealed the projects where the greatest needs could quickly be met. One of the first GIS initiatives identified was to digitize MAF's transportation operations. Given the vast differences among airstrips in the isolated areas MAF serves, ensuring a safe and accurate flight path is of utmost importance. Many airstrips are located on the sides of mountains, hacked out of thick jungle, and even found on rivers (these are serviced by MAF's floatplane). The runways are often short; covered in dirt, grass, or water; and not aided by air traffic control.

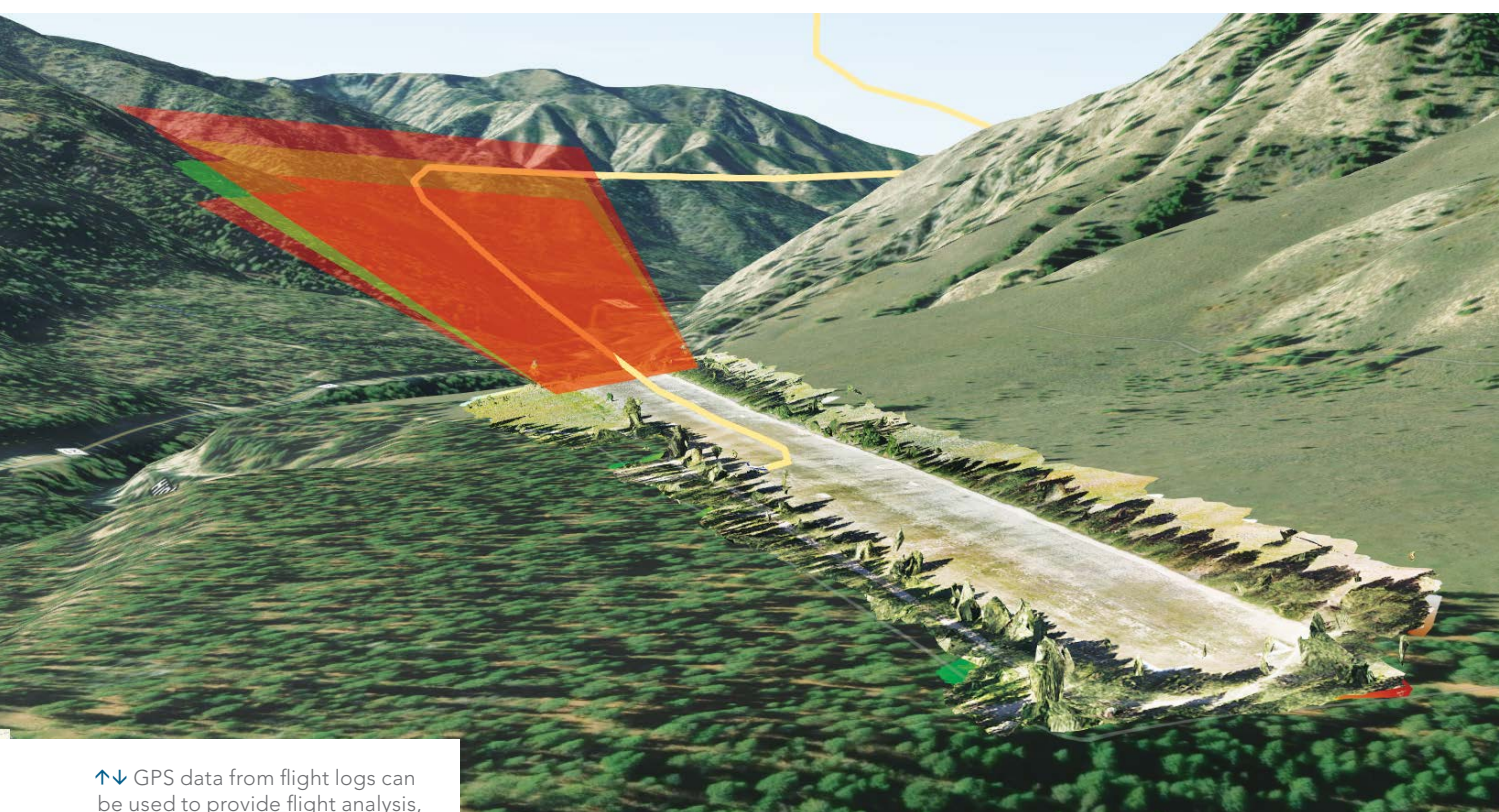
"The pilots are experts in the areas where they fly, but when a new pilot is joining that region, the briefings include key visualization indicators like, 'You go down this valley, you take a right at the tree'...and having a means to visualize [terrain] enables our missions to be safer, given that our pilots fly into some of the most challenging airstrips in the world," Roberts said.

To help the pilots, the MAF team used ArcGIS Online, ArcGIS Pro, and ArcPy to create MAF Globe, a 3D GIS tool that allows pilots to interactively spin a digital globe and zoom in to specific runways. The MAF team made this tool available for all its pilots via ArcGIS Enterprise, enabling them to prepare for their flight operations no matter where the missions occurred.

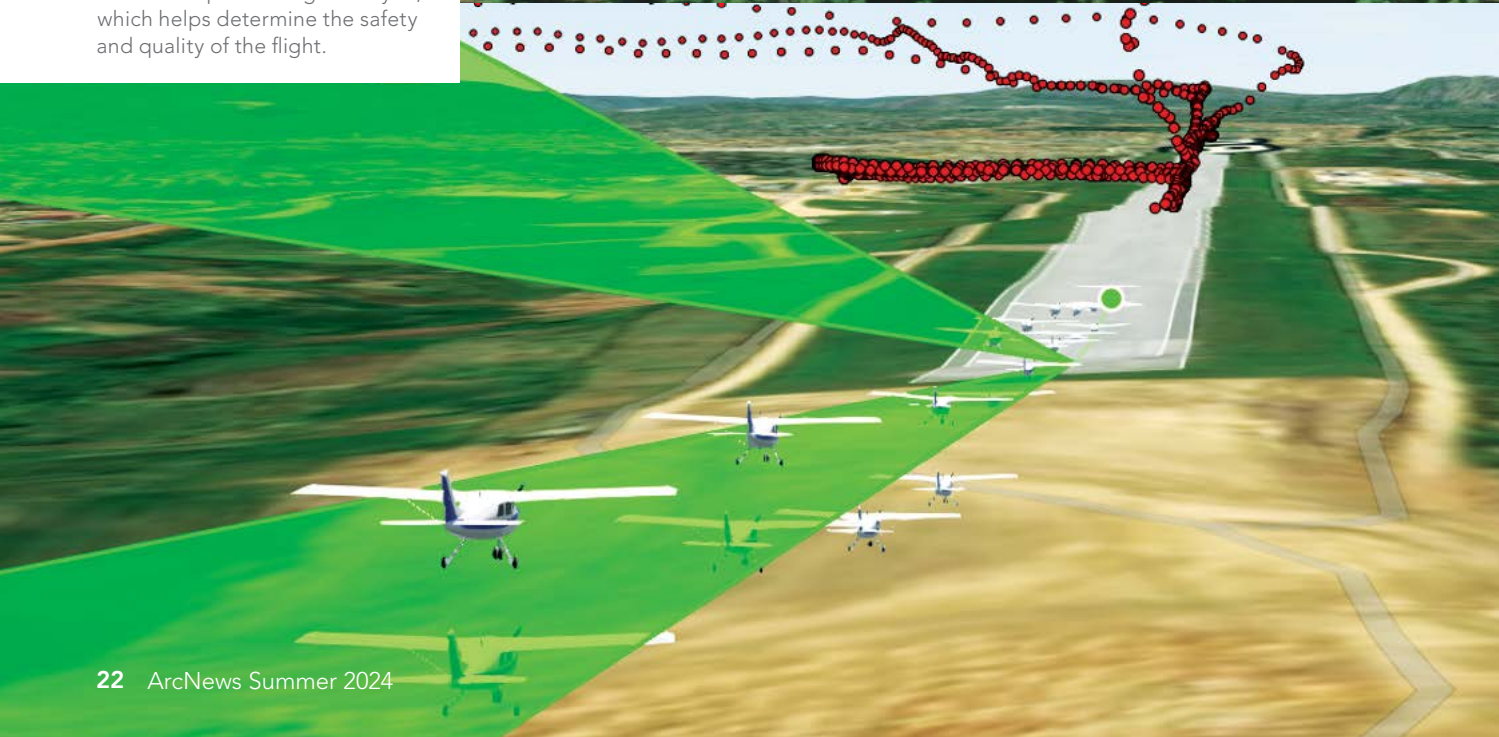
Before they used MAF Globe, pilots often relied on hand-drawn maps. To enable better and more accurate flight planning for future missions, MAF is using ArcGIS Pro and a configured ArcGIS Experience Builder app to digitize older maps to scale and incorporate important new features such as hillshades. This will furnish pilots with a more detailed and accurate representation of the terrain they will encounter, allowing them to be better prepared for their missions.



↑ Pilots use a standard airstrip map (left) of Nalca in Papua, Indonesia, along with the same airstrip depicted in 3D (right) to prepare for their flights.

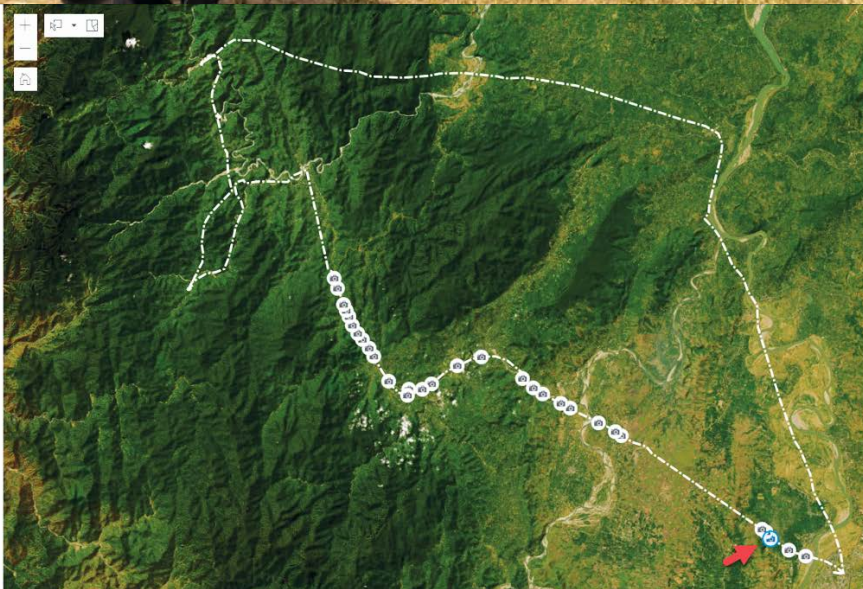
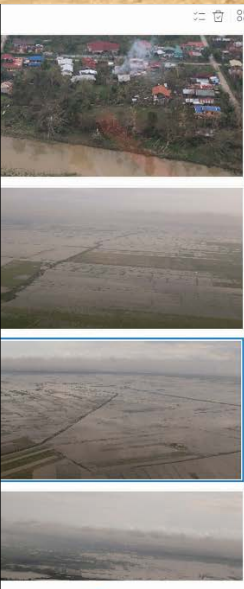


↑↓ GPS data from flight logs can be used to provide flight analysis, which helps determine the safety and quality of the flight.





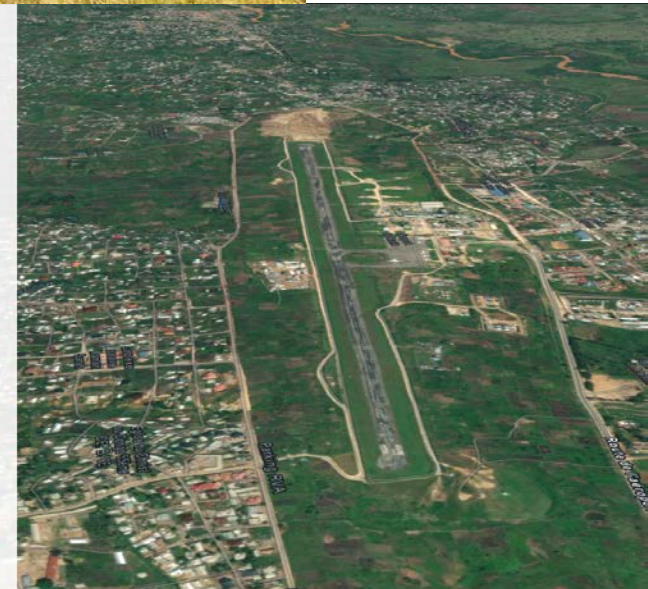
← Many of the airstrips that Mission Aviation Fellowship (MAF) pilots use are short; covered in dirt, grass, or water; and not serviced by air traffic control. (Photo courtesy of MAF.)



### Your Flight

Today you're in for a special treat. You'll be seeing parts of Africa that few people get to see

Your day starts in 3unia, Democratic Republic of the Congo (DRC), a rural city of one million people. After going through check-in at the airport, an MAF airstrip agent walks you to the airplane, a Cessna Caravan



↑ Disaster response team members can quickly populate a map with images taken from the sky and distribute the map to other responders as well as MAF partners.

↑ ArcGIS StoryMaps stories take viewers on a journey with MAF pilots.

