ArcNews

Esri | Winter 2024 | Vol. 46, No. 1

Briefly Noted

Microsoft Fabric Delivers Leading Spatial Analytics
Extending its long-standing strategic collaboration with Microsoft, Esri is integrating 140 spatial analytics tools and functions into Microsoft Fabric, an artificial intelligence-powered analytics platform that unites data and services. Slated to be available in the second quarter of 2024, the integration will allow data to flow across an organization, whether users are working in Microsoft OneLake, Microsoft Power BI, or the ArcGIS environment. Fabric users will have direct access to sophisticated spatial analytics tools and functions—as well as an extensive library of authoritative and curated spatial data—to produce interactive and intuitive visualizations and maps. Learn more at links.esri.com/fabric.

National Geographic Launches MapMaker
Esri and the National Geographic Society have launched the reimagined National Geographic Mapmaker, an online interactive mapping tool that empowers students, teachers, and others to explore the world through geography. The 2D and 3D app employs the latest GIS software, allowing users to visually experience and interact with geospatial information about Earth's interconnected social and physical systems while exploring the art of mapmaking. Discover Mapmaker at links.esri.com/mapmaker.

ArcGIS Platform Gets Key Enhancements
Esri has added two enhanced services to ArcGIS Platform, which helps developers integrate location capabilities into their apps and products. The first, called Places, enables developers to access point-of-interest data for built and natural environments. The second, called Data Hosting, offers a secure way for developers to store, manage, and access location-based data.

ArcGIS Basemaps and ArcGIS Living Atlas Data Added to Autodesk Software

Digital transformation is rapidly changing the foundational processes powering the architecture, engineering, and construction sectors. Industry leaders are relying on the interoperability of GIS and building information modeling (BIM) to reduce costs and boost efficiency across construction projects. In support of these organizations, Esri and Autodesk have cultivated a strategic alliance to unify GIS and BIM, delivering real business value to architects, engineers, planners, and contractors.

Deepening their collaboration, Esri and Autodesk have entered into an agreement to integrate ArcGIS basemaps and ArcGIS Living Atlas of the World layers into Autodesk's products. The Autodesk product suite will now provide rich, authoritative geospatial reference data from the foremost collection of globally sourced geographic information.

"Partnering with Esri is intended to combine the power of BIM and GIS, which will enable our shared

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↑ ArcGIS basemaps and ArcGIS Living Atlas of the World layers are being integrated into Autodesk's products.

Vermont Speeds Flood Response with ArcGIS Online and Site Scan for ArcGIS

During a disaster event, rapid response is critical. For Vermont residents who experienced flooding in July 2023—thanks to GIS and some quick thinking—disaster response meant receiving relief sooner instead of later.

Documenting a disaster's impact quickly and accurately can speed funding for recovery efforts. In Vermont, a long-standing partnership between state agencies and the state's largest university led to just the sort of rapid response needed to get resources rolling. Within hours of the floods, there were boots on the ground, unoccupied aircraft systems (UAS) were in the air, and GIS tools—such as ArcGIS Online, ArcGIS Instant Apps (including the Sidebar template), and Site Scan for ArcGIS—were being used to collect and process mapping data and imagery so it could be easily shared.

"We had a limited time to acquire data near peak flood levels, so we knew we had to move quickly," said Jarlath O'Neil-Dunne, director of the University of Vermont's Spatial Analysis Laboratory and its UAS team. "The fact that we could play a role in getting Vermonters the recovery money that they need and they deserve sooner is incredibly fulfilling for our mission as the state university."

← Floodwater reached the Vermont State House grounds (upper left).

Training for Disaster

The Spatial Analysis Laboratory has been on the cutting edge of GIS research for decades. Staffed by 14 full-time employees and more than 60 under-

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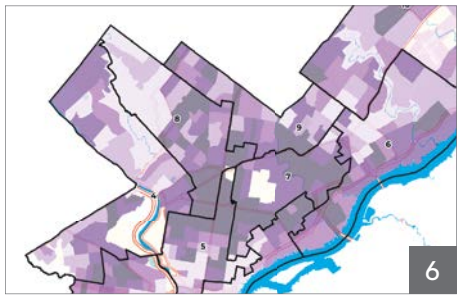
To preserve and protect historical sites and land, the National Trust in the United Kingdom is using ArcGIS Image for ArcGIS Online to share imagery in the cloud. This enables the organization's staff and partners to better visualize heritage sites and make more informed decisions.



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ArcGIS Knowledge Graphs Are Coming to the Web

ArcGIS Knowledge is a relatively new extension to ArcGIS Enterprise that enables organizations to connect, analyze, and visualize large amounts of diverse data together in knowledge graphs. Knowledge graphs store data as a network of entities and relationships in a graph database, enabling easy visualization and querying. This quickly gives users holistic context about any specific data point, such as a place, an asset, or a person. A knowledge graph allows users to create a model that simulates a real-world system in a nonspatial manner.

Performing this kind of network analysis is ideal for improving crime investigations; conducting intelligence analysis using numerous sources; planning out supply chains and infrastructure networks; identifying potential risks; optimizing logistics, facilities, and asset management; and more.

In the past, analysts were restricted to using ArcGIS Knowledge in ArcGIS Pro and ArcGIS AllSource in order to perform spatial and graph analytics to find hidden and important patterns more quickly in their data. With the new ArcGIS Knowledge Studio, released in beta in November 2023 with a general release planned for May 2024, this capability is being extended to the larger organization by enabling ArcGIS Knowledge users to easily open, explore, and share their existing knowledge graphs in a web browser.

Analysts can use ArcGIS Knowledge Studio to explore, search, visualize, and share specific entities or views of interest with other stakeholders in their enterprise via a simple, direct URL. Even stakeholders who have no GIS experience can use Knowledge Studio to view projects in an intuitive, easy-to-use interface.

Several key features in Knowledge Studio will benefit the investigative process by allowing users to do the following:

- Open knowledge graphs on the web and share them with analysts who don't use Esri's two supported desktop applications—ArcGIS Pro and ArcGIS AllSource—or who have no GIS training at all.
- Quickly find and validate data across an entire knowledge graph with text search.
- Add entities to new maps and link charts and explore their relationships using multiple layout views.
- Using a URL, easily share with other analysts or managers specific link charts and maps that feature views of curated entities and relationships of interest.
- With that URL, easily share a snapshot of an entity of interest that shows relevant context, such as that entity's relationships with other entities.

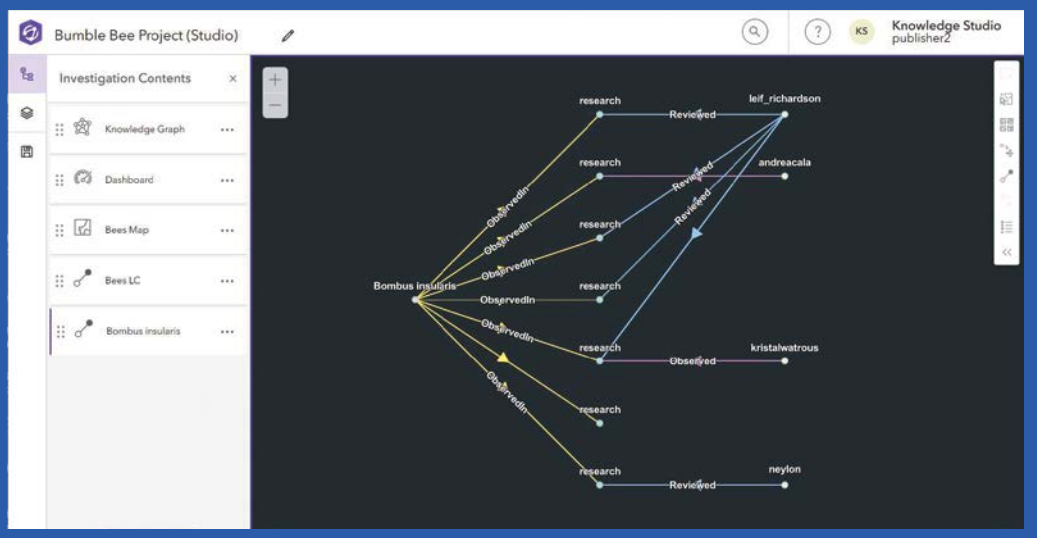
ArcGIS Knowledge Studio is available to all customers who have licensed ArcGIS Knowledge Server and ArcGIS Enterprise 11.2. The app is to be included as part of an organization's ArcGIS Enterprise installation without the need for a separate download. For the beta version, all ArcGIS named user types can access the app and open existing knowledge graphs.

A Few Caveats

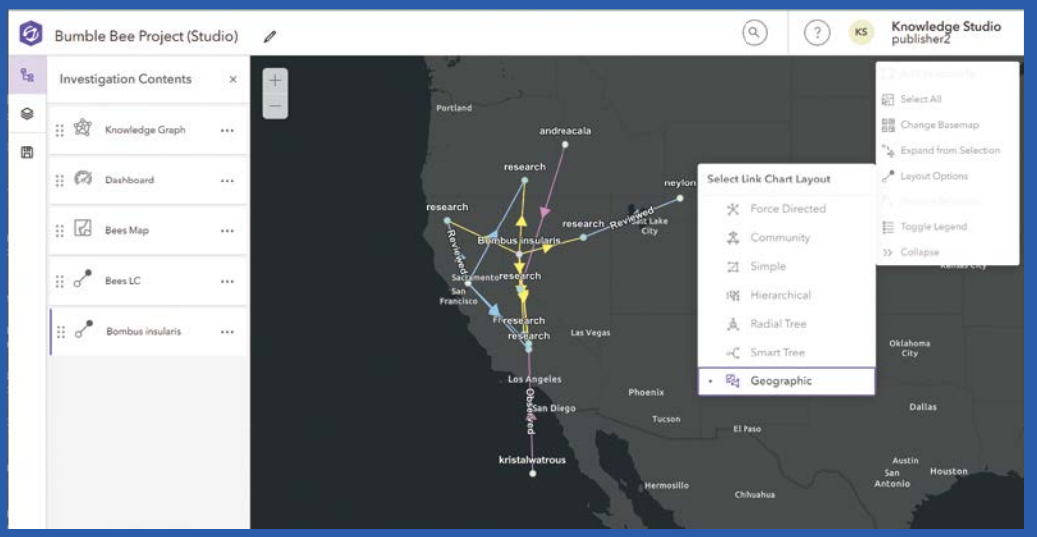
While in beta, the app will lack some key features that users will likely need to perform link analyses. Most notably, users will be unable to migrate Knowledge Studio projects that are saved in the beta version to ArcGIS Enterprise 11.3 or later versions. While knowledge graphs can be migrated, beta Knowledge Studio projects will eventually need to be reauthored in the general Knowledge Studio release.

To learn more about ArcGIS Knowledge, check out the ArcGIS Knowledge 11.2 release blog at links.esri.com/AG-blog. To add ArcGIS Knowledge to your organization's ArcGIS Enterprise deployment, contact an Esri representative at links.esri.com/a-k-overview.