## Using ArcGIS StoryMaps to Understand Disasters

With bases and airplanes around the world, MAF's pilots are often among the first to fly over affected areas after a disaster. They help assess the impact by capturing images of these areas from the sky.

Using ArcGIS StoryMaps, MAF now shares this imagery with other responders to help them understand the situation before they arrive on scene. With GIS, the MAF team has implemented an important new feature—the ability to quickly see before-and-after imagery of the area to better understand the infrastructure and terrain that existed prior to these catastrophic events.

In 2019, Mozambique had two major cyclones. Despite weather experts' having anticipated minimal damage, the reality was vastly different, as communities were severely affected by extensive flooding. The MAF team quickly prepared the organization's fleet of airplanes and positioned them to take flight once the storm had passed.

"During the flights, pilots discovered extensive flooding, and people were stranded, which meant critical needs were not being met," said

MAF director of communications Brad Hoaglund. "Knowing that our MAF GIS team can now take photos and populate those into a map helps our response efforts immensely. It's exciting to know that we can share this with our partners and donors to see how much of an impact we're making in these isolated areas."

MAF GIS analyst Cole McCall further explained, "Our goal is to create an online mapping tool that will allow responders to be able to get the photos with one to two clicks, helping them identify where the most damage is located. MAF partners with more than 400 organizations, and to get them information with ease would enhance our response efforts as a team."

## Visual Storytelling and Building a Digital Twin

GIS has made its way through various initiatives across MAF. One new project is having pilots share their stories with others to help keep them doing what they love most.

Planes and operations are not cheap, and as a nonprofit organization, MAF needs every pilot and mechanic to help fundraise to support field

operations. Using ArcGIS StoryMaps, pilots are sharing their passion with donors.

"[ArcGIS] StoryMaps [stories] are the best way to visually share information about the pilot [and] understand where their heart is and what their mission is," McCall said.

This effort evolved from sharing introductory information into providing a complete storytelling tool for mission efforts. ArcGIS StoryMaps stories now deliver a 3D visual experience of flights, displaying interesting features—such as wildlife reserves and even the dangers of local militia forces on the ground—to help convey the complexity of these missions.

MAF's latest GIS initiative is using a digital twin to enhance pilots' flight paths. To create the digital twin, the MAF team used GPS data from flight logs and imagery from drones and then processed everything with ArcGIS Drone2Map. All this helps pilots visualize the latitude, longitude, and elevation of their flights so that they can prepare for their missions—with a 3D view from takeoff to landing—and navigate properly.

"Once the data has been overlaid, we can see the approach just using two clicks to get the

data and two clicks to add the features to the map," McCall said.

## Uncovering the Potential of GIS

The MAF team accomplished all these projects in just one year.

"When I first came onboard at MAF," Roberts said, "I just did some sample visualizations. Those sample visualizations helped people understand GIS because they had not seen GIS used in this way [and didn't know] what GIS was."

With aviation being geographically focused, MAF's CEO recognizes the value of GIS not only for aviation operations but also for the rest of the organization, according to Roberts.

"We're just scratching the surface of how we can use GIS," he said. "Knowing we are making impacts at this scale makes me and us feel accomplished in our line of work. It's very impressive how this technology is being embraced by the organization."

Learn more about MAF's use of GIS at [maf.org/experienceGIS](http://maf.org/experienceGIS).

# How a Minneapolis Trailblazer Brought GIS to the Heart of Public Works

*From building the city's first sewer GIS database to inspiring interns, John Studtmann's two-decade GIS career in public service has made a lasting impact in Minneapolis.*

John Studtmann vividly remembers the first time he used ArcGIS technology.

"It felt like opening a whole new world with secret codes," explained Studtmann. "I could see that it was extremely powerful, and I was hooked."

At the time, he was a GIS technician learning ARC/INFO while working for an environmental consulting company that was contracted to digitize paper maps. He then moved to an orthophotogrammetric company that provided mapping and survey solutions along with contracting National Hydrography Dataset (NHD) work.

Now, Studtmann is the force behind groundbreaking geographic initiatives for the City of Minneapolis, Minnesota. These include the first comprehensive database to track surface and sewer water infrastructure and a dedicated GIS internship program for the city's Surface Water & Sewers Division of Public Works. Studtmann has also contributed to Minnesota's first and second stormwater data model standards.

## A Conservationist Who Loves Maps and Helping Others

Geography has captivated Studtmann since he was a child growing up in Minnesota.

"My dad had explained to me early on how maps represented real-world features, and by the time I was eight, he had me navigating our road trips," he recalled.

When Studtmann wasn't detouring his parents on these family road trips to the occasional amusement park or landmark he wanted to see, he was admiring the unique landscapes of the western states that his family visited while scrutinizing the cartography of the *Rand McNally Road Atlas*.

"At the time, I had no idea I was learning about geography," he said.

Later, Studtmann considered a career in the US Department of State and obtained an

undergraduate degree in political science at the University of Minnesota, with minors in history, international relations, and geography.

After working as a legislative assistant in the Minnesota State Senate for a session, however, he felt the pull of geography again. He eventually obtained a GIS certificate from the University of California, Riverside.

"I initially studied geography as a backup. Who does that?" Studtmann joked. "But I was fascinated by the endless opportunities to use GIS technology to analyze almost anything in our world."

Studtmann particularly enjoys finding the right GIS tool for the right project and, as he described it, "finding solutions where nobody can figure it out."

## Using GIS to Serve the Public During Emergencies

When a gas leak was discovered at the University of Minnesota in 2022, Studtmann worked alongside first responders out of the command center run by the City of Minneapolis to identify the leak's location.

"I was fortunate enough to work with a great team that asked good questions and listened to my input about what the data was telling me," he said.

Their collaborative efforts included researching the locations of nearby fuel sources and cross-referencing that information with infrastructure flow. This resulted in the emergency team redirecting its efforts and finding the possible cause more quickly.

"The most rewarding aspects of my career have been when I've been able to flex my creativity to solve a problem that serves the greater good," Studtmann said.

## A Dedicated Career to Public Service

For more than 18 years, Studtmann has served as an engineering and application analyst for the Minneapolis Public Works Department, working as a database manager, IT liaison, and GIS explorer. In this position, Studtmann has overseen innovative projects that have benefited his department and city residents, including training fellow staff members in GIS, integrating city systems with closed-circuit television inspection software, and linking GIS to the city's asset management system.

Studtmann is particularly proud of building the city's first GIS database for public works, surface water, and sewers. This database, which took Studtmann five years to build, tracks sanitary and stormwater infrastructure. It provides vital information for engineers to manage systems and facilities that are designed to perform various tasks, such as discovering inflow and infiltration and managing rainwater runoff. All of these functions are essential for maintaining healthy and safe living conditions and have been a driving force in Studtmann's daily work.

"It's not often you get to create your own database from scratch for critical use," said Studtmann. "It was exciting and impactful to lay the groundwork for data that would be used well into the future."

Studtmann also collaborated with staff at the Minnesota Department of Natural Resources to integrate their data with the NHD data model—making the data usable not only by Minneapolis but also by federal employees, academics, and residents wanting to study the city's stormwater flow.

"That's something I'm always looking for: How can I make the data more valuable to everybody?" he said.

## Empowering the Next Generation of GIS Experts

Today, Studtmann is instilling that drive in the next generation of GIS professionals. To provide students with hands-on experience, he started a GIS internship program for the Surface Water & Sewers Division in 2017.

"I look at the internship as an extension of their classroom," he said. "I'm there to provide them a view into real-world GIS work and help them learn."

He believes internships should help students understand the nuances of their chosen career and determine if they are pursuing the right path.

Studtmann involved his interns in developing the 811 Gopher State One Call ticket app, for example. This online platform allows the public to alert underground system operators, such as utility companies, about excavation projects. As a result, utility lines are accurately marked to avoid interference during excavation.

Through the interns' development, the ticket system now follows an automatic process to generate maps and polygons of designated areas. These

are shared with requesters via email and stored in Microsoft SharePoint. Minneapolis's mayor recognized the system at a 2023 awards presentation.

Studtmann has mentored five interns since the program launched. With his assistance, four have found GIS roles after graduating.

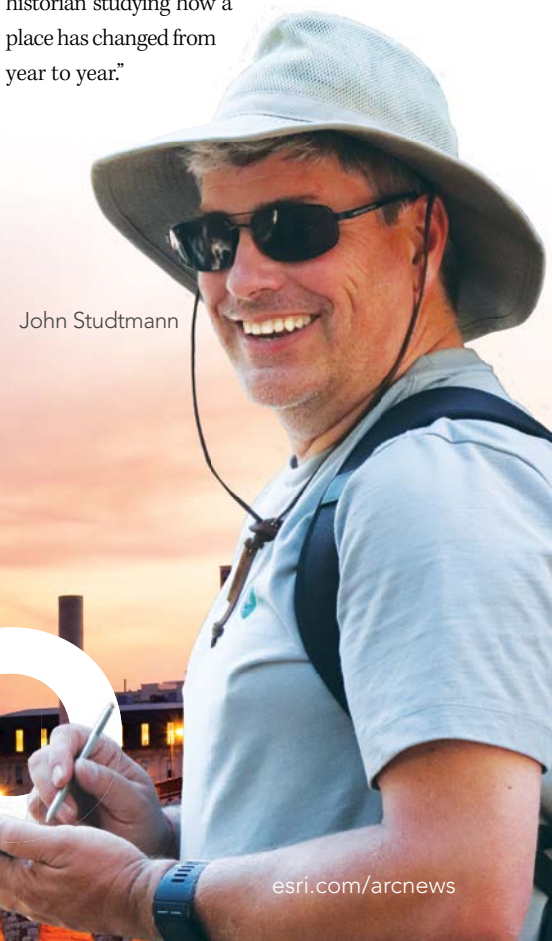
"My most important achievement in GIS is the legacy of interns I have turned out into our GIS professional community. That group of highly talented individuals will make an important difference in our world," Studtmann said. "It's been rewarding to challenge and develop interns and the future of GIS."

If there's anything that Studtmann hopes others in the GIS community can learn from his story, it is the importance of guiding interns and not simply giving them the work that no one else wants to do. Sure, they need to learn monotonous and time-consuming tasks, too, such as digitizing. "But they also need the chance to develop skills that will make them desirable to future employers," he said. "That means project work and programming."

## Keeping an Eye on the Future

When he retires, Studtmann hopes to create a group of volunteer retired GIS professionals who, as they travel across the United States, put their skills together to build a comprehensive collection of mapping data that they are passionate about.

"Every GIS professional has visited somewhere where they were sad to see a lack of GIS available to them for use, only to realize they cannot afford to collect the data because they don't have the time or resources," Studtmann explained. "How great would it be to pull up hiking trail data where scenic views, waterfalls, and other significant natural sites are located with a terrain profile? I think trail maps with collection points linked to web pages of photos or a trail website might be useful not only to the explorer but also to the homebound and the historian studying how a place has changed from year to year."



John Studtmann

# GIS Hero





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 Made in Canada

# ArcGIS Earth Assists in Monitoring 1,700 Miles of Pipelines in Texas

Operating out of western Texas, Kinetik provides a range of services to help bring natural gas, natural gas liquids, and crude oil to market—including constructing, maintaining, and repairing high-pressure steel pipelines. With more than 1,700 miles (2,735 kilometers) of pipe in the ground across five counties, Kinetik requires meticulous site planning to execute its operations.

Until about two years ago, Kinetik's project teams shared pipeline information using a system that lacked the detail and automation needed to properly access, manage, and collaborate around a single authoritative pipeline dataset in real time. To address this need, the company used ArcGIS Earth to create a streamlined method for engineers to upload, edit, synchronize, and share files containing pipeline information. Users can now sketch, annotate, and measure pipelines in ArcGIS Earth and share the results, making projects more collaborative and efficient.

## Solving Version Control Issues

Kinetik project engineers and construction teams formerly relied on KMZ files to communicate and collaborate during pipeline projects. While this format is often used in pipeline design and construction, the sketches and file information are static, requiring manual

updates to ensure consistency. This created the potential for information to become outdated. Kinetik needed a workflow that ensured that new or modified sketches, done by individual on-site teams, were unified into a single, authoritative dataset.

After coming to the company in 2021, Kinetik GIS manager Papillon Romero recognized that a large amount of time was being spent importing KMZ files, sorting through all the variations, and combining them into an updated dataset. Once the data had been consolidated, it then had to be exported via a new KMZ file to share with the project teams and others who needed the information.

"We were receiving a lot of direct requests for KMZs within the company, and those files are static as soon as we hand them out," Romero explained. "That means that there's no update to that file—it's not connected to our data model. The risk with the KMZs is that somebody can have an old version with incorrect information and act on it."

The time-consuming process of checking and updating information, compounded over many projects, would have left little time for Romero to review, update, and manage the company's datasets. Kinetik needed a new way to share reliable information across the pipeline engineering workflow.

## Discovering the Benefits of ArcGIS Earth

With assistance from Camron Hull of Full Circle GIS Consulting, Romero looked into implementing ArcGIS Earth, an interactive 3D tool for planning, visualizing, and evaluating events. Romero found a few Kinetik engineering volunteers who were willing to try ArcGIS Earth for a few weeks. Based on their feedback, the benefits were clear: the app provided company-wide access to current, correct data and had a short training and adoption time.