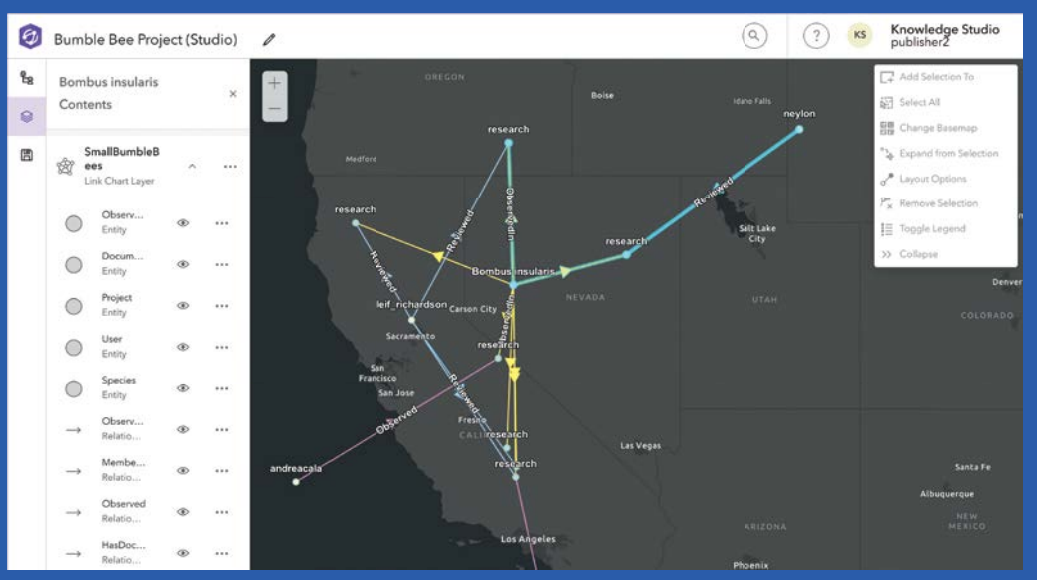
The beta community for ArcGIS Knowledge Studio can be found at links.esri.com/aks-beta.



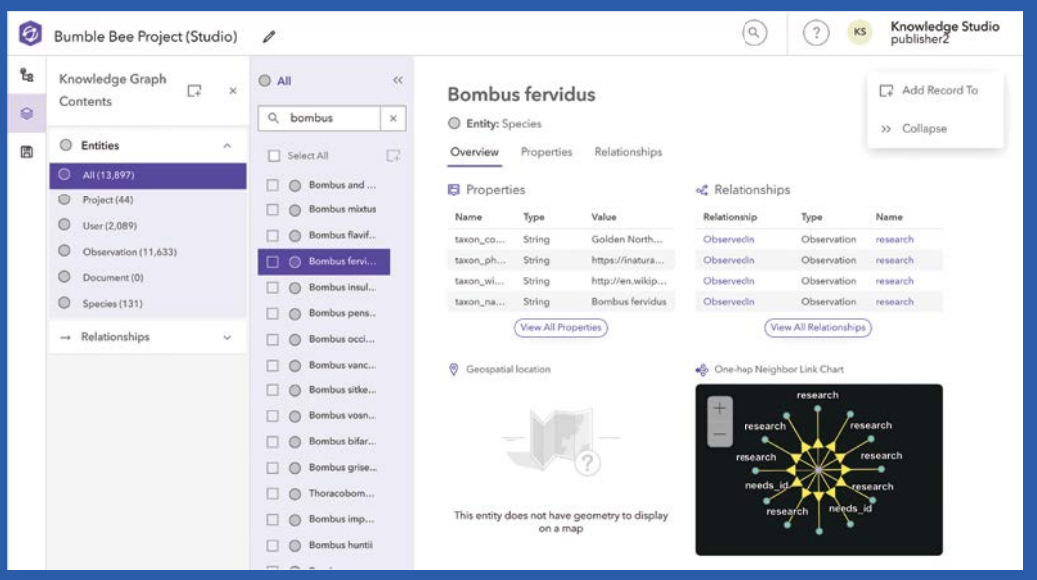
↑ Users can investigate the explicit relationships in their data on the web with link charts, maps, and entity cards.



↑ ArcGIS Knowledge Studio lets users easily toggle between geographic and other layout options to see data in its full context.



↑ Users can select and explore connections of interest and quickly add them to a new link chart or map.



↑ Users can search knowledge graphs consisting of several connected datasets for entities or relationships of interest.

ArcGIS Enterprise 11.2 Adds Key Analysis and Management Tools

ArcGIS Enterprise is the backbone of many organizations' data management and GIS workflows, powering products for collecting field data, conducting spatiotemporal analysis, creating maps and data visualizations, and sharing GIS work with stakeholders. Launched in November 2023, ArcGIS Enterprise 11.2 is part of the ArcGIS 2023 Q4 release and is available to all customers who are up-to-date on maintenance.

Map Viewer and Scene Viewer Get New Analysis Tools

In 11.2, Map Viewer includes spatial and raster analysis tools that were previously only available in Map Viewer Classic. These tools allow users to quantify data patterns and relationships. Users can browse or search for specific tools; set environment settings for an individual tool or a web map; and access a history of which tools have been run, their results, the parameters used, and any errors or warnings. When a user saves a map, the tool history is saved with it, providing job details and reopening tool parameters when the map is shared. This release also features item browsing improvements and scatterplot display features and allows users to configure and view related records in pop-ups.

↑ In Scene Viewer, a 3D model of the Desoto Park Community Center in Florida contains 40 million points. (Image courtesy of the University of South Florida.)

In addition, updates to Scene Viewer help users demonstrate 3D data in the following ways:

- They can snap to features while measuring distances.
- There are enhanced shading and higher-resolution terrains for elevation modeling.
- Higher-density point clouds capture building shapes for 3D city modeling.
- Higher-quality visuals—such as water reflections, better shading, and sharper labels—are available on all devices and in all ArcGIS web apps.

Updates to Content and Data Management

In terms of content and data management, 11.2 users can manage map services and feature services in the Enterprise portal. Prior to this release, all services referencing user-managed data stores had to be managed through ArcGIS Server Manager; now, some of these workflows can be done directly in the Enterprise portal via the item details page.

Likewise, the workflow to update data for hosted feature layers is easier and more streamlined. The item details page for a hosted feature layer now shows a single Update Data button and provides options to add and update features. Users also can remove fields and update field names when publishing a new hosted feature layer. These layers support overwriting and can be exported to KML for file-sharing via ArcGIS software or elsewhere.

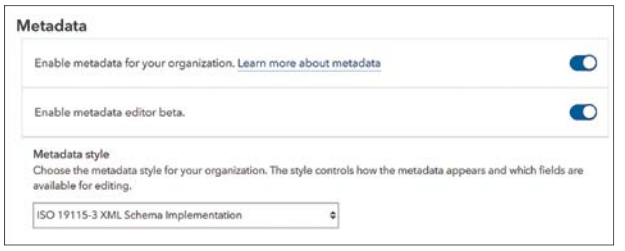
In 11.2, the ArcGIS Data Store comes in a few different configuration types, each of which is employed for a different purpose. The graph store, used by ArcGIS Knowledge Server, can now be configured to be highly available. To implement a highly available graph store, users can simply add a second graph store machine to their system. ArcGIS Video Server—new in 11.2—uses the object store to store video data. Because of this, there is added support to configure backups of the object store to protect against data loss. And the Data Store Configuration wizard has a new option to deploy the object store in single-machine or cluster mode, which benefits users who need high availability or scalability.

A New User Type Streamlines Licensing

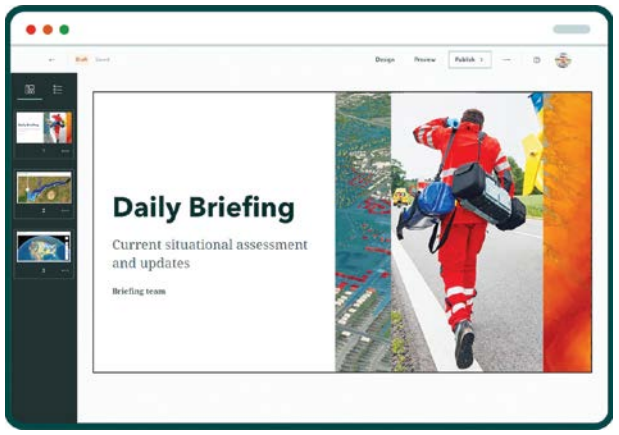
The ArcGIS Advanced Editing user type extension, which is being introduced in 11.2, provides additional advanced data editing and geodatabase capabilities in ArcGIS Enterprise, ArcGIS Online, and the ArcGIS Maps SDKs. This new user type extension streamlines licensing by replacing the existing ArcGIS Utility Network, ArcGIS Trace Network, and ArcGIS Parcel Fabric user type extensions and sets a foundation for future ArcGIS web editing capabilities. To learn more about this new user type extension, check out "Introducing the ArcGIS Advanced Editing User Type Extension" at links.esri.com/adv-edit-ute.

Several Interesting Features Released in Beta

Some of the new features in ArcGIS Enterprise 11.2 are in beta. Although this enables users to test-drive features and provide feedback to the product teams, beta features do not receive patching and are ineligible for Esri technical support. Limited



↑ Administrators can enable a metadata editor button.



← ArcGIS StoryMaps briefings allows users to integrate dynamic maps, data, multimedia, and more to create interactive stories.

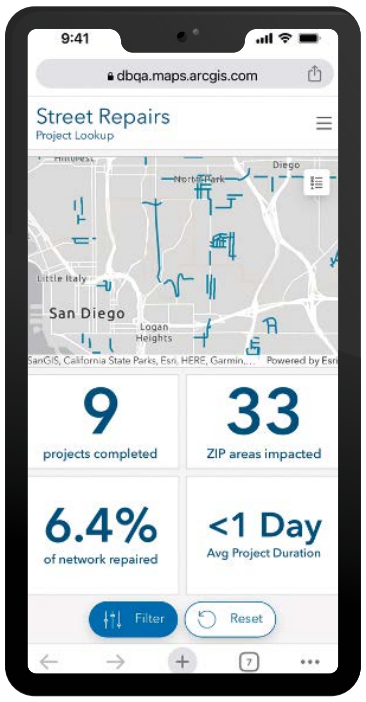
support is provided via an early adopter community or a similar forum. Users are encouraged to try beta features in test environments rather than production environments. Here are beta features included in this release (described in more detail at links.esri.com/11-2-beta-features):

- When enabled by an administrator, a new metadata editor adds a button that allows users to edit an item's metadata.
- Four new data field types—data only, time only, time stamp offset, and big integer—further refine how users handle date and time data.
- Users can upload 3D models in web scenes. After a 3D model has been uploaded, it can be resized, rotated, and placed anywhere in the scene.
- There's one-way, feature-service-to-feature-service synchronization. Users can establish a replica of a feature service that references the original data along with the copied data service. They can then run the synchronize replica operation to export and import any changes to the feature service.
- The new ArcGIS Knowledge Studio web app helps users explore and analyze knowledge graph data. Details about Knowledge Studio can be found on page 3 at links.esri.com/get-started-k-s.
- The ArcGIS StoryMaps briefings feature provides a slide-based output that lets users integrate dynamic maps, data, multimedia, and more to create interactive stories. Also, with the complementary briefings tablet app, users can view and present briefings whether online or offline.