Because ArcGIS Earth uses formats and processes—such as uploading and sharing information from KMZ files—that are similar to those that were already in place at Kinetik, teams were able to start working with the software almost immediately.

"I thought it would be a good fit [for staff members] because it can load KMZs just like they did with our previous software," Romero explained. "ArcGIS Earth connects directly to Portal for ArcGIS, so our teams would always be able to access what we've published as our current data, and we would know that the information was good."

## An Accelerated, Modernized Workflow

Kinetik staff began using ArcGIS Earth as part of their pipeline workflow in 2022. Romero now hosts an authoritative pipeline dataset on Portal for ArcGIS, an ArcGIS Enterprise component

that allows the sharing of maps, scenes, apps, and other geographic information. Project engineers and construction teams can create sketches or recommend data edits by sharing a KMZ file directly, and the latest information is shared with all project members.

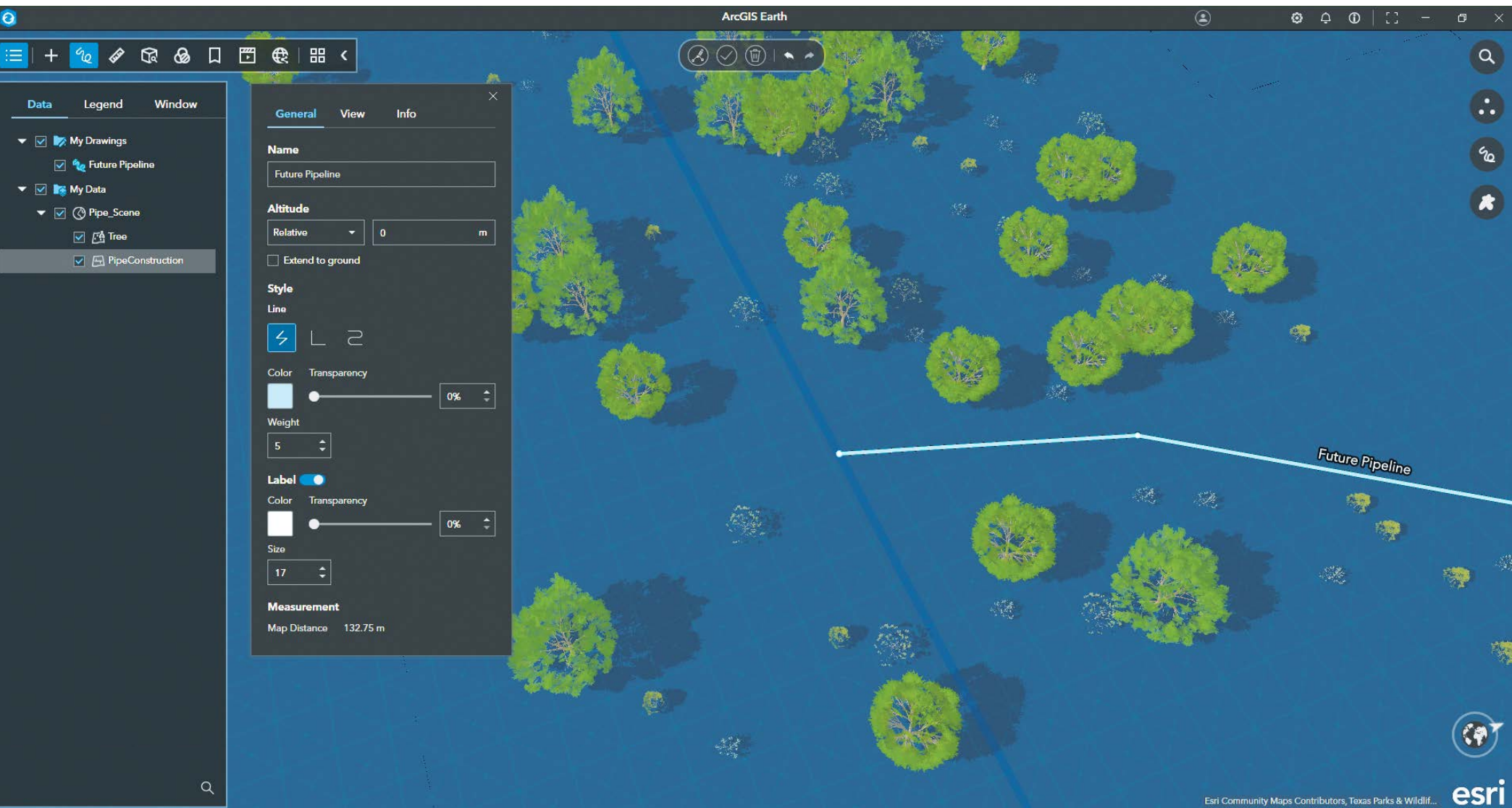
"Our engineering workflow is moving more quickly because we know that users are connecting directly to live, published data," Romero said. "It's the latest and greatest of what we have in the GIS."

ArcGIS Earth also provides Kinetik with a pathway to modernize its workflow even further by using the feature service editing capability added in last year's 2.0 release. Users can edit feature services directly in ArcGIS Earth and customize attributes and geometry to suit their project needs.

Kinetik employees are already seeing results from using ArcGIS Earth—particularly in improved project timelines and costs.

"ArcGIS Earth has made collaborating easier for our project teams," said Romero. "It has empowered them with an easy way to access the data readily in a format that they're used to."

Engineers have been quick to embrace the switch, and teams are finding that they can share project data quickly. The GIS team can help ensure that reliable company data is easily discoverable, understandable, and valuable to the people who need to use it.



↑ Kinetik used ArcGIS Earth to model a proposed pipeline extension.

# Using Field Data with GIS to Protect and Restore Rare Inland Saline Wetlands

By Gordon Coke and Justin Cermak, The Flatwater Group

More than 100 million years ago, North America consisted of two landmasses separated by a giant inland sea—the Western Interior Seaway, which connected the Arctic Ocean to the Gulf of Mexico. Today, along with a plethora of marine fossils strewn across the Great Plains, vestiges of this ancient sea include a handful of inland saline wetland areas, with groundwater pickled by underground salt deposits from evaporated seawater.

Wetlands are important for wildlife habitat, water quality, flood protection, erosion control, recreation, and aesthetic value. Inland saline watersheds have additional conservation concerns due to their environmentally unique ecosystems and the many endangered species that rely on them.

Some of these inland saline wetlands lie in eastern Nebraska's Little Salt Creek watershed near the state's capital city of Lincoln, about 1,000 miles (1,609 kilometers) from the nearest ocean. They are home to many unique or endangered plant and insect species, such as the federally protected Salt Creek tiger beetle. The wetlands cover only about 4,000 acres (approximately 16 square kilometers)—down from about 20,000 acres (about 81 square kilometers) prior to European settlement—and much of the habitat has been degraded or lost due to factors such as urban development, levee construction, and stream-channel straightening.

Many of this area's current, former, and potential saline wetland areas are now being protected and restored with help from ArcGIS technology. By applying ArcGIS Pro, the Arc Hydro Wetland

Identification Model (WIM), and several ArcGIS apps, water resources engineering consulting firm The Flatwater Group (TFG)—together with wetland managers from the Saline Wetlands Conservation Partnership—developed 120 ecosystem restoration project plans for this area, known as Nebraska's eastern saline wetlands.

**ArcGIS StoryMaps Story Helps Launch a Watershed Plan**  
Formed in 2003, the Saline Wetlands Conservation Partnership includes the City of Lincoln, the Lower Platte South Natural Resources District, the Nebraska Game and Parks Commission, and Pheasants Forever. With funding from the Natural Resources Conservation Service's Watershed and Flood Prevention Operations program, TFG and the partnership developed an environmental assessment as well as restoration project plans that will address erosion, control sediment, stabilize streams, and more.

To raise awareness and educate the public about Nebraska's eastern saline wetlands, their financial value, and their importance to local ecosystems, the partnership held a virtual public meeting in 2021 that featured an ArcGIS StoryMaps story—available at [links.esri.com/LittleSaltCreek](https://links.esri.com/LittleSaltCreek)—and an interactive app made with ArcGIS Web AppBuilder. The meeting's presentation outlined the planned conservation approach and the need for ecosystem restoration and protection in Nebraska's Little Salt Creek watershed. The story and the app also facilitated required functions for the project, such as soliciting public comments.

## From Data Inputs to Spatial Analysis

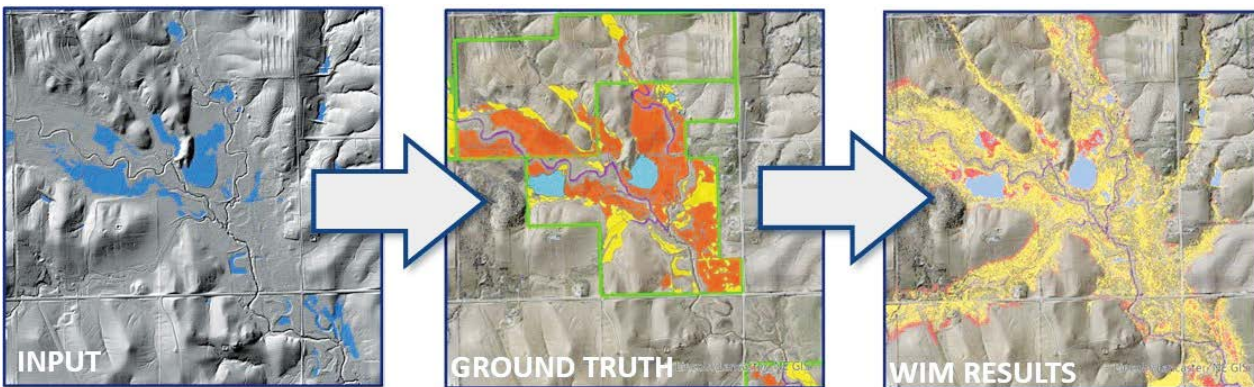
The partnership and TFG evaluated the Little Salt Creek watershed's saline wetlands and habitats using ArcGIS Pro, Arc Hydro WIM, and GIS datasets. They considered vegetation, soil, and hydrology—the three factors that can determine whether an area is a wetland or has the potential to become one.

For vegetation, TFG engineers and scientists enhanced data from the US Geological Survey's 2011 National Land Cover Database with saline wetland categorization maps. For soils, they referred to the Natural Resources Conservation Service's Soil Survey Geographic Database. For hydrology, they used the Arc Hydro WIM, which predicts wetland locations using lidar elevation data and machine learning, along with a surface water raster to develop a depth-to-water index and predict specific areas' suitability for restoration or other actions.

When combined using a raster matrix, the vegetation, soils, and hydrology data helped generate saline wetlands restoration suitability rankings. This included a map that facilitated a first-of-its-kind functional assessment for saline wetlands—something that's needed to do a federally required economic cost-benefit analysis.

As these restoration projects proceed, planned operations and maintenance phases will employ the same ArcGIS tools to assess the projects' benefits. Drone photography, multispectral imagery, and lidar data will be used alongside ArcGIS software to enhance monitoring and track site changes, such as the boundaries of groups of native and invasive vegetation. After implementation, the projects will provide the next chapter in the protection and restoration of Nebraska's eastern saline wetlands.

↓ Salt flats hint at ancient maritime history at the Arbor Lake Complex saline wetland area near Lincoln, Nebraska.



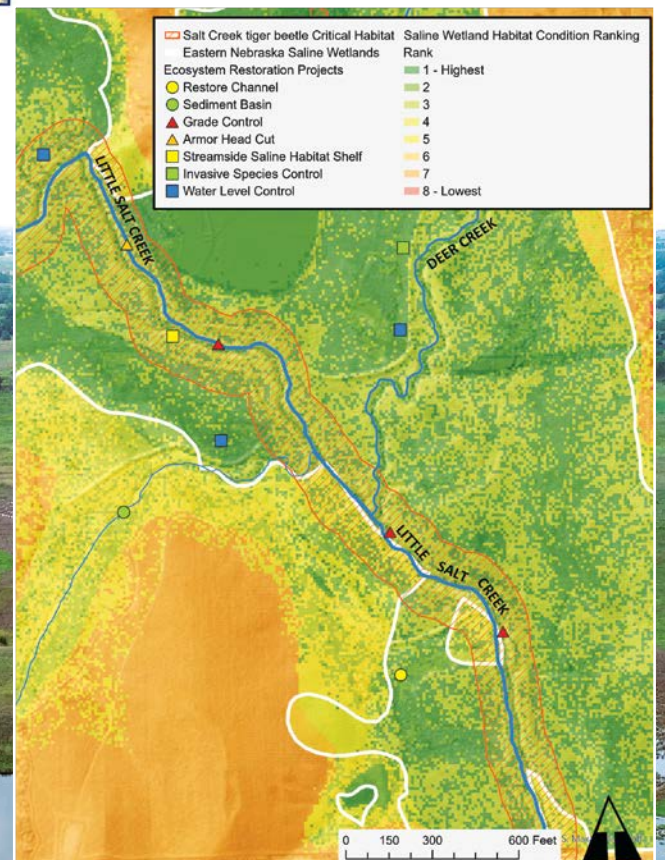
### Wetland Identification Model (WIM) - Analysis Procedure: Data Inputs > Ground Truth Training / Testing > WIM Results

Inputs	Ground Truth & WIM Results
Surface Water, 2016 Aerial Imagery	Freshwater
2016 LIDAR Topography Data	Impounded
	Riverine
	Saline

## About the Authors

Gordon Coke is an environmental planner at TFG. Justin Cermak, PE, is a water resources engineer at TFG.