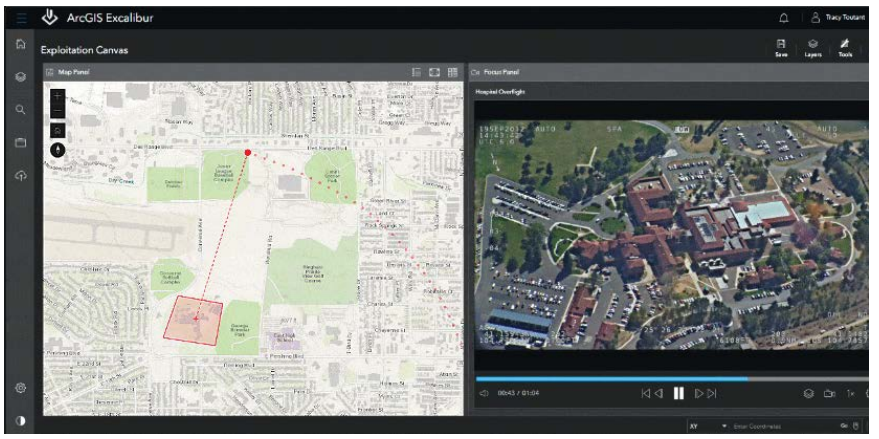
ArcGIS Enterprise on Kubernetes Supports New Environments and More

ArcGIS Enterprise on Kubernetes is key for running a high-performance, high-availability, Kubernetes-based GIS. For users of Windows- or Linux-based software, ArcGIS Enterprise on Kubernetes gives them the same ArcGIS Enterprise experience they are used to as they produce maps and apps, analyze data, and collaborate. New features and enhancements to ArcGIS Enterprise on Kubernetes include the following:

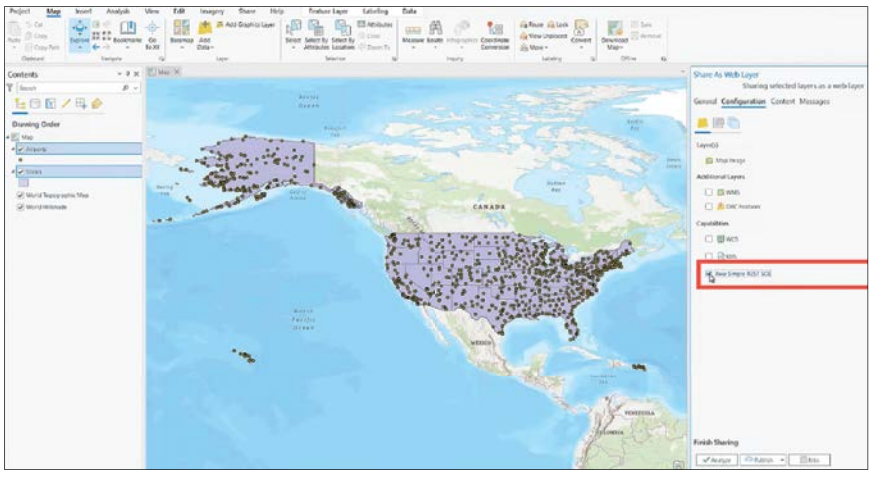
- Users can now license raster analytics to run within the deployment. Running deep-learning, analytics, and raster functions in Kubernetes is a perfect fit for these technologies, as raster analytics are typically batched and require a burst in resources and the need to scale quickly.
- Server object extensions (SOEs) are now available for ArcGIS Enterprise on Kubernetes map services. SOEs allow users to create service operations to extend the base functionality of map or image services, mostly by using custom code to work with geospatial data and maps. SOEs provide organizations with options to perform well-defined business logic that is not easily accomplished using the ArcGIS client APIs. For this release, SOEs must be enabled when sharing the service from ArcGIS Pro.
- ArcGIS Enterprise on Kubernetes supports two new environments—Rancher RKE and RKE2—opening more opportunities for customers to use Kubernetes.
- There is also new support for Red Hat OpenShift Service on Amazon Web Services (AWS) and Microsoft Azure Red Hat OpenShift. This additional support gives organizations increased flexibility to decide where to host their Red Hat OpenShift clusters.



↑ In ArcGIS Dashboards, users can configure a dashboard view for mobile devices.



↑ A video layer published through ArcGIS Excalibur plays in canvas view alongside a map showing the video telemetry.



↑ Server object extensions enable users to create service operations to extend the base functionality of map or image services.

What's New in Apps and ArcGIS Enterprise Server Roles

ArcGIS Image Server 11.2 has 28 new raster analysis tools in the terrain, deep learning, and multidimensional analysis categories.

ArcGIS Notebook Server 11.2 has an improved user experience and updated sharing capabilities. Users can now import code snippets into a snippet library and export a snippet library as Python (.py) files. The Notebooks home page has a new UI/UX to manage notebooks and scheduled tasks. It also enables users to access the ArcGIS Notebook Server Manager app (depending on user roles and privileges).

ArcGIS Workflow Manager 11.2 features new ways to manage workflows via the Diagrams tab. For example, users can review and compare changes using the Active/Draft toggle button or discard drafts via a dialog box without affecting active diagrams.

ArcGIS Mission 11.2 has many new features and enhancements for mission planning and execution. One is Broadcast Notifications, which allows for important information to be disseminated to all mission members at once. Another is the new Responder Navigation feature, which gives users quick and accurate directions to areas in need to help improve response time and overall mission effectiveness.

ArcGIS Video Server is now available as a new server role for ArcGIS Enterprise. It enables users to index, search, publish, and stream video as a service alongside its geospatial and temporal context.

ArcGIS Enterprise Sites introduces features and enhancements that enable users to configure permissions and page discovery at a more granular level. Site managers can choose who can edit individual pages without granting editing access to the entire site, preview how site and page drafts will display on different devices, and use meta tags to optimize how sites and pages appear in search results.

ArcGIS Dashboards in ArcGIS Enterprise 11.2 features enhancements that simplify and optimize the user experience. The Find my location option, for example, zooms to a device's approximate location, and the compass option reorients the map to point north. Users also now have the flexibility to configure a dashboard view for mobile devices using the same elements as the desktop view, as well as new dashboard elements to support viewers wherever their work takes them.

ArcGIS Experience Builder introduces new widgets that allow users to change basemaps, use interactive infographics with ArcGIS Business Analyst, and compare different layers and maps with just a swipe.

Details on ArcGIS Enterprise 11.2, including ArcGIS Enterprise on Kubernetes, can be found at links.esri.com/11-2. More information on migration resources and support can be found at links.esri.com/11-x-prepare.

Using GIS to Improve Accessibility for Philadelphians with Disabilities

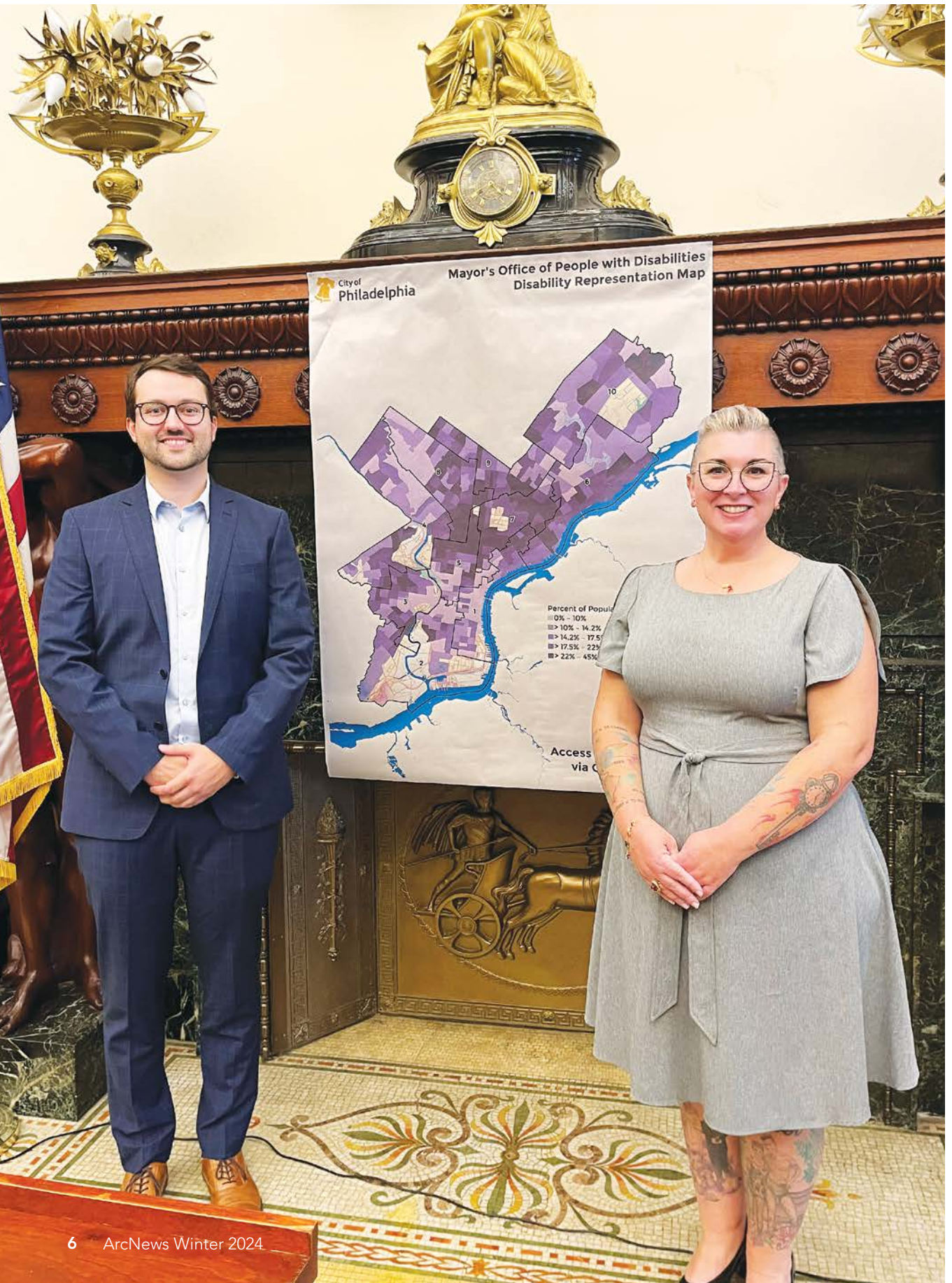
According to the Pew Research Center, roughly 42.5 million Americans—about 13 percent of the country's noninstitutionalized population—have disabilities. These individuals, who face challenges related to hearing, vision, cognitive function, walking, self-care, independent living, and more, often struggle to be seen and heard relative to the rest of the population.

Of all major US cities, Philadelphia has the highest percentage of individuals with disabilities—almost 17 percent. According to US Census Bureau data from 2020, Philadelphia is also one of the poorest major cities in the United States, which has made addressing disability-related issues particularly challenging.

This is why two Philadelphia city employees set out to create a map, published in 2022 and incorporating major accessibility upgrades in late 2023, that shows characteristics of the nearly quarter-million Philadelphians with disabilities.

In the process of creating this map, and with assistance from the Esri accessibility team, these GIS visionaries have set the stage for improved representation of people with disabilities in Philadelphia and beyond. They also may have set new standards in map accessibility.

↓ In Philadelphia's city hall, city employees Daniel Warner and Amy Nieves show Philadelphia's *Disability Representation Map* at an October 2023 press conference.



Using GIS to Represent the Underrepresented

In 2019, Daniel Warner, a GIS analyst for the City of Philadelphia, used US Census Bureau estimates to create a map showing the population density of Philadelphians with disabilities on a neighborhood level. His idea was to use this information to get more Philadelphians with disabilities to participate in the 2020 Census.

Of course, when COVID-19 hit, other issues took center stage. By 2021, the map was all but forgotten, and Warner was thinking about deleting it.

But one key person remembered Warner's map: Amy Nieves, a longtime advocate for the city's disabled population who was named executive director of Philadelphia's Mayor's Office for People with Disabilities in 2021. Nieves reached out to Warner, beginning a collaboration that has helped improve programs, services, and activities for people with disabilities in Philadelphia, along with their ability to advocate for themselves.

Improving Services and Representation Where They're Needed Most

The map, known as the *Disability Representation Map*, is available at links.esri.com/PhillyMap. Created using ArcGIS Online, ArcGIS Pro, ArcGIS Instant Apps, and ArcGIS Living Atlas of the World, it visually represents populations and provides a written summary of people's disability status, age, race, national origin, and gender. Its geographic overlays include census tracts, neighborhoods, ZIP codes, city council districts, Pennsylvania House and Senate districts, and US congressional districts.

It also shows a broad range of results. For example, the percentage of Philadelphians with disabilities ranges from less than 10 percent in some neighborhoods to as high as 40 percent in others.

Many Philadelphia city departments have used the map to help make city services more equitable and accessible in projects related to hazard mitigation, recreation, mobile libraries, outdoor dining areas, sidewalk curb grading, signage, and more. As Esri senior accessibility project manager Jessica McCall explained, "The map helps city leadership make better-informed decisions on where to locate essential services and support for specific communities." The map has also been useful in city grant applications; emergency planning; efforts to increase disability awareness; residential outreach and engagement; and compliance with the Americans with Disabilities Act of 1990, which prohibits discrimination based on disability.

For Philadelphians with disabilities, the map also represents a leap forward in representation and empowerment. For example, a Philadelphian with a disability can look at the map, read a written summary about a specific area, and then advocate for more services based on the data. According to Warner, "With this map, a disabled person can go to their councilperson or another elected official; show them the data; and say, 'These are your constituents. What are you going to do to improve their lives?' I think that's one of the most beautiful things I've encountered in this project."

Making Maps More Accessible

While the map was launched in 2022, in 2023 it was overhauled to improve its accessibility. This is when the US Access Board got involved, advising the Philadelphia project leaders and Esri on best practices for accessible design.

An independent federal agency that promotes equality for people with disabilities, the Access Board provides leadership in accessible design and developing accessibility guidelines and standards. The Access Board and the Esri accessibility team worked with the City of Philadelphia and dozens of Philadelphians with

disabilities to make the map as accessible as possible and to help improve ArcGIS accessibility standards. The upgraded map uses colors that are most likely to be clear to individuals with visual disabilities. It even has a monochromatic layer for people who have monochromatic color blindness.

It was one of the first maps to use Esri's Enhanced Contrast basemaps to improve accessibility, Warner said. "A lot of GIS professionals, myself included, are not accessibility experts," he explained. "With census data and this basemap, anybody can make a map like this now." Keyboard navigation options, thoughtful symbology, and a separate QR Code are other tools that support use of the map by people with disabilities.

Bringing Builders and Dreamers Together

Nieves noted the power of a solution that is not only built *for* a specific group but also *by* that group.

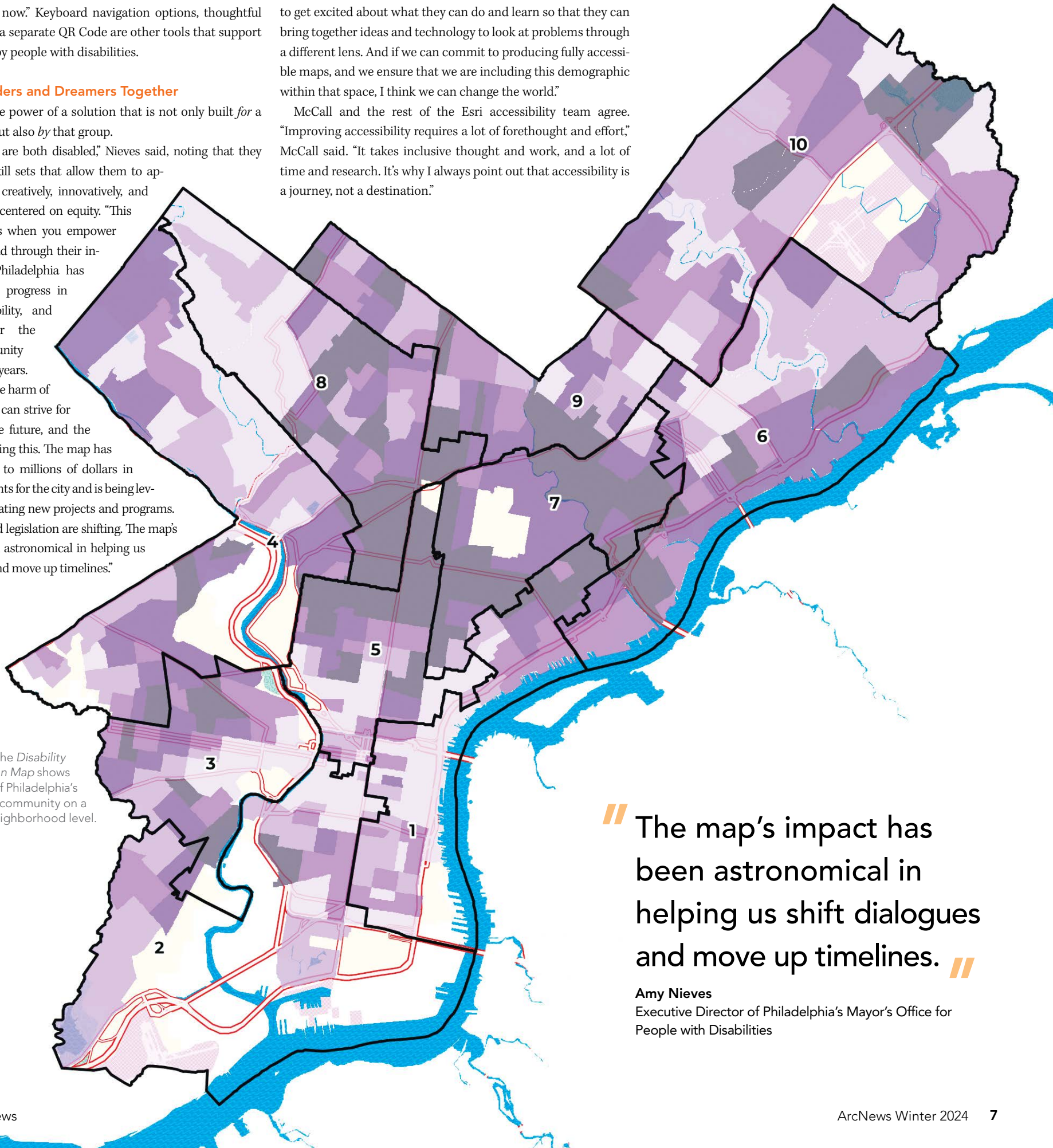
"Daniel and I are both disabled," Nieves said, noting that they have different skill sets that allow them to approach projects creatively, innovatively, and in a way that is centered on equity. "This is what happens when you empower employees to lead through their intersectionality. Philadelphia has made incredible progress in justice, accessibility, and engagement for the disabled community in the last few years. We can't erase the harm of the past, but we can strive for a more equitable future, and the map is key to doing this. The map has been connected to millions of dollars in equity-based grants for the city and is being leveraged when creating new projects and programs. Even policies and legislation are shifting. The map's impact has been astronomical in helping us shift dialogues and move up timelines."

Referring to Warner, McCall, and herself, Nieves said, "When you bring builders and dreamers together to solve a problem, it opens up a wealth of information for everyone else."

Looking forward, Warner and Nieves said that Philadelphia, with Esri's help, will continue to improve the map's ease of use for the disabled community—an effort that has much broader implications. "GIS unlocks so much, whether it's bird migration patterns, lava flows, or addressing poverty," Nieves said. "I want to see more people with disabilities and young people starting to get excited about what they can do and learn so that they can bring together ideas and technology to look at problems through a different lens. And if we can commit to producing fully accessible maps, and we ensure that we are including this demographic within that space, I think we can change the world."

McCall and the rest of the Esri accessibility team agree. "Improving accessibility requires a lot of forethought and effort," McCall said. "It takes inclusive thought and work, and a lot of time and research. It's why I always point out that accessibility is a journey, not a destination."

← This QR Code is one of many accommodations that facilitates access to the map.



→ The *Disability Representation Map* shows characteristics of Philadelphia's disabled community on a neighborhood level.

> "The map's impact has been astronomical in helping us shift dialogues and move up timelines."
>
> **Amy Nieves**
> Executive Director of Philadelphia's Mayor's Office for People with Disabilities

Sightsavers Uses ArcGIS Pro to Expand Trachoma Treatment in Kenya

Trachoma is the leading infectious cause of vision loss and blindness in the world, according to the World Health Organization. In Kenya, the disease is highly prevalent due to inadequate water access, poor sanitation, and limited health care, especially in the country's rural and remote areas. An additional challenge is the difficulty of tracking seminomadic tribes such as the Maasai.

Though it's easily preventable and treatable in its early stages, trachoma is considered a major health risk in Kenya and about 40 other countries where an estimated 115 million people are at risk of vision loss due to trachoma. The disease is spread by infected flies or from contact with an infected person. When left untreated, trachoma causes scarring and inward-growing eyelashes, which scrape a person's eyeballs and can eventually lead to blindness.

To address this devastating disease, the World Health Organization recommends a strategy of surgery, antibiotics, face cleanliness, and environmental improvements. The organization aims to eliminate trachoma as a public health problem by 2030.

Sightsavers is a nongovernmental organization and Esri Nonprofit Program participant that was founded in 1950. Sightsavers partners with government agencies and other nongovernmental organizations in developing countries to treat and prevent avoidable blindness. As part of this effort, Sightsavers is using ArcGIS Pro, ArcGIS Online, ArcGIS Field Maps, ArcGIS QuickCapture, and ArcGIS Dashboards to help Kenya's Ministry of Health identify gaps in the distribution of antibiotics that prevent trachoma transmission in Kenya.

Sharing GIS Data to Prevent Vision Loss

Sightsavers began working in Kenya in 1952. Although the country's government has committed to universal health care, many people in Kenya—especially in remote areas—struggle to access health-care services and water for sanitation. As a result, an estimated 7 million people in Kenya are at risk of trachoma.

"Our participation in the Esri Nonprofit Program, as well as other relationships that we have developed, has helped us expand our services to those in need through the exchange of data," said Alexandre Chailloux, senior research associate for spatial analysis at Sightsavers.

Many nongovernmental organizations work on different projects in the same geographic areas where the availability of population records and administrative data is poor, Chailloux said. "Capitalizing on the opportunity to share GIS data between the different organizations improves the efficiency, accuracy, and outcomes of their activities—ultimately improving the life opportunities of many more individuals," he added.

The Ministry of Health has performed annual mass drug administration campaigns in those areas of rural Kenya where trachoma has been prevalent for many years, Chailloux said. "However, significant reinfection was common only a few years after treatment. A primary reason for the limited success was because we weren't entirely sure of the locations of all community groups living in rural areas," he explained. "Additionally, there's a corridor that runs through Tanzania and Kenya used by the Maasai, a seminomadic community, and knowing where they are located at the moment of the drug distribution is challenging."