↓ A saline wetland suitability map provides qualitative and quantitative assessments for ecosystem restoration projects in Nebraska's Little Salt Creek watershed.



Located in eastern Nebraska, Little Salt Fork Marsh Preserve includes open prairie and saline and freshwater wetlands.

## Spatial Foundations

By Dr. Amy Frazier and Dr. Trisalyn Nelson,  
Professors, University of California, Santa Barbara



# GIS in an Age of Scientific and Societal Disruptions

GIS and geographic information science (GIScience), the science that underpins GIS technology, are fundamental to how practitioners and researchers work to advance collective knowledge and solve pressing, real-world problems.

Spatial data and the technologies that support its collection, management, analysis, and visualization have become integrated into daily life, with billions of people using interactive digital maps every day. Smartphones have become modern geographic data loggers, and now anyone with access to the internet can use AI.

These technological advances have had innumerable benefits for humans, but they are also driving major disruptions. Given how crucial spatial data is to modern technology and scientific research, spatial data scientists and GIS practitioners need to be at the forefront of developing solutions to ensure that this field is open, collaborative, and inclusive and keeps up with the latest breakthroughs in technology.

### Technological Advances Present Opportunities and Challenges

New technologies are changing how scientists approach problems. Data-intensive scientific discovery has shifted not only the practice of science but also the set of scientific products that researchers prioritize and pursue.

For example, the expanding cyberinfrastructure ecosystem and algorithmic advances in AI have created new modes of discovery that challenge long-standing practices and open the possibility of widespread social reorganization. At the same time, climate change and other societal disruptions continue to alter physical and human geography, shifting the theoretical and empirical rocks on which many scientific disciplines stand.

These disruptions show no signs of slowing anytime soon. Predictive AI, generative AI, and causal AI have reached different levels of

maturity, but each needs further development, particularly with respect to spatial data. New forms of spatial data continue to become available in a variety of contexts, resolutions, and veracity, while private industry remains the leading authority to control access. The effects of climate change and communication platforms are apparent, but attribution science and social media research continue to change as the impacts of both phenomena evolve. While these disruptions may serve as a catalyst for innovation and make it possible for humans to tackle the tremendous global challenges at hand, they simultaneously raise ethical questions about science and practice and bring into focus structural barriers to equity and participation in research and education.

### How GIScience Can Help Overcome Grand Challenges

It was under this framing that the Center for Spatial Studies at the University of California, Santa Barbara (UCSB), held a specialist meeting in December 2023 on spatial data science in an age of scientific disruptions.

Twenty-five GIScientists from around the world came together to discuss priorities for teaching and research in a time of disruption. Over the next year, papers and conference sessions will broaden participation in the conversation that started at the specialist meeting.

Themes emerged around the need for spatial data scientists to lead open, collaborative, and convergent science; foster inclusion and diverse partnerships; engage more directly in data creation processes; and develop safe and secure infrastructure for accessing private or

↙ Codesign expert Dr. Elizabeth Sanders (center) leads an activity to gather input from many stakeholders across a variety of government sectors that are participating in Colombia's collaborative land-use project.

sensitive data. Participants also noted a resounding need to integrate generative AI and large language models such as ChatGPT into GIS technology and GIScience research and training.

A particularly exciting theme that emerged from the workshop was the idea that GIScience and the geographic approach need to be amplified to overcome these grand challenges. This can be done via collaborative science and community-embedded work.

### Working Together to Expand Knowledge

The goal of collaborative science is to cocreate or codesign knowledge in a manner that informs management and decision-makers by involving scientists,

practitioners, policymakers, communities, and others to advance understanding in a way that each group could not achieve by working alone.

Codesigning project aims, methods, products, and outcomes first requires a link where participants from varied backgrounds, industries, disciplines, or training can find common ground. Maps often serve as the link that can draw many voices to the table.

Participatory GIS—which brings the practices of GIS and mapping to the local level to promote knowledge production by local and nongovernmental groups—is naturally inclusive and well-suited for codesign. It can, therefore, play a fundamental role in collaborative science that addresses key challenges such as housing, conservation, and sustainability.

GIS practitioners and GIScientists are naturally positioned to lead and contribute to these collaborative efforts through the geographic approach by facilitating codesign through participatory GIS. Dr. Amy Frazier's team, for example, is working with partners at the Alexander von Humboldt Biological Resources Research Institute in Colombia—an independent entity of the Colombian government that conducts scientific research on biodiversity—to codesign maps and scenarios of future land-use needs. By including many different voices, actors, and agencies throughout Colombia in the mapping process, the team aims to build collaborative land-use scenarios that balance future needs for increased food production and clean energy expansion with the preservation of key plant and animal species.

### Integrating Science with Decision-Making

Community-embedded research connects science to practice, and GIScientists—who are often trained in geography—are uniquely positioned to be the connective tissue that integrates science and decision-making.

### About the Authors

Dr. Amy Frazier is a professor and holder of the Jack and Laura Dangermond Endowed Chair of Conservation Science at UCSB. Frazier and her team use a variety of GIS-based technologies and methods—including drones, remote sensing, machine learning, and statistics—to harness massive amounts of biological and environmental data and develop tools that integrate conservation knowledge into policymaking pipelines. Dr. Trisalyn Nelson is a professor and holder of the Jack and Laura Dangermond Chair of Geography at UCSB. She studies a variety of phenomena, from spatial ecology to cities, and led the creation of BikeMaps.org. Nelson has developed new ways of using fitness app data to map bicycling traffic volume and employs big data to quantify and monitor patterns of urban cycling safety and ridership.



↑ BikeMaps.org is advertised on popular social media sites to help gather new crowdsourced data.

An example is the participatory GIS initiative BikeMaps.org, which maps bicycle collisions, near misses, and hazards around the world. Founded by Dr. Trisalyn Nelson, the BikeMaps.org platform not only offers a user-friendly map but also pairs GIS technology with outreach and engagement resources that support city-level decision-making.

For more than a decade, Nelson's team has been using BikeMaps.org to assist transportation planners in deciding where, when, and how to invest in infrastructure that makes bicycling safer and more accessible for all people. The team is using the BikeMaps.org mapping platform as a tool for community engagement and, through the map, is generating important conversations among community members, decision-makers, industry leaders, advocates, and policymakers.

Given that GIS professionals are often invited to provide information for decision-making, BikeMaps.org is a good example of how GIS and mapping can be used to convene conversations, generate knowledge, and build consensus around public policy.

### How to Amplify the Impact of Your Work

GIS professionals all leverage maps to better understand the world around them. So think about who is being included and supported in these efforts.

Who is involved and who is excluded in the creation of GIS questions and answers? And how can you pair your GIS work with codesign and community engagement to amplify the impact of your work?

There has never been a more exciting time to be a GIScientist. It will be exciting to see where all this leads!

For more information, reach out to Frazier at [afrazier@ucsb.edu](mailto:afrazier@ucsb.edu) or Nelson at [trisalyn@ucsb.edu](mailto:trisalyn@ucsb.edu).



## From the Meridian

By Dr. Emily Skop

Professor of Geography, University of Colorado Colorado Springs



# Research Needs a Realignment of Care

Centers of learning and research are dynamic, inventive, and complex places. They are also too often places of exclusion, isolation, and stress. This is caused by hyperindividualism; competition; pressure to “publish or perish;” and institutionalized power dynamics that create disproportionate barriers for people who identify as women, BIPOC (Black, Indigenous, or other people of color), LGBT2QIA+, and disabled—and many whose identities cross these and other categories, compounding the impacts. This is true at the campus level and across the research landscape, especially at underresourced minority-serving and emerging research institutions.

Those of us who are academic researchers, students, or faculty know that a life of teaching, mentoring, and research can be intrinsically rewarding and highly impactful. Alone and together, we navigate the systems that create barriers to our ability to thrive.

So how can we ensure that these systems not only reward research and ideas but also support and regard all people as they are? How can we be part of a research enterprise that not only brings together people who represent many backgrounds but also fosters and sustains equity among us, recognizing all perspectives and supporting people’s full lives?

### Addressing the Long-Standing Inequities of Research

Three years ago, as a professor of geography at the University of Colorado Colorado Springs (UCCS), I was collaborating on research projects, teaching classes, and chairing my department. The world was in the thick of a pandemic and undergoing massive social change, and I was simultaneously managing pressing family needs and several stunning personal losses.

The dissonance grew between the demands that I and others were facing at work and the profound personal and societal experiences we were having. This is when I knew that something was not right about what was happening in academia.

I felt compelled to sit down and write out what became a sort of manifesto for a care ethos in research. The Ethos of Care hinges on feminist ideas—especially those from Black feminists—as well as antiracist, queer, and anti-ableist work, to imagine more ethical ways of being in the academy.

I shared my thoughts with inspirational colleagues and then coauthored an article with them on this idea for *Inside Higher Ed* ([links.esri.com/higher-ed](https://links.esri.com/higher-ed)). We devised a 10-point pledge to support care, authenticity, and collectivism in research. It has resonated widely and led to the creation of a gathering called Convening of Care ([links.esri.com/convening-care](https://links.esri.com/convening-care)), planned for September 2024. About 30 researchers and academics will come together to examine the pledge and begin to find ways to enact it as individuals and at the systemic level.

Funded by the National Science Foundation and jointly sponsored by the American Association of Geographers (AAG), the National Organization of Research Development Professionals (NORDP), and UCCS, the convening will call on participants to pause and think about other ways of being and doing in their work. Participants will also examine what care looks like when engaging in knowledge production, as well as how to build more supportive academic and research environments. This may include formulating less-hierarchical approaches to mentoring, making laboratory culture more inclusive, and encouraging a move away from grind culture—as described in *Rest Is Resistance: A Manifesto* by Tricia Hersey—to contest deeply ingrained systems of power.

Participants will also focus on systemic reform efforts, such as how to change policies and structures in ways that transform research landscapes. The goal is to identify and catalyze scalable practices in many institutional and organizational contexts.

This material is based upon work supported by the National Science Foundation under Award No. 2324401 and Award No. 2324402. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author and do not necessarily reflect the views of the National Science Foundation.

### Change at Multiple Levels

The kind of change that my colleagues and I envision is individual, institutional, and systematic because change is intertwined at all these scales. Reorienting academia toward justice and compassion requires recognizing that academic systems are made up of systems and structures as well as hearts and minds.

The Ethos of Care pledge is an opportunity for individuals and institutions to think about new norms and strategies for how they do their work. This pledge is a living document—a starting point from which to consider ways to collaborate and something to check back in on over time. It can also serve as a prompt for navigating difficult conversations around the inherent imbalances of power at institutions—conversations that get approached with care, acknowledging the vulnerability of various collaborators and the potential consequences for everyone involved.

### The Ethos of Care Pledge

In our work together, we promise to

- Center our academic pursuits around a feminist ethic of knowledge production—one that recognizes the long-standing inequities and injustices of academe.
- Embrace an explicitly antiracist, feminist approach that highlights the compounded academic pressures and hypervisibility/invisibility of BIPOC scholars.
- Develop, promote, and reward strategies to do academic work that centers social justice imperatives.
- Make space to hear and learn from uncomfortable, innovative, and transgressive ideas.
- Create transparency and fairness by setting, communicating, and respecting clear boundaries. Take time each year to reflect and revise these boundaries in recognition that over the course of our personal and professional lives, those boundaries adapt and change.
- Protect our mental, emotional, and physical well-being and growth in the research process by supporting each other’s professional and personal aspirations.
- Share and rotate the labor of intellectually joyful and tedious tasks.
- Mentor up, down, and across professional and personal life-course stages to unsettle hierarchical relationships and promote an ethos of care.
- Disrupt perfection. Share insight and experiences in overcoming challenges, failures, and rejections, as well as motivations, successes, and ambitions.
- Humanize our work by valuing the intellectual and ethical centrality of friendship, connection, and responsibility.

Taking these principles to heart means disrupting what researchers and academics think is inevitable about their work and their institutions. In her provocative book *The Promise of Happiness*, Dr. Sara Ahmed asserts that those who work in academia can challenge the accepted definitions of academic happiness. Ranking, productivity, and influence can be supplanted by a more caring vision of equity, justice, and reparation to cocreate transformative, radical futures.

Given the outsize underrepresentation of women and minority-identified scholars, this willingness to unsettle destructive expectations is more important than ever.

### Committing to Care in Geography and Beyond

This collaboration between AAG, NORDP, and UCCS elevates the expectation that institutes commit to an ethos of care—in geography and beyond.

Our aim is to redefine what it means to partner on research, not just in terms of work productivity but also in feeling supported and held by one another. As we endeavor to create diverse, inclusive, and innovative knowledge centers that respond to the world’s most urgent challenges, we also need to learn to care for one another, and care well.

To express thoughts, ideas, and questions about the Ethos of Care pledge, email Dr. Emily Skop at [eskop@uccs.edu](mailto:eskop@uccs.edu).