A New GIS Methodology

In 2022, Sightsavers provided support to the Ministry of Health by introducing a new GIS-based mass drug administration system. First, satellite imagery is used to identify all of Kenya's potentially inhabited rural areas. Those areas are then georeferenced along with the rural communities that local community drug distributors currently visit. This allows Sightsavers and the Ministry of Health to identify gaps in the distribution of trachoma drugs.

Sightsavers and the Ministry of Health employ ArcGIS technology throughout the process. Sightsavers' GIS analysts use online population and settlement data along with satellite imagery to identify dwellings in ArcGIS Pro, which is also used for geoprocessing and spatial analysis. The analysts develop interactive maps and apps in ArcGIS Online. Community drug distributors use Field Maps to find settlements and dwellings and to georeference their locations while employing QuickCapture for data collection. Supervisors use Dashboards to monitor progress.

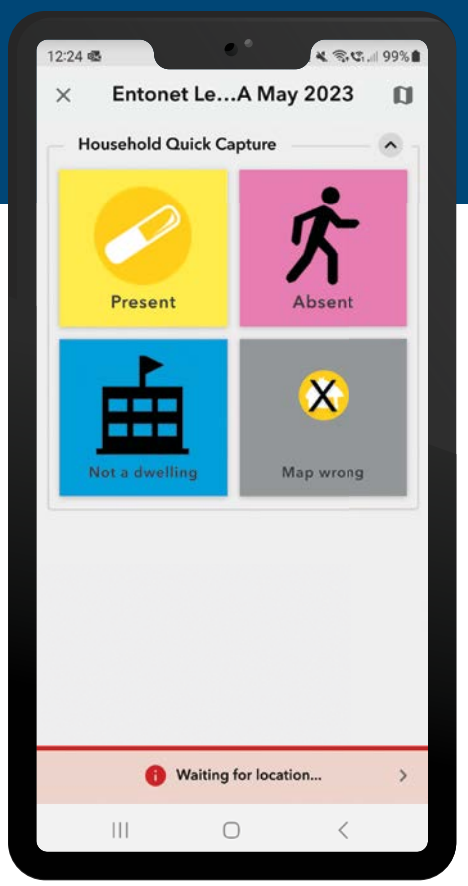
To evaluate the effectiveness of the GIS-based system, Sightsavers implemented real-time mass drug administration monitoring in three wards of Kajiado County. This is an area where trachoma is endemic, Chailloux said, noting that QuickCapture is easy for community drug distributors to use for data collection and that it doesn't add too much work. "Information collected included the number of household members at home; the number of household members that were treated with trachoma drugs; and the identification of buildings, such as communal structures and animal shelters, where no treatment was necessary," Chailloux explained.

The ArcGIS technology-based process proved to be very successful, significantly increasing mass drug administration coverage and community drug distributor resource planning while allowing trachoma treatment to be expanded.

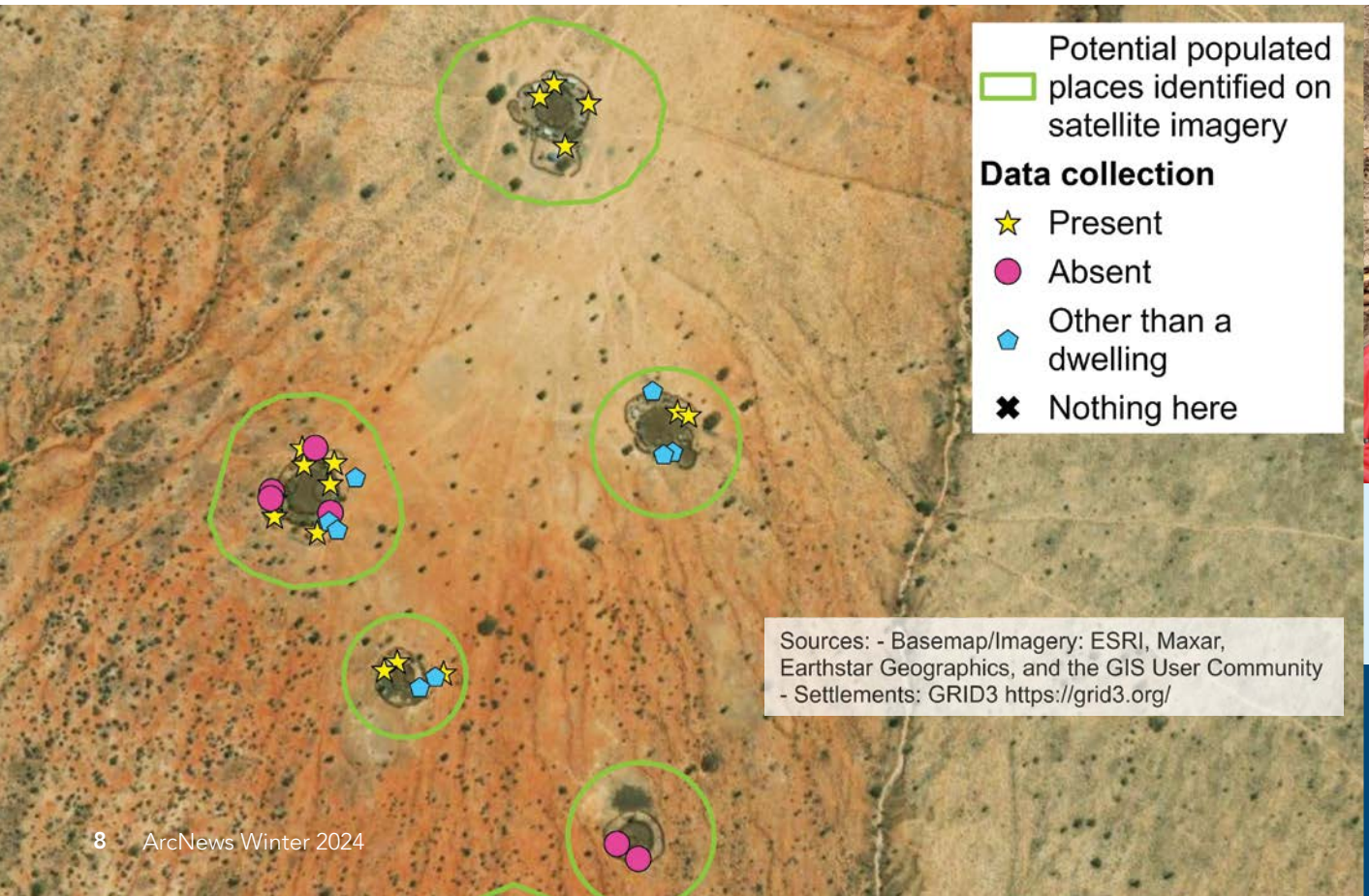
Scaling Up GIS and Cross-Border Coordination

Looking forward, Chailloux would like to better understand the factors that lead to severe reinfection events, despite good mass drug administration coverage. "We'd also like to expand our cross-border coordination of trachoma treatments to ensure that those living in remote border areas are included," he said. "This will help countries to meet the World Health Organization's goal of eliminating trachoma by 2030."

Sightsavers also wants to scale up its use of GIS, including mapping nomadic communities' migratory patterns so that these can be linked with the dates of mass drug administration campaigns. "Lastly, we want to develop new geospatial tools to enhance the supervision and timely oversight of our trachoma elimination campaigns," Chailloux said. This will result in quicker decision-making that is based on data analysis and will ultimately help the Ministry of Health improve mass drug administration coverage.



↑ ArcGIS QuickCapture provides Kenya field staff a simple method to collect data for mass drug administration.



↑ Community drug distributors prepare azithromycin for trachoma treatment during a mass drug administration activity in Kenya.

← Satellite imagery and data collection provide visual data in the effort to expand trachoma treatment in Kenya.

More information on the Esri Nonprofit Program can be found at links.esri.com/nonprofitprogram.

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"I truly believe GIS currently is and will be one of the most effective forms of communication in the coming years. Intuitively, humans have an innate sense of looking at a map and understanding what story it is trying to tell. Regarding whatever realm of work, there is always a place where GIS can be utilized effectively. Without the GIS knowledge that I acquired from the program at Redlands, the experience I received, and the Redlands Alumni Network, I would not have this position or unbelievable lifestyle I have today."

—J. Keaton Thompson '21
GIS Engineer
Naval Facilities Engineering Systems Command of Hawaii

Nigeria Applies Advanced Geospatial Technology for Census Preparations

For the First Time in Its History, the Country Plans to Use Digital Tools to Prepare an Accurate Population Count

Based on 2006 census data, the United Nations (UN) estimates that 224 million people now live in Nigeria. According to this estimate, Nigeria is Africa's third-most populous country and the sixth-most populous country in the world. The UN predicts that by 2050, Nigeria will be the third-most populous country in the world, behind only China and India.

Having a more accurate count of how many Nigerians there are—and a better understanding of where they live—is critical for many reasons, including implementing health and education plans and discovering where housing may be in short supply. However, it's been nearly 18 years since Nigeria conducted an official census.

In 2006, Nigeria's census information was collected and recorded on paper. Now, Nigeria is preparing for its first digital census. Nigeria's National Population Commission (NPC), which conducts the census, has embraced GIS technology—in particular, ArcGIS Online, ArcGIS Pro, and ArcGIS Enterprise—as it prepares to create a digital record of the country's population and housing. The census will be essential for eventually determining where to invest the country's resources and provide services to the people who live there.

Former Nigerian president Muhammadu Buhari has said that the country's inability to conduct a census since 2006 had created an "information vacuum," as the data had become out-of-date. Originally scheduled to take place in March 2023—less than a month after a presidential election—the census has been postponed twice as the country continues to wait (as of press time) for its new president to declare when it will be conducted.

Using GIS for an Accurate Count

In the meantime, the NPC has spent years preparing, including conducting a trial census to test its operations. Its mission is focused on accurate and reliable data collection and analysis. That's why the NPC turned to cutting-edge technology, said Foluke Yetunde Adebayo, coordinating director for the NPC's GIS and data quality management.

"We developed a suite of customized geoprocessing tools designed to streamline and enhance critical aspects of our data management processes," she said. The tools address several key functions in the NPC's data management workflow, including data cleaning, editing, boundary delineation, geocoding, and data validation.

The NPC based the foundation of its mapping work on the Global Statistical Geospatial Framework, established by the UN.

"A fundamental aspect of this approach is the assignment of precise geospatial attributes to all new entities or records of persons, households, and buildings that are collected from the field," Adebayo said. "These attributes are assigned based on the geographical location of the entities, enabling a robust geospatial dimension in the database."

The NPC began introducing GIS into its census preparations in 2014 using ArcGIS technology. High-resolution satellite imagery was used to identify features on the ground, including buildings, roads, railways, water bodies, and boundaries of villages and towns. The identified features were then geocoded, resulting in a countrywide basemap. The basemap was then used to create enumeration areas, the geographic areas that census takers canvass.

Technology Plays a Critical Role in Preparations

ArcGIS Online serves as a central repository for the NPC's large dataset, which includes millions of building records and the enumeration area frame. During an end-to-end test conducted in preparation for the census, ArcGIS Online also allowed for about 600,000 devices in the field to access the server simultaneously without any glitches or downtime, Adebayo said. This enabled workers to access and update data seamlessly, a critical aspect of a successful census operation.

The NPC's GIS analysis team used ArcGIS Pro—and ArcPy in particular—to clean the dataset, identify and correct spatial topology errors, create thematic maps, and geocode.

In ArcGIS Enterprise, the commission used ArcGIS Server, ArcGIS Data Store, and ArcGIS Enterprise portal for tests and the trial census. So far, ArcGIS Enterprise has managed the results of field data collection, including household listing datasets. The NPC has also used ArcGIS Enterprise to create census dashboards for data visualization within a secure organizational environment. Eventually, ArcGIS Enterprise will play a vital role in managing and visualizing the resultant census data, Adebayo said.

Once the census is underway, the data collected by field enumerators will be cross-referenced with initial mapping data. This comparison helps identify any significant changes or discrepancies between the two datasets. The validation process will be automated using custom scripts in ArcGIS Enterprise. The scripts are designed to evaluate whether the observed level of change in the data falls within the expected range or if it exceeds the predetermined threshold, which prompts further review.

The commission plans to use a hybrid census mapping methodology to count people living in remote locations and areas of conflict. Aided by high-resolution satellite imagery and neighborhood analysis theory, the NPC demarcated all conflict areas that may be inaccessible. If the areas ultimately can't be accessed by enumerators during the census, the NPC plans to estimate populations by using modeling techniques developed by spatial data solutions company GRID3.

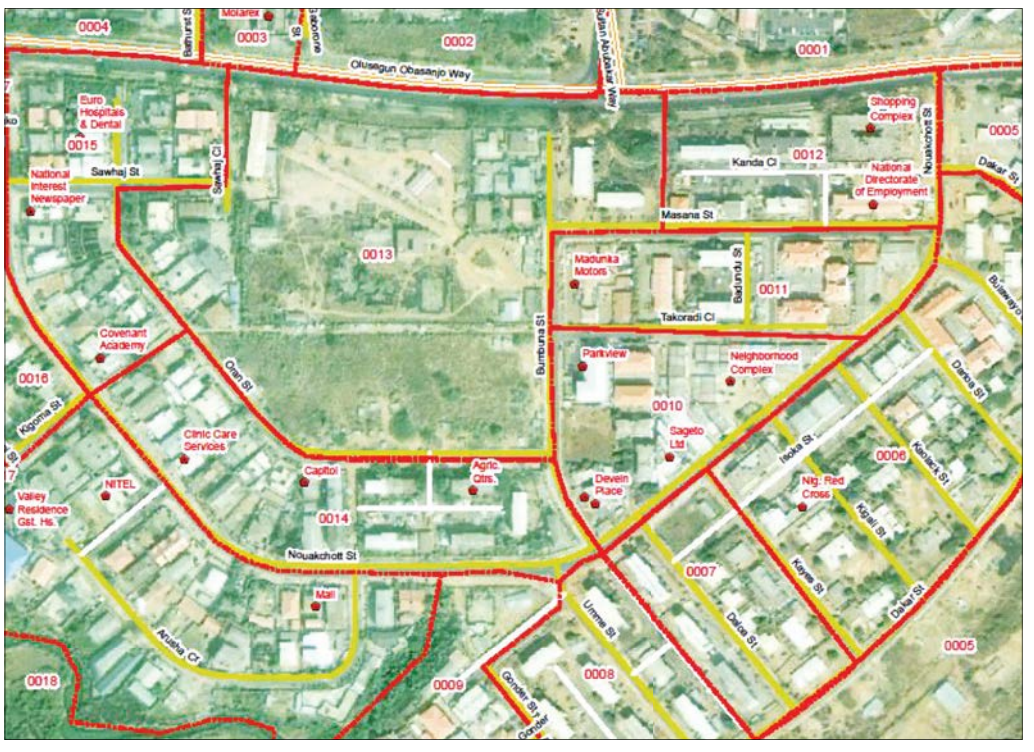
Looking Beyond the Census

Using the maps created for the census, the Nigerian Postal Service is developing a modern, digital postal code system. The NPC created custom tools in ArcGIS Pro to apply a set of well-defined rules and a coding system to meet the unique requirements of the project. "Its core function is to delineate the entire country into postcode areas, each of which was restricted to a size not exceeding two hectares *[nearly five acres]* and limited to containing no more than 99 postcode units," Adebayo said.

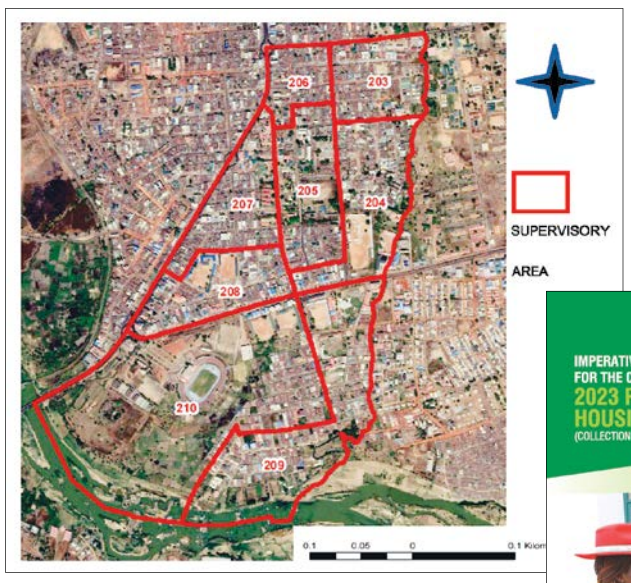
In the future, the commission hopes to use geospatial artificial intelligence tools to assist in updating maps, processes, and estimates. "This will significantly enhance the accuracy, efficiency, and automation of geospatial data management and reduce the resources required to update the data," Adebayo said.

The NPC also expects to develop more GIS tools and models for analysis. It won a Special Achievement in GIS Award at the 2022 Esri User Conference for its use of GIS technology in preparing for the census. By basing the census on a well-planned geospatial platform, the country will be able to standardize its procedures and more easily extract critical demographic data.

↑ A state coordinator trains researchers for the Nigeria census.

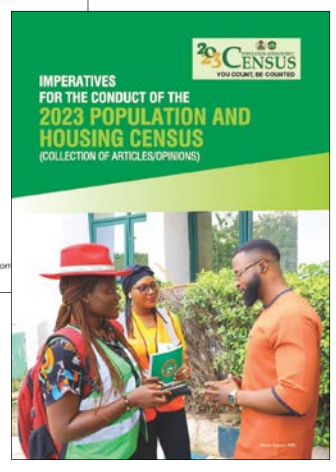


← Nigeria's capital city of Abuja was also demarcated into enumeration areas.



→ Field researchers conduct research for the Nigeria census.

← To prepare for the census, all of Nigeria was demarcated into enumeration and supervisory areas, which generally include from two to five contiguous enumeration areas.



Córdoba Implements GIS to Boost Smart Community Strategy

↑ In developing its smart-city approach, Córdoba sought to improve the lives of residents and where they live, work, study, and play.

Home to more than 1.5 million people, Córdoba is Argentina's second-most populous city. The centrally located capital city stretches 222 square miles across the center of Córdoba province and is connected by a complex bus network. It's an economic and cultural hub, with the National University of Córdoba—the country's oldest university—attracting students from around the world.

For decades, city staff have used GIS to monitor and improve infrastructure, public safety and health, planning, and engineering. Córdoba's local government is divided into 16 decentralized community participation centers so that the needs of residents in individual regions can be prioritized.

Recently, city staff implemented a variety of geospatial tools including ArcGIS Dashboards, ArcGIS Survey123, ArcGIS Experience Builder, ArcGIS Web AppBuilder, ArcGIS Hub, and ArcGIS StoryMaps to enhance the government's territory management strategy and help Córdoba become a smart city. These tools modernize operations, balance the natural and built environments, fuel equitable and inclusive policies, promote sustainable development, and allow city agencies to more easily engage with the public.

Opting for the Cloud

For Córdoba, being a smart city isn't just about collecting geographic data—the goal was to improve the lives of residents and the places where they live, work, study, and play. Mayor Martín Llaryora requested an effective way for each government office to gather, visualize, and analyze data, which would help senior management make data-driven decisions.

Before establishing this strategy, it was often difficult to understand and use city data in meaningful ways. "People would produce reports with printed out pages of a spreadsheet," said Víctor Di Rienzo, Córdoba systems and connectivity undersecretary. "I saw one report that had 35 columns and more than 500,000 rows of data. This made it very difficult to sort through data for analysis and decision-making."

The first step in the process was to migrate georeferenced data to ArcGIS Enterprise, creating a comprehensive geodatabase that employees could maintain, update, and validate. This data is used to improve transportation routes, identify new economic centers, launch enhanced and accessible health services, plan for future roads and services, and accomplish other evidence-based initiatives. Because city agencies must respond to issues across the region, it's important that data is centrally located and easily accessible by all departments, regardless of their location. A cloud-based GIS makes information accessible to city staff, external partners, and the general public.

From inspections to repairs, information is collected with ArcGIS Survey123 and synced to the cloud. According to Córdoba data and statistical analysis director Andrés Michel, training and implementation were swift; in less than a week, teams were able to use the tool. It was important that staff members who weren't familiar with GIS could use it.

Di Rienzo said teaching staff members to use Survey123 is an easy way to convey fundamental GIS concepts to beginners. "We found that once we provided training; set up initial workflows; and explained how to upload, manage, and format the data, it didn't take long for a user to learn the basics and some of the more advanced features of ArcGIS," he said. "It opened their eyes to data visualization and decision-making like never before."

Sharing Information

Using ArcGIS Hub, the city launched a smart community portal, which can be found at comunidadinteligente.cordoba.gob.ar, to share collected information with partners and the public. Users can access planning and survey data or explore cultural and environmental information. The portal is a collaboration tool for city agencies, external partners, and residents. For example, residents can interact with data about the city forest plan by species or neighborhood. Users can learn which trees they can plant based on their location or how a certain species is dispersed in an area.

"We're using GIS data to provide context for the information," said Michel. "With a little bit of work, you can readily perform spatial analyses with your tabular data and show it in the context of a map of the urban passenger transport system."

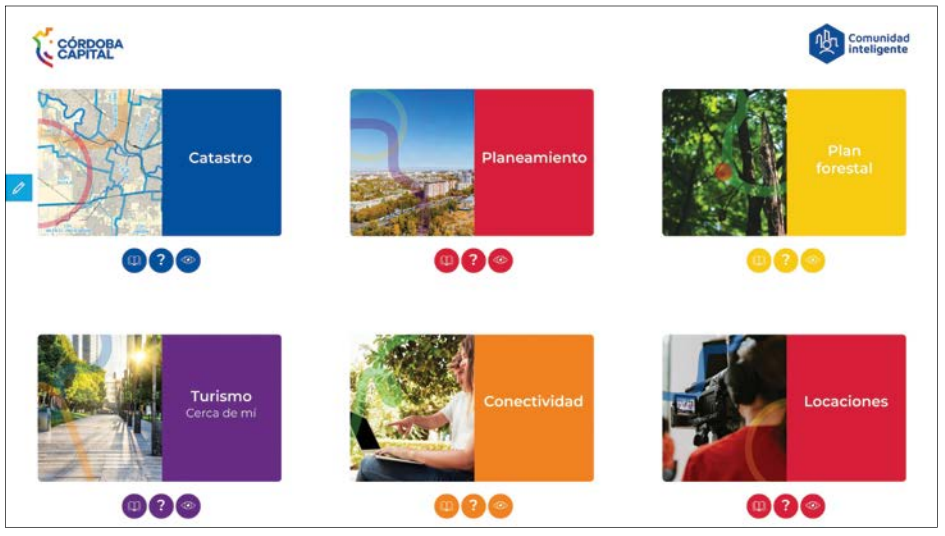
Combining geographic information in one accessible system allows for other integration opportunities. Cadastral data—plots, addresses, and streets—is standardized so that neighborhoods are defined in accordance with cadastral standards and are georeferenced transparently. This information can then be displayed and analyzed in one view with ArcGIS Dashboards, making it easier for city leaders to make decisions.