From the Meridian is a regular column from AAG, a nonprofit scientific and educational society whose members, from nearly 100 countries, share interests in the theory, methods, and practice of geography. Find out about AAG’s programs and membership at [aag.org](https://aag.org).

### About the Author

Dr. Emily Skop is a professor in the department of geography at UCCS. She has built a significant research record focused on refugee resettlement and broadening participation in higher education. Her work weaves together definitions of refuge and care through cocreation and the Ethos of Care pledge. Skop is grateful to her many collaborators for their support in developing the ideas in this column.



## Scientific Currents

By Dr. Dawn Wright  
Chief Scientist, Esri



# Don't Miss This Year's Science Summit

The Science Summit, formerly the Science Symposium, at the Esri User Conference (Esri UC) brings together Esri UC attendees who are interested in learning about science, how science informs the pressing issues of the day—such as the climate, conservation, and sustainability—and how science intersects with the evolution of geospatial technology. It is one of several summits occurring during the week at the Esri UC that aim to deepen attendees' understanding of specific topics and sectors.

This year's Science Summit will celebrate a truly remarkable scientist, Dr. Rae Wynn-Grant, by featuring her as the keynote speaker. If you have never attended this event before, I truly hope that you will be able to this year to hear about Wynn-Grant's inspiring journey as a GIS-wielding wildlife ecologist. She currently has her dream job as the cohost of *Mutual of Omaha's Wild Kingdom Protecting the Wild* on NBC. Wynn-Grant is, in fact, the first Black woman to host a nature show on broadcast television.

Those who have attended Esri UC in the past might remember Wynn-Grant as the cohost, along with Esri chief customer officer Nick Frunzi, of UC Central Live during the pandemic years of 2020 and 2021. Some of these segments, still available online at [links.esri.com/uc-central-live21](https://links.esri.com/uc-central-live21), include intimate conversations between me and Wynn-Grant about global environmental challenges on land and sea, the meaning of "inclusive conservation," and the rigors of scientific fieldwork—including her experience as the

first research fellow of The Nature Conservancy's Point Conception Institute, in association with the Jack and Laura Dangermond Preserve. UC Central Live, along with her science communication work as a National Geographic Explorer, showcased Wynn-Grant's stage presence and her talent for conducting interviews and facilitating discussions on camera. It was inevitable that someday she'd host her own TV show.

Wynn-Grant's path in this regard is quite inspiring. Growing up in San Francisco, California, Wynn-Grant's only exposure to the wilderness was through nature documentaries. As a child, she wanted to someday host a nature show of her own, but she had no clear road map for how to achieve that. Wynn-Grant didn't really have her first experience in the great outdoors until she was in her early twenties. Her journey toward eventually becoming the cohost of the reboot of *Mutual of Omaha's Wild Kingdom*, which was first broadcast on NBC in 1963, is a study in both perseverance and pivoting.

Wynn-Grant studied environmental science in college by first obtaining a bachelor of science in environmental studies from Emory University and then getting a master of science in environmental studies from Yale University. She then obtained her PhD in ecology and evolution from Columbia University. In an interview with writer and editor Sarah Khan for *Condé Nast Traveler* earlier this year, Wynn-Grant said she realized in college that "TV show or no TV show, I can have a career helping to design the science that saves endangered species from extinction and takes me around the world and offers me adventures—and I can be a smarty-pants scientist."

Her research as a large-carnivore ecologist—a scientist who studies meat-eating animals—has taken her all over the world,

often as one of the first African American women to ever do these kinds of studies. And she and her colleagues conduct them with excellence and rigor in scientific practice. In the GIS community, Wynn-Grant has gained notoriety for using GIS to study black bear habitats in the western Great Basin of the United States and, with the aid of GPS collars, monitor the bears' movements and behaviors around human areas. She does this all with an eye toward reducing conflict between humans and bears.

Wynn-Grant chronicles her experiences up to this point in her amazing career in her recently released memoir, *Wild Life: Finding My Purpose in an Untamed World*. Incredibly, it was when she was writing the book—in which she describes, in the very first chapter, her childhood dream of hosting *Mutual of Omaha's Wild Kingdom*—that she was asked by NBC to be one of the hosts of the modern adaptation of the series. Wynn-Grant has said in many interviews that she hopes readers will take away from the book the unique and beautiful intersections between nature and humanity and how humans' protection of wild spaces is intimately tied to who we are and what we hope to become.

At the Science Summit, Wynn-Grant will take the audience on a remarkable journey through all of the above and more during her keynote presentation.

Interestingly, I am coming out with a memoir of my own this year as well. *Mapping the Deep: Innovation, Exploration, and the Dive of a Lifetime* is about my record-setting dive to the deepest point on Earth and the critical importance of mapping all aspects of the ocean, at all depths. (See page 37 for more details.)

Both Wynn-Grant and I will be signing copies of our books during the Science Summit's networking social. Secure your spot at this special gathering by adding the event—taking place Tuesday, July 16, 4:00 p.m.–6:30 p.m., in Ballroom 20D at the San Diego Convention Center—to your Esri UC calendar after registering for the conference.

Please don't miss out on this unique opportunity. I hope to see you there!

### About the Author

As chief scientist of Esri, Dr. Dawn Wright aids in strengthening the scientific foundation for Esri software and services while also representing Esri to the scientific community. A specialist in marine geology, she is an elected member of both the National Academy of Sciences and the National Academy of Engineering. Wright has authored and contributed to some of the most definitive literature on marine GIS.



↑ Dr. Rae Wynn-Grant (top left) cohosted UC Central Live with Nick Frunzi (top right) in 2020.



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# Esri Commends Partners for Outstanding Achievements in GIS

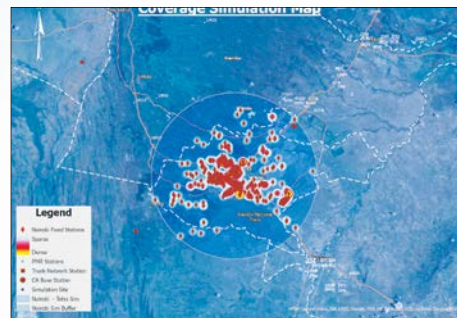


At the 2024 Esri Partner Conference, held in March in Palm Springs, California, Esri recognized 14 partners for their work in helping customers use and make the most of ArcGIS technology. Read on to discover what these noteworthy Esri partners do and how they help a variety of organizations complete projects and reach their business goals.

## Leveraging ArcGIS for New Markets and New Customers

### Aegir Consult | [aegirconsult.systems](http://aegirconsult.systems)

Aegir Consult is at the forefront of Africa's digital transformation, empowering businesses with innovative geospatial solutions. The company's digital-first approach—which leverages ArcGIS software for tailored solutions that drive efficiency and scalability—helps ensure that its customers seamlessly integrate and optimize enterprise systems. With industry-leading expertise and award-winning technology solutions, Aegir Consult is reshaping the landscape of geospatial information communication technology in Africa while helping clients enhance operational effectiveness and achieve significant cost savings.



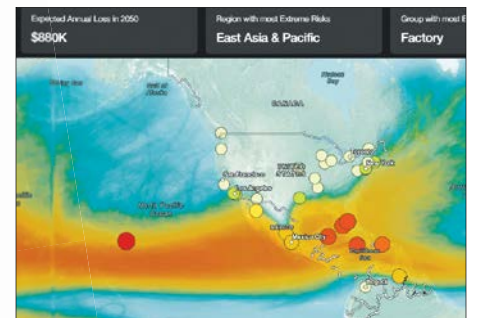
### Beans.ai | [beans.ai/esri](http://beans.ai/esri)

Using ArcGIS Pro, ArcGIS Enterprise, and ArcGIS Indoors, Beans.ai provides real estate professionals in the United States with scalable 3D and indoor GIS mapping. Facilitating self-guided property tours and advanced indoor routing analytics, Beans.ai helps property managers market properties efficiently and allows tenants to navigate potential homes with ease. For emergency response and public safety operations, Beans.ai solutions yield detailed layouts for quick and informed decision-making. The company's solutions enhance property engagement and marketing in the housing industry and establish new standards for apartment searching and community safety.



### PwC | [pwc.com](http://pwc.com)

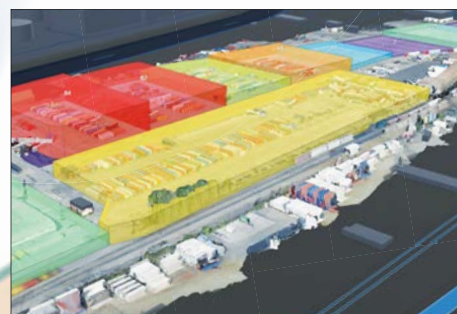
As companies and investors focus on decarbonization and other environmental, social, and governance goals, societal and consumer pressures are driving the creation of new technology and novel ways of collaborating. To help address these issues and more, PwC offers a variety of services related to IT-GIS integration, stand-alone GIS implementations, and business-focused geospatial solutions. Using ArcGIS software such as ArcGIS Enterprise, ArcGIS Experience Builder, and ArcGIS Dashboards, PwC helps clients achieve business goals that include effecting system modernization, improving data quality, assessing climate risk, and making specific investment decisions.



## Innovating with Analytics or AI for Solutions, Content, or Services

### ESP Logistics Technology | [esplogisticstech.com](http://esplogisticstech.com)

ESP Logistics Technology enhances logistics and supply chain efficiency by performing geospatial analysis of asset flows. ESP provides workflow and route optimization and integrates real-time data to help track assets and solve problems using proprietary technology, ArcGIS Online, and AI. Recently, ESP collaborated with A1 Group, a national third-party logistics company, to enhance drayage and yard management, boosting asset productivity. ESP set up an operational center for A1 employees, equipping them with specialized tools for data analysis and visualization. This enabled them to streamline workflows and reporting.



### GeoDecisions | [geodecisions.com](http://geodecisions.com)

GeoDecisions, a division of Gannett Fleming, harnesses geospatial technology, data science, and analytics to offer innovative solutions to complex challenges. Using Esri products such as ArcGIS Enterprise and Esri's deep learning packages, GeoDecisions discerns emerging trends and optimizes enterprise technology to offer scalable solutions that address customers' business objectives. The company transforms data into actionable insight, streamlining processes and fostering collaboration. Committed to using technology for good, GeoDecisions employs analytical capabilities to work with companies, government agencies, and partners to enhance their business intelligence.



### Platte River Analytics | [platte-river.com](http://platte-river.com)

Platte River Analytics promotes business development by helping clients across the United States analyze internal data, establish dynamic mapping and dashboard analysis, and extract business insight. With an ArcGIS System Ready specialty designation and more than 15 years of experience with Esri products such as ArcGIS Pro and ArcGIS Online, the company's industry specialties include oil and gas, solar energy, right-of-ways, broadband, and local government. Its services include consulting and training, interactive mapping, dashboard analysis, data collection, market analysis and competitor intelligence, and site selection analysis.

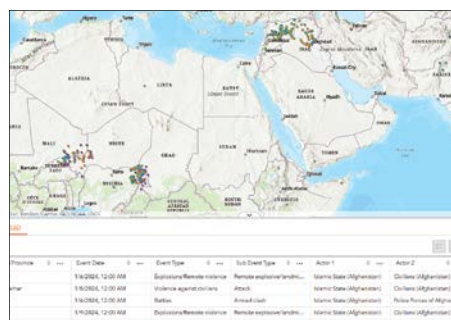




## Successful Integration of ArcGIS with Another IT System to Support Customer Business Needs and Workflows

### Geospatial Consulting Group International (geocgi) | [geocgi.com](http://geocgi.com)

Geocgi is a woman-owned small business technology and consulting firm that supports national and global federal enterprise geospatial programs. The company specializes in enterprise GIS implementation and integration, program management, data management and analysis, small unpiloted aircraft system imagery collection, cloud infrastructure, and other emerging technologies. Geocgi leverages Esri technology such as ArcGIS Experience Builder, ArcGIS Knowledge, and ArcGIS Business Analyst to help integrate business systems with geospatial data and capabilities that enhance organizational decision support solutions.



### Hammerhead Technology | [hammerheadtechnology.com](http://hammerheadtechnology.com)

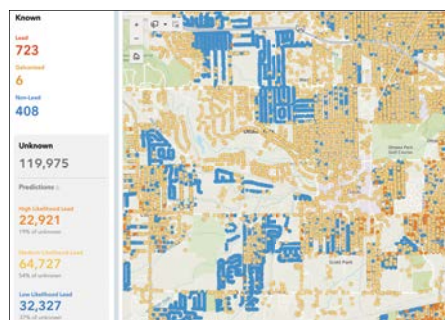
With a mission to create innovative, relevant, and sustainable solutions, Hammerhead Technology is a full-service IT delivery organization with expertise in traditional and cutting-edge technology solutions. To address wildlife electrocutions in Costa Rica, the company took a conservation-based approach and used ArcGIS Pro and ArcGIS Online to map incidents with power infrastructure and create a financial analysis that allowed power companies to identify areas of higher incident densities. This showed that it is more affordable to take preventive measures than to deal with the repercussions of wildlife electrocutions.