A Plan for the Future

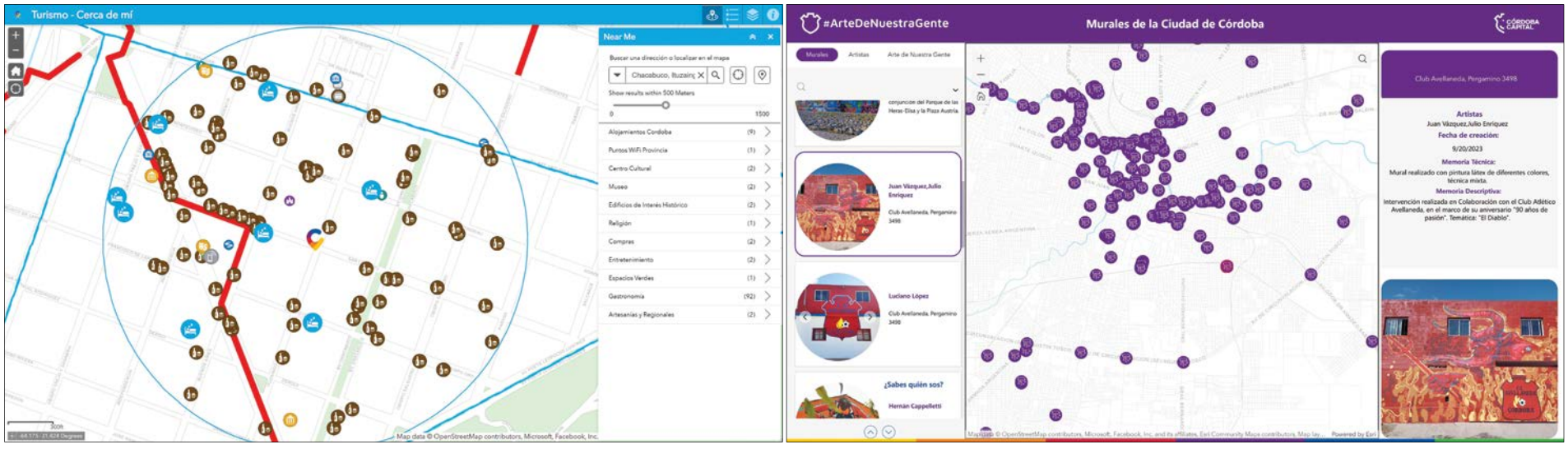
Córdoba's objective is to enhance the lives of its residents. As a smart community in today's evolving landscape, this requires a comprehensive long-term strategy that places residents at the core of its plans. Whether assessing the impacts of ongoing developments or reevaluating zoning regulations, environmental considerations, and infrastructure, it is crucial to incorporate reliable data, analysis, and mechanisms that facilitate transparent communication with the public.

Geospatial tools improve Córdoba's territory management strategy by revealing patterns in transportation, land use, density, and more. These insights ensure that all populations are duly considered and adequately served while equipping decision-makers with the information they need to plan for the future.

Prioritizing individuals and geographic location as guiding principles for planning projects makes the pursuit of smart initiatives worthwhile. By implementing the right tools and processes, Córdoba is revolutionizing its operations and enhancing the well-being of its residents at the same time.



↑ Córdoba's smart-city apps include land registry and planning, forestry, tourism, and internet access.



↑ The maps that city staff have developed include ones that show the locations of urban art in Córdoba and places of interest for tourists.

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Vermont Speeds Flood Response with ArcGIS Online and Site Scan for ArcGIS

graduate students, it has also quickly become an authority for using drones for mapping.

Depending on the need, five to 15 drone operators in the lab map everything from forest health to stream corridors to gravel pits. The drone team has even been tapped for train derailments, missing-person searches, and homicide investigations.

The team has also carried out congressionally directed research funded by the Federal Aviation Administration since 2020, examining the role of drone technology in disaster response and recovery. This work, carried out through the Federal Aviation Administration's Alliance for System Safety of UAS through Research Excellence (ASSURE), is helping integrate drone technology for use with emergencies and disasters.

In fact, an environmental disaster ultimately led to the start of the lab's drone program. During Tropical Storm Irene in 2011, O'Neil-Dunne said, clouds hampered data collection by satellites and piloted aircraft and it was difficult to task staff in a timely manner. O'Neil-Dunne believed that there had to be a better way. The tropical storm also inspired the decade-long effort to further the laboratory's relationships with state agencies, eventually leading to the successful collaborative response during July's historic flooding.

"There was such a need 12 years ago for this rapid data collection and dissemination," said Evan Robinson, the Vermont Agency of Transportation's UAS program manager, referring to Tropical Storm Irene. The transportation agency has been operating drones for about five years and has partnered with O'Neil-Dunne's team since the beginning, Robinson said.

Coincidentally—and conveniently—two weeks before the July 2023 storm hit, Esri staff had convened multiple state agencies in the same room with O'Neil-Dunne and his lab team to discuss how to approach collaborating on an emergency situation and various what-if scenarios.

"That really set us up for success," O'Neil-Dunne said.

Using GIS to Collaborate in the Midst of a Storm

On the morning of July 10, 2023, O'Neil-Dunne was steps away from attending the opening remarks of the Esri User Conference Plenary Session in San Diego when he got a call from Robinson. In an already saturated Vermont, a rainstorm—not even a named storm—was unleashing inches of water that would exceed what Tropical Storm Irene delivered and lead to catastrophic flooding.

Ultimately, "the storm parked there. It just kept pouring," according to John Adams, director of the Vermont Center for Geographic Information. Satellite imagery wasn't coming through as quickly, easily, or clearly as the agencies needed. The state needed drone support to document the impact. Robinson and Adams knew they could depend on O'Neil-Dunne's team of staff and students.

Working from a hotel lobby, O'Neil-Dunne prepared a strategy with his colleagues. Before his red-eye flight touched down back in Vermont, his team was already outside launching drones.

Adams used ArcGIS Online to create a single site—a common operational viewer—within hours of the storm's start, where the lab's team and state agencies would contribute and view imagery and geospatial data.

To capture its aerial imagery, the University of Vermont's drone team worked long hours, sometimes knocking on residents' doors for permission to launch a drone from a front yard or backyard or venturing into remote areas with limited or no cellphone service in order to find and capture landslide imagery.

The team's 11 drones took oblique aerial photos to determine high-water marks and for mapping, and the imagery was orthorectified (processed to correct optical distortions from the sensor system) to map the storm's topographic impact. Lidar-equipped drones helped quantify sediment loss and identify landslides that were under tree cover. In other cases, by using mapping with multispectral sensors, the team could assess crop damage. In the weeks after the flood, the lab acquired satellite imagery from Esri partner Planet Labs, which captures imagery of all the land on Earth each day, to quantify any drop in crop productivity based on data before and after the flood.

The lab initially used ArcGIS Drone2Map as it captured imagery, bringing the results into ArcGIS Pro and then configuring

↓ Flooding from the Winooski River and its tributaries affected homes, businesses, and the roundabout in Waterbury, Vermont.

↑ A University of Vermont student launched a drone for reconnaissance prior to a lidar mapping mission of a landslide in Barre, Vermont.

→ The Federal Emergency Management Agency used an orthomosaic drone map showing flooding in Cambridge, Vermont, to support the disaster-area declaration.

it in ArcGIS Online. At the suggestion of Esri's Disaster Response Program staff, though, O'Neil-Dunne tried Site Scan for ArcGIS, which reduced the number of clicks required to do even further processing. "That really changed things for us," he said. Through Site Scan, he could more easily share what his team was capturing—via links, files, and interactive sliders that showed what an area looked like before and after the storm—as well as 2D and 3D views.

"The ease of use of the technology was crucial because we were working 20-hour days," he said.

As imagery came into the shared site from the Spatial Analysis Lab and state agencies, Adams's team read metadata, obtained geographic points, and formatted them into a hosted feature layer that could be made available in a web app within hours of the images being captured. The team eventually set up an automated task that would rename photos based on the towns where they were taken. The team also turned the lab's orthomosaics into cloud-optimized GeoTIFF files containing spatial reference information that could be imported into ArcGIS Pro and preserved in an archive.

Then, without overloading any servers, it was all shared with the Federal Emergency Management Agency in a secure ArcGIS Online group as well as with the emergency operations center and local media via a map viewer app.

Taking a Problem-Solving Approach, Together

O'Neil-Dunne credited his team of students and staff for their confidence under pressure, noting that it was crucial to the mission at hand: getting data to the people who needed it, as quickly as possible.

"Because they have degrees in geography, environmental science, forestry, *[and]* wildlife biology, they really come at this from understanding that the data products are what's crucial in these cases," he said. "The commonality is they've all taken GIS courses. In the end, this is about mapping. This is about getting mapping data."

O'Neil-Dunne hopes that, for future emergencies, every town in Vermont will have drones that can send imagery and data for analysis. He plans to use the July flood response as a case study for a drone training course. "We're in this together, and what matters most is helping Vermont respond, recover, and rebuild," he said.

Interact with a map of collected imagery from the July flooding event at links.esri.com/VermontFloodMap.

Share Curated Map Collections Quickly with the Atlas Instant Apps Template

Organizations of all types need to leverage geospatial data in ways that improve operations, support collaboration, and boost business outcomes. Being able to quickly implement solutions that make data more accessible to stakeholders across an organization is key to making this happen. But that's not always easy.

Consider the GIS department at a government agency. The department receives frequent requests to assemble geospatial content in support of specific tasks, projects, or missions, such as transportation and land development or disaster response. This content needs to be used by agency staff members, external stakeholders, and sometimes the public—none of whom typically have time to deal with a steep learning curve. The GIS team collates data from different departments and, at times, several industry partners, meaning that the data is stored in multiple locations and can be difficult to gather, parse, and share.

Using Atlas, a new app template in ArcGIS Instant Apps, GIS analysts can instead—within minutes—create lightweight, interactive web apps that enable stakeholders to explore collections of carefully curated geospatial content. The app essentially allows GIS analysts to create a digital atlas that's easy to explore, presents layers of context that enable users to conduct simple analyses, and allows for easy sharing.

There are several advantages to using Atlas to build simple apps of curated content, including the following:

It's Easy to Assemble a Relevant Data Collection

When GIS analysts first receive a request, they need to determine what data is relevant to the request and where to locate it. Oftentimes, relevant data is stored privately on someone's computer, shared with a specific group in an organization, or saved within another organization's system.