## Compelling Use of Esri Technology to Impact Current Global Issues

### BlueConduit | [blueconduit.com](http://blueconduit.com)

BlueConduit helps water systems organizations make data-driven decisions in the face of uncertainty and public health risk. BlueConduit's Lead Service Line platform—supported by expert data scientists and directly integrated with Esri's Lead Service Line Inventory solution—helps water systems organizations efficiently manage lead pipe identification and replacement by predicting whether there's likely to be lead at every address where the service line material is unknown. BlueConduit's predictive modeling has allowed communities to improve planning, reduce costs, and enable more equitable replacement plans based on the risk of lead exposure.



### GeoComm | [geocomm.com](http://geocomm.com)

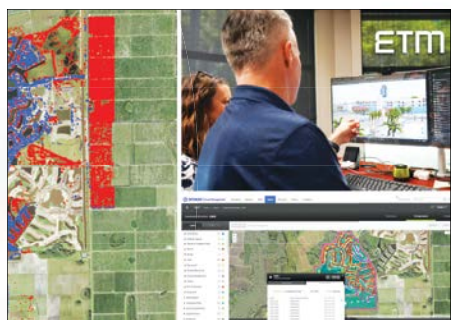
With offerings related to public safety location intelligence and vertical location services, Minnesota-based GeoComm empowers schools and emergency responders with actionable location intelligence for school campuses. By using detailed indoor GIS maps, emergency response times can be greatly reduced. GeoComm has provided indoor maps and GIS apps to more than 1,400 K–12 schools in Iowa. These schools use GeoComm School Safety, a solution that leverages ArcGIS products such as ArcGIS Enterprise, to streamline and reduce response times from initial contact to on-scene activity.



## Successful Customer Engagement via Partner-to-Partner Collaboration

### England-Thims & Miller | [etmgeo.com](http://etmgeo.com)

From capital improvement project prioritization and enterprise asset management to land acquisition and management, England-Thims & Miller's team of geospatial technology professionals uses leading GIS technology such as ArcGIS Pro and Esri's GeoAI technology to furnish clients with interactive, web-based data and mapping systems. The company's innovative solution uses AI to provide dynamic spatial insight, enabling public and private organizations worldwide to improve their processes, make data-driven decisions that transform their operations, and significantly enhance stakeholder satisfaction.



### ROK Technologies | [roktech.net](http://roktech.net)

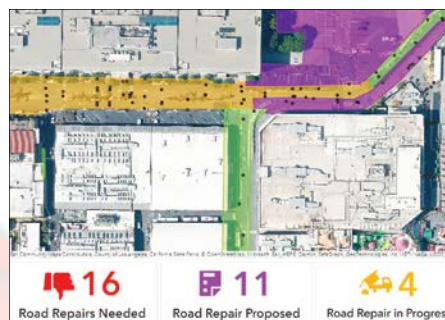
ROK Technologies focuses on handling the day-to-day management of ArcGIS software and its supporting infrastructure. This allows ROK Technologies' cloud-first clients to focus on what they do best—delivering exceptional GIS experiences to their customers. ROK Technologies serves clients across all Esri's industries, from Fortune 100 companies to small municipalities. With its mastery of cloud services, GIS, and IT, combined with its collaborative partners' niche expertise, ROK Technologies helps its clients maximize ArcGIS Enterprise on Windows, Kubernetes, and Linux, as well as their capabilities in the cloud.



## Large-Scale ArcGIS Implementation Using Multiple ArcGIS Products

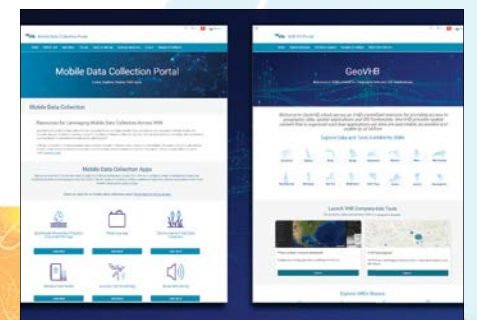
### Langan Engineering & Environmental Services | [langan.com](http://langan.com)

Langan stays at the forefront of ArcGIS technology to provide its clients with a high level of support. Esri products such as ArcGIS Enterprise, ArcGIS Online, and ArcGIS Pro have allowed Langan to implement digital solutions that streamline operations, integrate data streams, leverage the power of geospatial artificial intelligence (GeoAI), and solve a wide variety of business problems. In many cases, these solutions have helped clients enhance operational efficiency by more than 80 percent while reducing operating costs and achieving an overall return on investment in a short time.



### VHB | [vhb.com](http://vhb.com)

VHB's Mobile Data Collection platform is a centralized web app that provides standardized field applications that can be used for collecting fieldwork data and training resources. This engine gives users access to preconfigured ArcGIS Survey123 or ArcGIS Field Maps apps and sends data to a dashboard that runs on ArcGIS and Autodesk software. To streamline the use of public datasets, VHB also created a GIS portal that inventories and classifies datasets in a digital library that can be made available to all staff.



Esri partners represent the rich ecosystem of organizations around the world that work together to extend the ArcGIS system and implement it in distinct ways to solve specific problems. Find partners that meet your needs at [esri.com/partners](http://esri.com/partners).

# Esri Startup Partner Models Pipe Failure Risk for Smarter Utility Management

When water pipes age and deteriorate, they can fail catastrophically—an outcome that's much more expensive for water utility companies than replacing pipes before they burst. But deciding when to replace pipes and other water assets can be a difficult and complicated process, partly due to the many factors involved.

This was an issue facing the Metropolitan Utilities District, which serves more than 620,000 customers across the Omaha, Nebraska, area. With more than 3,000 miles (4,828 kilometers) of water mains and natural gas infrastructure, the district's goals of achieving resilience and reliability are continually challenged by aging pipes, environmental factors, and increasing demand. The district needed a step-by-step improvement plan to replace infrastructure that was worn out.

In the past, staff at the district made infrastructure renewal decisions by conducting spreadsheet assessments that provided limited details and were based on historical pipe-break data recorded on paper maps. To help mitigate pipe failure risk in the most cost-effective way, the district turned to Esri startup partner Aquanuity (aquanuity.com) and its AquaTwin products for ArcGIS Pro.

## A Safer, More Reliable Risk Model

The district's digital transformation began in 2008, when staff converted its legacy infrastructure data from MicroStation-based CAD files into an Esri geodatabase. They then added to the database characteristics such as job numbers, installation dates, and material properties—including diameter, thickness, and what an asset is made of—for pumps, valves, and other equipment. In 2019, when the district's asset management division was formed, staff digitized more than 15,000 paper-based water main leak reports, which were later analyzed to create the risk model.

Staff worked with Esri partner HDR to develop a data-driven linear asset management plan (LAMP), a water system simulation that includes all of the district's linear assets such as pipes and related equipment, including valves and taps. The LAMP contains details related to each asset's material properties; how it was installed; and its condition based on the number of leaks or breaks recorded, the average pressure and water velocity, and other criteria. These factors help generate comprehensive risk models that leverage several GIS datasets and data from the new hydraulic model, also completed by HDR.

The district and HDR developed likelihood-of-failure and consequence-of-failure factors based on various pipeline attributes. A main's likelihood of failure is affected by the pipe break rate (the number of pipe breaks during a given period), the material the pipes are made from and when they were installed, the diameter, the water pressure, and the number of service connections involved. Consequence-of-failure factors are determined by using the number of customers who would be affected by a disruption and how badly a

disruption would impact them, as well as nearby roadway types, zoning, and other factors.

District staff and the HDR team then applied the dataset to each of the district's approximately 80,000 pipe segments. To further improve the model's accuracy and adaptability, the team reached out to Aquanuity for its AquaTwin products—all ArcGIS Pro add-ins.

## Smarter and More Sustainable Water Infrastructure

Aquanuity is a civil engineering company that creates software to help water utilities and engineering firms manage water infrastructure. Its AquaTwin Asset Pro software, which allows users to create asset condition computer simulations for what-if scenarios in water systems, powers the LAMP. AquaTwin Asset Pro integrates with the Environmental Protection Agency's industry-standard Storm Water Management Model engine, adding hydraulic, hydrologic, and water quality simulation capabilities and allowing sewer infrastructure capacity analysis results to be incorporated into risk and criticality assessments.

"The district knew that the software solution supporting the LAMP had to be user-friendly and versatile enough to effectively translate any nuances in the factors that were developed," said Metropolitan Utilities District director of infrastructure integrity Jared Svagera, explaining why the district chose AquaTwin solutions.

The district also uses Aquanuity's AquaTwin Water Pro, which enables the creation of what-if scenarios as well but focuses on water systems' hydraulic and water quality computer simulations.

One of the reasons district staff chose AquaTwin Water Pro is its complete integration with the district's ArcGIS Pro environment, Svagera said. He also noted other advantages, such as that all data is kept natively in ArcGIS Pro geodatabases, bypassing the need for file conversion, and that AquaTwin Water Pro supports ArcGIS Utility Network functionality out of the box.

## Risk Mitigation for a Safer Water System

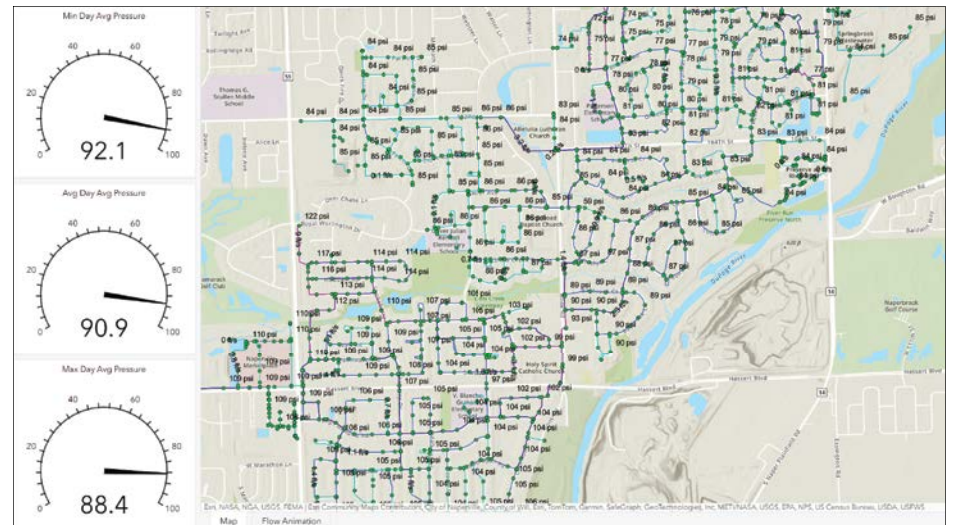
Using ModelBuilder, district staff can combine several GIS features to create a single, comprehensive table that they can use to easily update the risk models generated by AquaTwin. These models combine service taps (smaller pipes that run from water pipelines to houses), break rates, and break counts (the number of individual breaks in a pipe), and normalize the data based on water main age. Staff then add the results to the AquaTwin products' models.

The consequence-of-failure factors make use of a powerful AquaTwin tool called Saved Selections, which allows AquaTwin users to select pipe features, such as line features representing water mains. Users then save those selections and assign risk scores. AquaTwin Asset Pro quickly combines likelihood-of-failure and consequence-of-failure data into risk-priority scores, which staff can then display in dashboards.

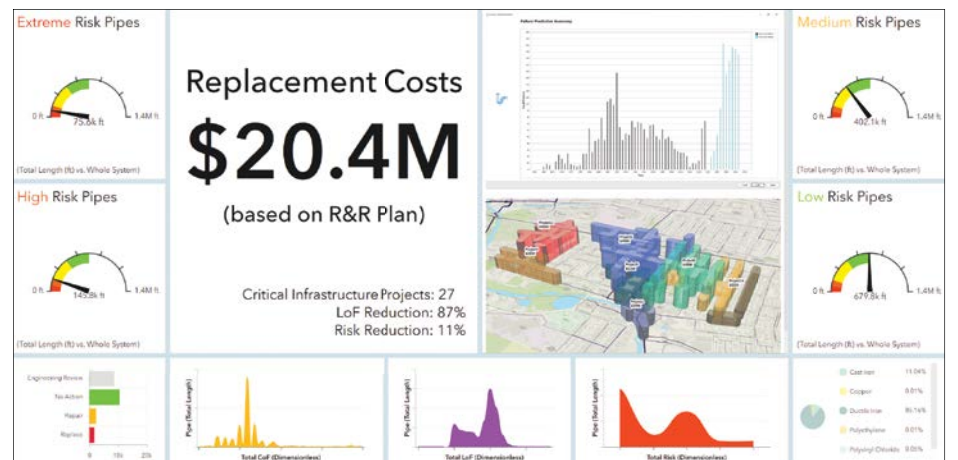
This linear asset risk model helps the district prioritize water main renewal and condition assessment projects. It also assists in monitoring areas of highest consequence for active water leaks. Since it's not always economically feasible to replace just one high-risk block of water mains, engineers can choose to also replace surrounding medium-risk mains to create a more efficient and economical project.

Powered by ArcGIS Pro, the LAMP and AquaTwin products revolutionized the district's previous approach, employing system-wide data to prioritize essential maintenance and mitigate as much risk as possible.

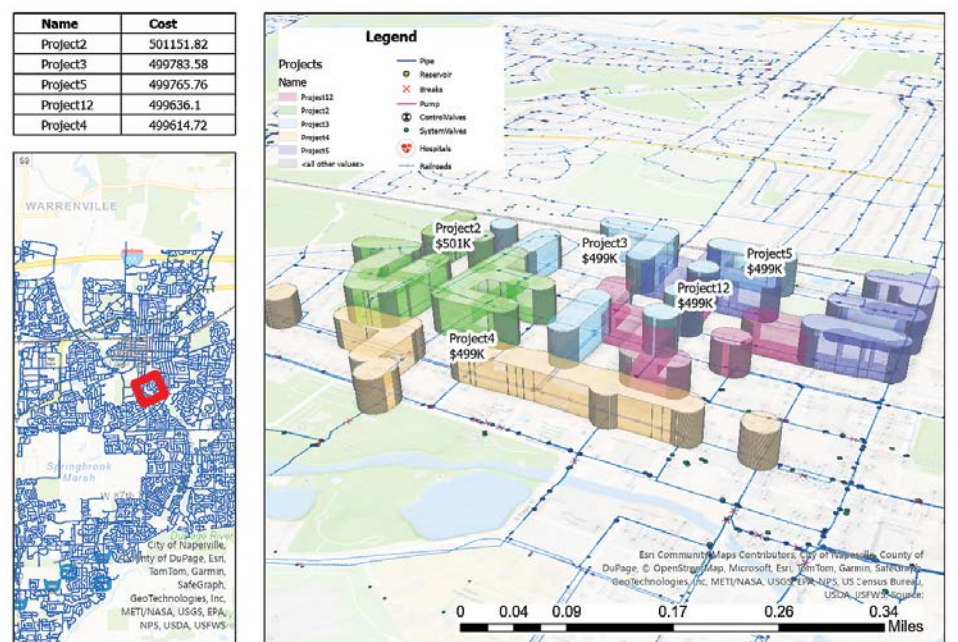
"Our work with Aquanuity is helping us plan a future where we can provide the safest, most reliable services possible to our customers—making their lives easier," Svagera said.



Created by Esri partner Aquanuity to run as an ArcGIS Pro add-in, AquaTwin Water Pro shows the Metropolitan Utilities District's system hydraulics across spatial areas.



An AquaTwin dashboard displays Metropolitan Utilities District pipe replacement costs.



AquaTwin Water Pro shows prioritized projects based on asset risk levels.

# The Relevance of Cartography

## A Cartographer's Perspective

By Georg Gartner

President, International Cartographic Association



# What a Good Meal and a Good Map Have in Common

Finding and using geospatial data, or geodata, is a lot like finding and eating food. There are lots of options for how to get each, but some versions are more comprehensive and offer a more substantial experience than others.

Let me show you what I mean.

### *So, you're hungry. What do you do? Here are your options.*

#### **You can go find a farm.**

This is where raw food is produced—where the fundamental ingredients for a meal are acquired. Farmers harvest grains, milk cows, pick berries, dig up beets, and so much more.

This is laborious. Some of this food can be eaten right away, but some of it can't and needs to be refined before it can be consumed.

To get bread, for example, it's essential to have grains; but grains are not bread. Grains need to be ground into flour. Then bakers need to add water, salt, and other ingredients to the flour to make a dough before baking it in an oven to make bread.

#### **You can go find a supermarket.**

In a supermarket, most food has been enhanced. It has been ordered, packed, and sorted so it is easy for customers to find and use in various ways.

Shoppers can take some of the food—say, berries or even bread—and eat it right away. They can also take bread and buy other ingredients, such as cheese and lettuce, and make a sandwich. Or they can buy a premade sandwich. That sandwich,

whether it's turkey or tuna, will taste like similar sandwiches. In other words, it will be standardized.

#### **You can go find a restaurant.**

This is where you order an entire meal. Here, a cook has used select ingredients—whether raw from the farm or prepared at a supermarket—and aggregated them; designed a composition; added some oils, spices, and sauces; and created an entire meal. The cook has made sure that you are not only satiating your hunger but also enjoying what you eat.

A meal in one restaurant may taste different from a similar meal at another restaurant, since cooks add personal touches and unique flavors. This likely affects which restaurant you choose. Some restaurants have standardized meals, while others vary in quality from day to day and from meal to meal. Some cooks can also compose meals that you can't make yourself, leading to new tasting experiences and different levels of enjoyment.

### *So, you have a question related to location. What do you do? Here are your options.*

#### **You can go find some data.**

You can even acquire the data yourself by engaging in data gathering activities. You'll need to dig into this raw data—find the coordinates, examine the numbers, or look at the pixels in the imagery. The answers to your question might be there, but it will be laborious to discern the patterns, detect the trends, and see the stories and narratives that you are looking for or, perhaps, haven't even thought about.

To get answers to spatial questions, it is essential to have geodata. However, would the mayor of a city go to a geodatabase and try to dig into the raw data to get more information before making a decision? Would a tourist in a foreign city look at the polygons of that city's transportation lines to figure out the optimal route for getting from their hotel to a museum? Would a hiker plot the coordinates of a trajectory to find a path and learn the context of a hike?

For all three of these questions, the answer is likely no—just like someone who's hungry likely wouldn't go to a farm to get food. Finding geodata is like finding food on a farm. It's raw.

#### **You can go find geoinformation.**

With geoinformation, someone has the data. It has been ordered, packed, and sorted.

You can take some of this geoinformation and use it right away, like when you buy bread and toast it to eat for breakfast. Just like how bread satiates hunger, geoinformation can yield an answer to your question. But it may take some effort to browse this geoinformation, interact with it, and explore it to find patterns and trends—sort of like taking that bread and making a more enticing sandwich.

Finding geoinformation is like finding food in a supermarket. It's prepared and can be used as is but will probably work better if it's enhanced and even standardized.

#### **You can go find a map.**

Here, a cartographer or cartographic algorithm has used select data; aggregated

it; designed a composition; added some shapes, colors, and points of interest; and created an experience with that data that enables you to not only get an answer to your question but also perceive it in a tailored, pleasing, and enjoyable way. By looking at a skillfully assembled and well-designed map, you may experience new thoughts and ideas, much like how at a restaurant, you may experience new tastes.

Sure, some maps are more like fast food, and that is fine. There is a huge variety of maps, just like there is a huge variety of restaurants and meals. It is possible, though, to acknowledge the difference between a special map and one that is used for everyday convenience, just like it is possible to acknowledge the difference between an exceptional meal at an upscale restaurant and a simpler meal you get when you're in a rush.

### **Enjoy the Experience**

The next time you sit down at a restaurant and enjoy a delicious meal, think about how you're not eating the raw ingredients straight from a farm or the packaged ingredients purchased at a supermarket. Instead, you're receiving the synthesized result of a creative process that allows you to experience additional value.

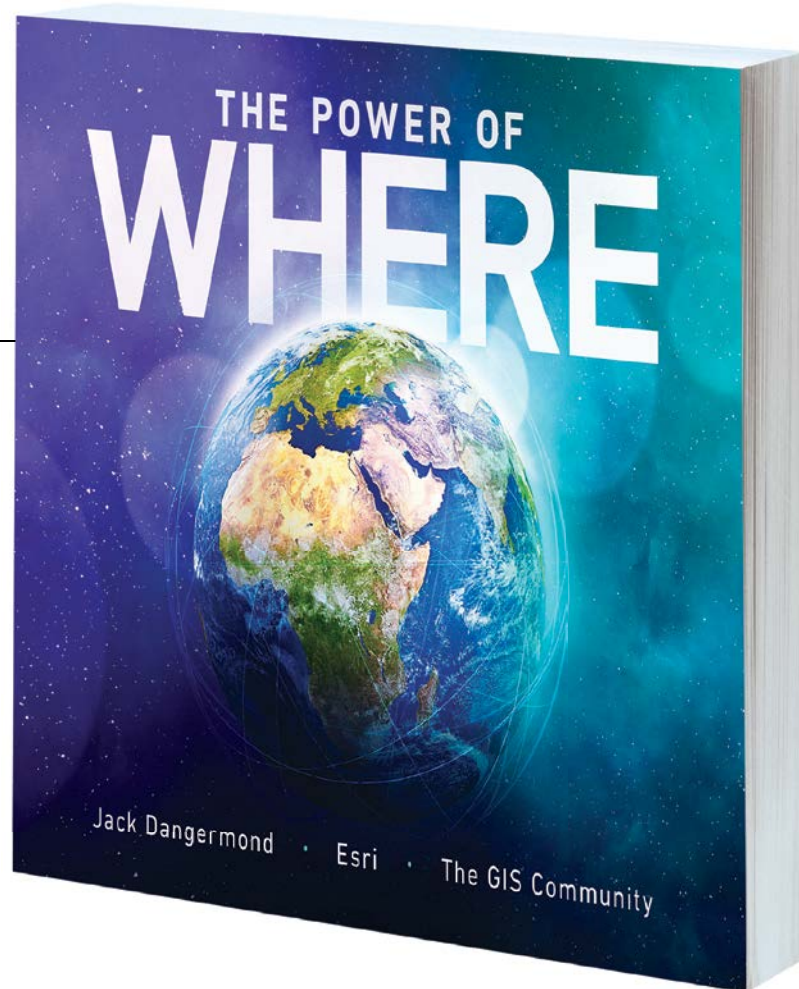
The same is true for maps. The next time you find yourself enjoying a map, acknowledge that this map is more than data and more than geoinformation. It is the result of a creative process that enables you to experience deeper thinking.

# Esri Press

## The Power of Where: A Geographic Approach to the World's Greatest Challenges

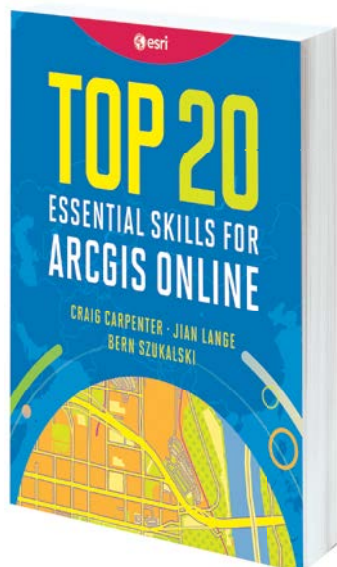
By Jack Dangermond

Discover the growing potential of modern GIS to address the most considerable problems of our time. With a foreword by James Fallows, bestselling author and writer for *The Atlantic*, *The Power of Where: A Geographic Approach to the World's Greatest Challenges* is filled with the latest web maps, illustrations, and real-life stories from GIS users that demonstrate how the geographic approach can be used to monitor wildlife migration, address rising sea levels, plan urban spaces, streamline food production, and more. Author and Esri president Jack Dangermond draws on his 60 years of research and experience in the industry to argue that GIS and the geographic approach are well-suited to tackle climate change, hunger, water scarcity, inequity, and other issues large and small. July 2024, 300 pp. Ebook ISBN: 9781589486072 and paperback ISBN: 9781589486065.



**The Locators: Adventure in Oceania**  
By Kyle Bauer and Colleen Connor, illustrated by Wesley Jones

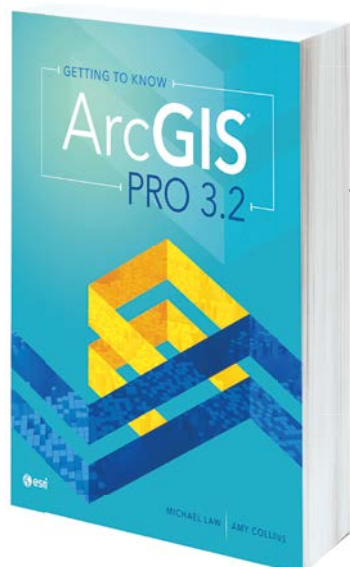
Lucy, Oliver, and Moe the Parrot are on another mission—this time in Oceania, where they use maps, technology, and spatial thinking to study the Great Barrier Reef, Papua New Guinea, and more. With a mission to provide help to those who need it, the trio finds and grows healthy coral in the Great Barrier Reef and rescues unique species facing a dangerous wildfire in New South Wales, Australia. While completing the illustrated activities in each chapter, readers get to scuba dive in the ocean, check out a wombat's burrow, and even follow a pod of whales! *The Locators: Adventure in Oceania* is perfect for children ages 8–11 who love geography and exploring the world. July 2024, 132 pp. Ebook ISBN: 9781589487574 and paperback ISBN: 9781589487567.



### Top 20 Essential Skills for ArcGIS Online

By Craig Carpenter, Jian Lange, and Bern Szukalski

*Top 20 Essential Skills for ArcGIS Online* guides readers, step-by-step, through the process of creating maps that simplify location data and help users unlock spatial insight. Bite-size chapters—each of which takes about 45 minutes to complete—demonstrate how to create layers, build web maps, and showcase location data in professional visualizations. This book is perfect for students seeking a comprehensive guide to follow from beginning to end; professionals looking to learn specific skills; and anyone who wants a single, reliable, and comprehensive resource for learning how to create web maps. June 2024, 282 pp. Ebook ISBN: 9781589487819 and paperback ISBN: 9781589487802.



### Getting to Know ArcGIS Pro 3.2

By Michael Law and Amy Collins

The newest edition in this best-selling series, *Getting to Know ArcGIS Pro 3.2* introduces readers to ArcGIS Pro and walks them through how to use 3D GIS, build a geodatabase, create maps for web and physical presentations, and more. With easy-to-follow workflows and more than 300 full-color images, the book clarifies complicated processes, such as developing a geoprocessing model, using Python to write a script tool, and creating space-time cubes. May 2024, 352 pp. Ebook ISBN: 9781589487789 and paperback ISBN: 9781589487772.

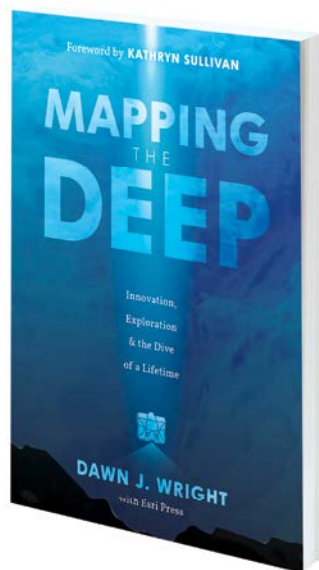
The books on this page  
will be available at the 2024  
Esri User Conference (Esri UC).

# These books will be available at the 2024 Esri UC, and there will be book signings. Visit the Esri Press booth to find out more.

## Mapping the Deep: Innovation, Exploration, and the Dive of a Lifetime

By Dawn J. Wright with Esri Press

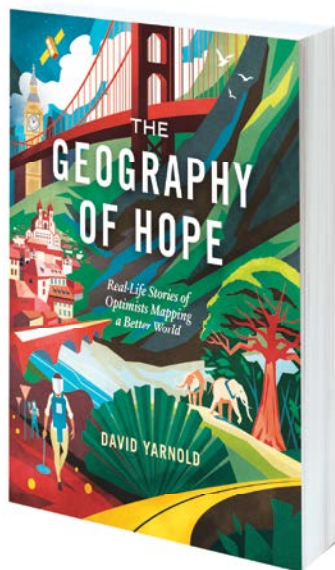
Oceanographer and author Dawn J. Wright made history in 2022 when she became the first Black person to visit Challenger Deep, the deepest and least-explored place on Earth. With a foreword by oceanographer and former astronaut Kathryn Sullivan, *Mapping the Deep: Innovation, Exploration, and the Dive of a Lifetime* takes readers on an extraordinary adventure with an extraordinary woman to the depths of the Pacific Ocean. Focusing on Wright's historic dive, her personal journey, and the cutting-edge technology that made the expedition possible, the book highlights the importance of mapping the ocean as well as deep-sea exploration's profound impact on our planet's future. September 2024, 190 pp. Ebook ISBN: 9781589487895 and paperback ISBN: 9781589487888.



## The Geography of Hope: Real-Life Stories of Optimists Mapping a Better World

By David Yarnold

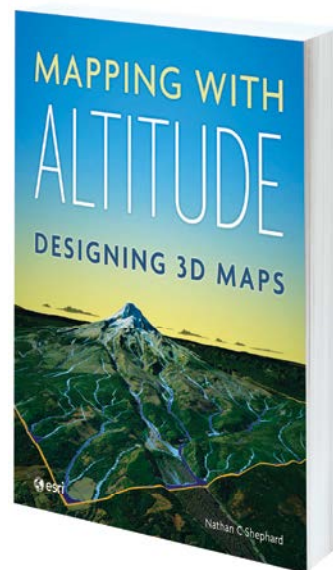
Former National Audubon Society CEO and award-winning writer and photographer David Yarnold traveled the world to introduce readers to people who are effecting change using "the most important technology you've probably never heard of." *The Geography of Hope: Real-Life Stories of Optimists Mapping a Better World* includes nine topical stories that span the globe, from Prague to Berkeley and from Nairobi to Kyiv, showcasing how AI is reshaping national intelligence, a father-daughter duo fighting for fair elections, how deadly explosives are removed after conflicts, and how K-12 education can be improved. This book puts human faces to GIS in a way that hasn't been done before, revealing the GIS that's all around us all the time. October 2024, 246 pp. Ebook ISBN: 9781589487420 and paperback ISBN: 9781589487413.



## Mapping with Altitude: Designing 3D Maps

By Nathan C Shephard

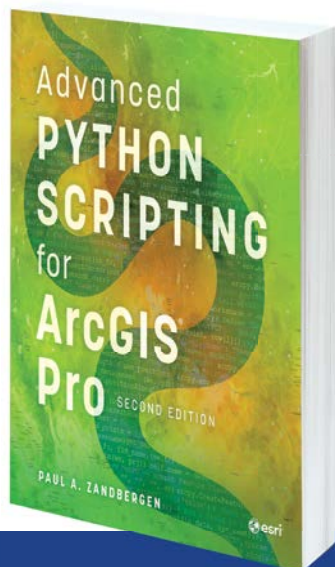
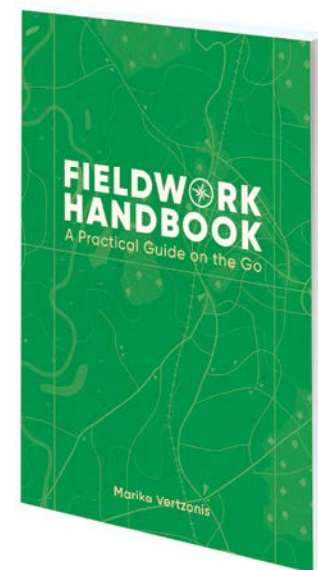
Representing and reviewing data on maps in 3D lets viewers explore complex relationships in new ways, identifying patterns and potential problems more effectively. But creating digital 3D maps that are accurate, intuitive, engaging, and easily navigable can be daunting—even for experienced cartographers. In *Mapping with Altitude: Designing 3D Maps*, author and Esri senior product engineer Nathan C Shephard takes a fun and enthusiastic approach to exploring the concepts, challenges, and opportunities in 3D cartography while focusing on the practical decisions and techniques that mapmakers need to use as they boldly enter the world of 3D map authoring in ArcGIS. July 2024, 280 pp. Ebook ISBN: 9781589485549 and paperback ISBN: 9781589485532.



## Fieldwork Handbook: A Practical Guide on the Go

By Marika Vertzonis

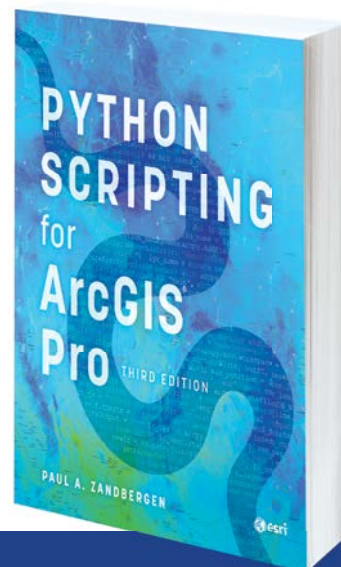
Fieldwork is anchored by location, whether it's a biologist in a rainforest observing indigenous frogs, an engineer maintaining utility equipment, or a community scientist taking water samples from a creek. *Fieldwork Handbook: A Practical Guide on the Go* has tips, best practices, and activities to make working in the field more productive and successful. Author and Esri product engineer Marika Vertzonis covers preparation, equipment, workflows, and data to teach readers how to organize and reconcile field data, effectively coordinate and dispatch field resources, refine fieldwork workflows, and sync the office with the field. March 2024, 200 pp. Ebook ISBN: 9781589487185 and paperback ISBN: 9781589487178.



## Advanced Python Scripting for ArcGIS Pro, Second Edition

By Paul A. Zandbergen

An easy-to-follow guide to writing specialized Python scripts, *Advanced Python Scripting for ArcGIS Pro*, Second Edition, is updated for ArcGIS Pro 3.2. Intended for users who have a good foundation in Python, the book explores how to turn scripts into tools, develop notebooks to share with others, employ third-party packages, and more. May/September 2024, 286 pp. Ebook ISBN: 9781589488045 and paperback ISBN: 9781589488038.



## Python Scripting for ArcGIS Pro, Third Edition

By Paul A. Zandbergen

*Python Scripting for ArcGIS Pro*, Third Edition, teaches readers how to write Python scripts to automate tasks in ArcGIS Pro. The book begins with the fundamentals of Python programming and then dives into how to write useful Python scripts that work with spatial data in ArcGIS Pro. With step-by-step instructions and practical examples, it reveals how to use geoprocessing tools; describe, create, and update data; and execute specialized tasks. May/September 2024, 414 pp. Ebook ISBN: 9781589488021 and paperback ISBN: 9781589488014.

For more information on all Esri Press publications, visit [esri.com/esripress](https://esri.com/esripress).

# New Training and Certification Offerings

## Training

### Hone Your GIS Skills with Instructor-Led Courses

Esri's instructor-led courses help GIS users learn ArcGIS best practices and the essential concepts that allow them to apply the technology to gain insight from data, improve their organizations' operations, and meet complex challenges. Classes are taught in person, online, and as private training events for groups.

A new course called **Graph Analytics Using ArcGIS Knowledge** is ideal for GIS analysts, intelligence and all-source analysts, researchers, data scientists, and others who need to visualize and analyze relationships among datasets that are stored in multiple formats. Participants learn the foundational concepts, terminology, and workflows needed to perform graph analysis using ArcGIS Knowledge; build skills to prepare data for use in knowledge graphs; and gain experience performing spatial and nonspatial analyses. Explore course details at [go.esri.com/arcgis-knowledge-class](https://go.esri.com/arcgis-knowledge-class).

Teams can also simplify their access to instructor-led classes by getting the Esri Training Pass, which offers prepaid training days that can be redeemed over the course of one year. Learn more at [go.esri.com/training-pass-details](https://go.esri.com/training-pass-details).

### Discover a Lot in One Hour

Given their short duration and convenient timing (9:00 a.m. and 11:00 a.m. Pacific time), live training seminars provide a popular way to stay up-to-date with ever-changing technology. In one hour, attendees enjoy a lively chat with fellow GIS enthusiasts while learning from Esri presenters who have deep expertise. Participants leave with tips to get better and faster results from their ArcGIS technology-supported work. All live training seminars are recorded and made available via Esri Academy for easy viewing afterward. Visit [esri.com/lts](https://esri.com/lts) for seminar details and to get calendar reminders.

The following topics will be covered next in 2024 (dates are subject to change):

- **Geospatial artificial intelligence (GeoAI):** August 15
- **ArcGIS StoryMaps:** October 10
- **ArcGIS QuickCapture:** November 14

### A Massively Popular Way to Learn

Tens of thousands of students, working professionals, and lifelong learners attend Esri's massive open online courses (MOOCs) each year. With a MOOC, participants can stay up-to-date with trending GIS topics and cutting-edge technology, no matter their geographic location, job title, or career stage. Esri provides all the software needed to complete course exercises, and a certificate is awarded for course completion.

Upcoming MOOCs include the following:

- **Spatial Data Science: The New Frontier in Analytics** (August 28–October 9)—This six-week MOOC is for anyone who's fascinated by machine learning and advanced analytics. Participants learn data-engineering workflows and build skills to gain insight from data using spatial methods and algorithms, regression analysis, deep learning models, space-time cubes, and more. Course exercises provide detailed instructions, and experts present complex topics using relatable examples. Sign up at [go.esri.com/sds-mooc](https://go.esri.com/sds-mooc).
- **Make an Impact with Modern Geo Apps** (September 25–October 30)—This new MOOC shows participants how to create and share engaging apps that feature geospatial content and capabilities—without coding. Each week focuses on a different app: ArcGIS Instant Apps, ArcGIS Experience Builder, ArcGIS Dashboards, and ArcGIS StoryMaps. Register for the course at [go.esri.com/modern-geo-apps-mooc](https://go.esri.com/modern-geo-apps-mooc).

## Certification

### How to Prepare for an Exam

For experienced professionals as well as those entering the workforce, achieving an Esri technical certification is a great way to get noticed by supervisors, colleagues, and hiring managers. On the surface, a certification validates someone's knowledge and skills in using ArcGIS software and developer technologies. At a deeper level, achieving a certification showcases one's personal commitment to growth and desire for professional excellence. These are intrinsic qualities that employers value.

For those who have decided to pursue certification, the first question they often ask is, "How do I prepare for the exam?" The answers are found via Esri Academy. All Esri technical certifications have a curated learning plan with links to training resources related to the skills measured by each exam. If you have decided to achieve a certification this year, explore exam learning plans at [go.esri.com/cert-learning-plans](https://go.esri.com/cert-learning-plans). (Tip: search for *certification*.)

Explore all Esri technical certification exams at [go.esri.com/certification](https://go.esri.com/certification). To get help choosing one, watch *Preparing for an Esri Technical Certification* at [go.esri.com/cert-prep-video](https://go.esri.com/cert-prep-video).



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## Esri Resources

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Tel.: **1-800-447-9778** (USA only)

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Esri Store  
[esri.com/store](https://esri.com/store)

ArcGIS Developers  
[developers.arcgis.com](https://developers.arcgis.com)

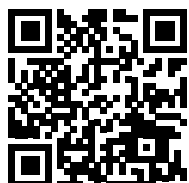
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