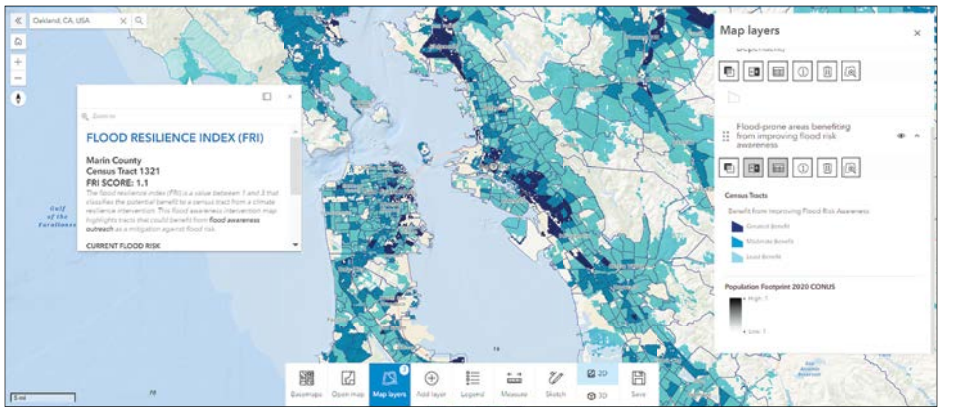
Once GIS analysts locate the data they need and load it into ArcGIS Online, they must organize it in a way that end users can access it. A common practice is to create a group in ArcGIS Online, where GIS analysts gather curated content and grant access to stakeholders (from both inside and outside the organization) by making them members of the group. GIS analysts can also enable group members to retrieve and see other organizations' content by establishing a partnered collaboration between ArcGIS Online organizations.

↑ Atlas automatically pulls each item's title, thumbnail image, and description.

From within the group, GIS analysts can then use the Atlas template in ArcGIS Instant Apps to create an interactive app that serves as a digital atlas for users to explore maps and data. All the maps and layers that were added to the group automatically populate the Atlas app, putting them in one place where group members can access them. (Alternatively, GIS analysts who don't create a group in ArcGIS Online in advance can manually pick and choose what content to add to the app as they're configuring it.)

Atlas automatically pulls each item's title, thumbnail image, and description and organizes the content into predefined categories that are relevant to the group. This enables users of the Atlas-built app to easily browse the maps and layers or search for specific content using keywords.

To create a good user experience, GIS analysts should think about what content is most relevant to the app's audience and double-check that maps and layers have easy-to-read pop-ups and sufficient metadata. They should also organize the content into categories that are pertinent to group members and create bookmarks that users can employ to focus the map on certain areas of interest.



↑ Users can interact with areas on a map by opening pop-ups, measuring distance and area, and more.

It Provides an Intuitive Map Exploration Experience

Since the users of an app may have little or no GIS experience, GIS analysts need to ensure that all members of their audience can effectively explore and interact with the data and discover the information they need without guidance.

Atlas enables GIS analysts to efficiently create a simple app that lets users open various maps from a gallery and interact with different areas on a map by searching for a location or zooming to a spatial bookmark, opening the legend and pop-ups, using a swipe tool, and measuring distance and area. Users can also choose other basemaps and add or remove map layers to gain additional insight. The Atlas app-building template includes a large toolbar menu on the bottom that allows GIS analysts to add or remove tools to best suit the group for which they're building the app.

For example, to provide additional perspectives on the same dataset, GIS analysts can add a tool to their app that lets users change the view of the map from 2D to 3D. With this, users can explore the terrain, observe shade and wind shields by panning the map, open a weather simulation, and calculate an area's elevation profile.

↑ GIS analysts can add a tool to their app to let users change the map view from 2D to 3D.

It Allows Stakeholders to Save and Share Their Work

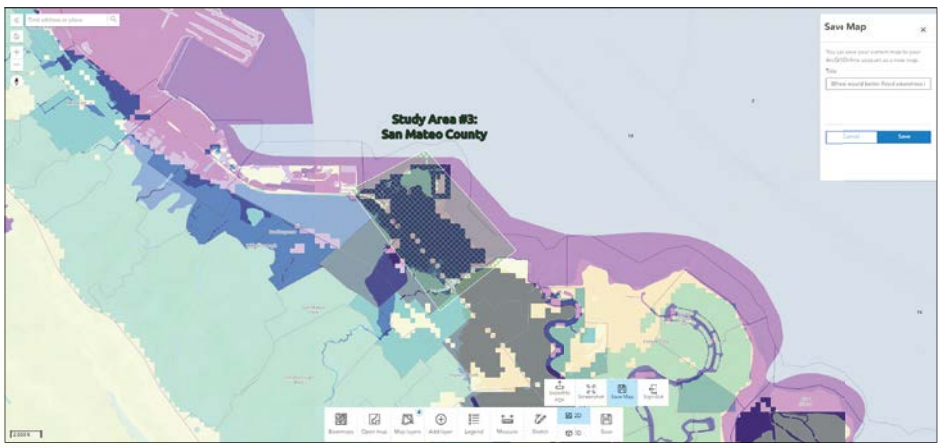
In many instances, stakeholders need an easy way to share the geospatial work they've done so that they can effectively collaborate with others. After a hurricane, for example, a city government GIS department may be asked to coordinate with federal agencies to get aid, insurance companies to report damaged areas, emergency medical teams to coordinate rescues, and the media to keep the public updated.

Apps made using the Atlas template allow users to employ sketch tools to make notes and mark locations on a map. After users explore the map, glean insight from the data, and add notes and markups, they can save their work as a new map in ArcGIS Online and create an entirely new app with it, such as an ArcGIS StoryMaps story. They can also share their work with other stakeholders by taking a screenshot of the map, complete with a legend and pop-ups, or exporting it as a PDF.

GIS Analysts Can Quickly Meet Deadlines and Organizational Requirements

Even when GIS analysts need to create solutions on a short timeline, those solutions often must meet their organizations' requirements for accessibility, mobile responsiveness, and even branding.

Instant Apps—including Atlas—is designed to help GIS analysts and other app creators build focused, interactive web apps from their maps in minutes. Using the default express setup options, GIS analysts can publish their apps quickly by only including the essential settings in Atlas, such as a preset theme and simple map tools like search and zoom control. For apps that require additional customization, they can use the full configuration of Atlas to explore and add other map tools and change the app's appearance by, for example, including a cover page, inserting a customized app title, and incorporating a logo.



↑ Users can export a map as a PDF, take a screenshot of it, and save their work.

Make Use of a Variety of Purpose-Driven App Templates

Instant Apps has nearly two dozen purpose-driven app templates that enable GIS analysts to quickly build apps that can display an organization's collection of content (Atlas, Portfolio, and Category Gallery); showcase 2D, 3D, and temporal data in a map (Sidebar, Insets, Exhibit, 3D Viewer, Slider, and others); and deliver local information based on proximity to a certain location (Nearby, Zone Lookup, and Public Notification). The resultant apps let users interact with different capabilities and features in a map, including attachments, charts, and bookmarks.

The apps perform well on desktop computers and mobile devices, support accessibility, and include theming tools that help GIS analysts customize the look and style of their apps to conform to their organizations' branding requirements.

Instant Apps is part of the essential apps bundle in ArcGIS Online and ArcGIS Enterprise, and using it requires no additional licensing.

Learn more about ArcGIS Instant Apps and the Atlas template at links.esri.com/instant-apps/overview and links.esri.com/instant-apps-templates.

continued from cover

ArcGIS Basemaps and ArcGIS Living Atlas Data Added to Autodesk Software

customers to build anything, anywhere," said Autodesk CEO Andrew Anagnost. "Our goals are to provide industry and city planners with the ability to design in the context of the real world. This will allow communities to build more connected, resilient cities and infrastructure with a focused eye on sustainability."

"Using GIS and BIM as a single integrated system provides decision-makers with a holistic understanding of how an infrastructure project will impact the community and environment, supporting sustainable outcomes," added Esri president Jack Dangermond.

Incorporating Esri basemaps and ArcGIS Living Atlas layers into Autodesk products unlocks added context of the natural and built worlds, combining visual appeal and up-to-date maps and layers from the global community. Esri and Autodesk's shared vision to unite GIS and BIM continues to help users leverage data-driven location intelligence to mitigate risk, improve resilience, maximize investments, and more.

Get additional details about the Esri and Autodesk partnership at go.esri.com/esri-autodesk.

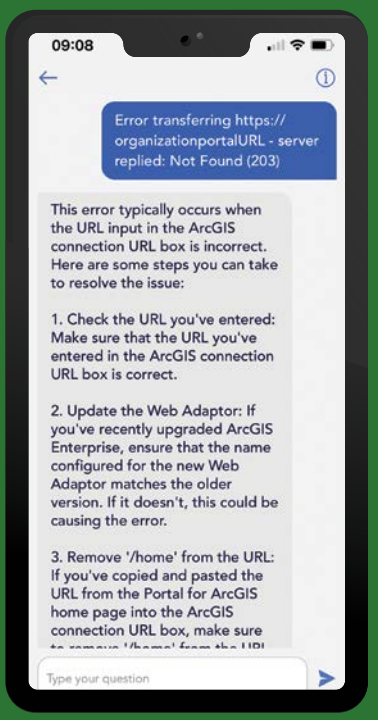
↓ Basemaps from Esri are available at multiple scales and in more than 40 languages.

AI-Powered Chatbot Answers Esri Tech Support Questions

The Esri Support app, which enables users to connect with Esri Support through their mobile devices, has launched a new artificial intelligence-powered chatbot that makes it easier to get answers to questions—from simple to complex—about ArcGIS technology.

Built on a large language model, the chatbot works like a fast search engine. Users can ask it questions about Esri products—for example, "How do I create a layer in ArcGIS Online?" and "What causes Error 001624 in ArcGIS Pro?"—and get answers in seconds. The more detailed the question, the more specific the answer.

The chatbot is trained exclusively on Esri content, including data from Esri's technical support site, product documentation, and *ArcGIS Blog* posts. This means that users don't have to wade through those resources themselves. Additionally, the chatbot supports about 40 different languages. So if a user asks a question in Spanish or Japanese, the chatbot responds in the same language. And the chatbot is designed to answer technology questions just as an Esri technical support employee would; at times, it may be quicker to use the chatbot.



↑ The new chatbot in the Esri Support app can answer technical questions about Esri products.

The Esri Support app is available in the Apple and Google Play app stores. While anyone can use the chatbot, only authorized callers can take advantage of the app's other functionalities, such as submitting a technical support ticket, following the progress of bug fixes, keeping tabs on patch releases, and getting product life cycle information.

To find out more about the new chatbot, go to links.esri.com/chatbot.

GIS-Based Predictions Advance Geothermal Energy Exploration

By Elijah Mlawsky and Dr. Cary Lindsey, the Great Basin Center for Geothermal Energy at the Nevada Bureau of Mines and Geology, University of Nevada, Reno

Geothermal energy is a reliable and sustainable source of power that's always available, regardless of weather conditions. In North America's Great Basin region—which spans much of Nevada and Utah and portions of California, Idaho, Oregon, and Baja California—there are about 30 operating geothermal power plants with a combined capacity of more than one gigawatt. But there are still many untapped geothermal systems in the region that remain hidden underground, without any visible surface features such as hot springs or steam vents. These hidden systems have an estimated potential of 30 gigawatts, which could provide electricity to more than 20 million homes.

To locate and assess these hidden geothermal systems, scientists need a comprehensive understanding of the earth's subsurface. Geophysical surveys, field measurements, and subsurface observations such as well logs (various parameters recorded and reported in the process of drilling) are used to gather valuable data on geologic composition, fracture patterns, fluid flow, and temperature at depth. This information can indicate geothermal energy potential. Observing and analyzing various indicators and parameters can help create predictive models.

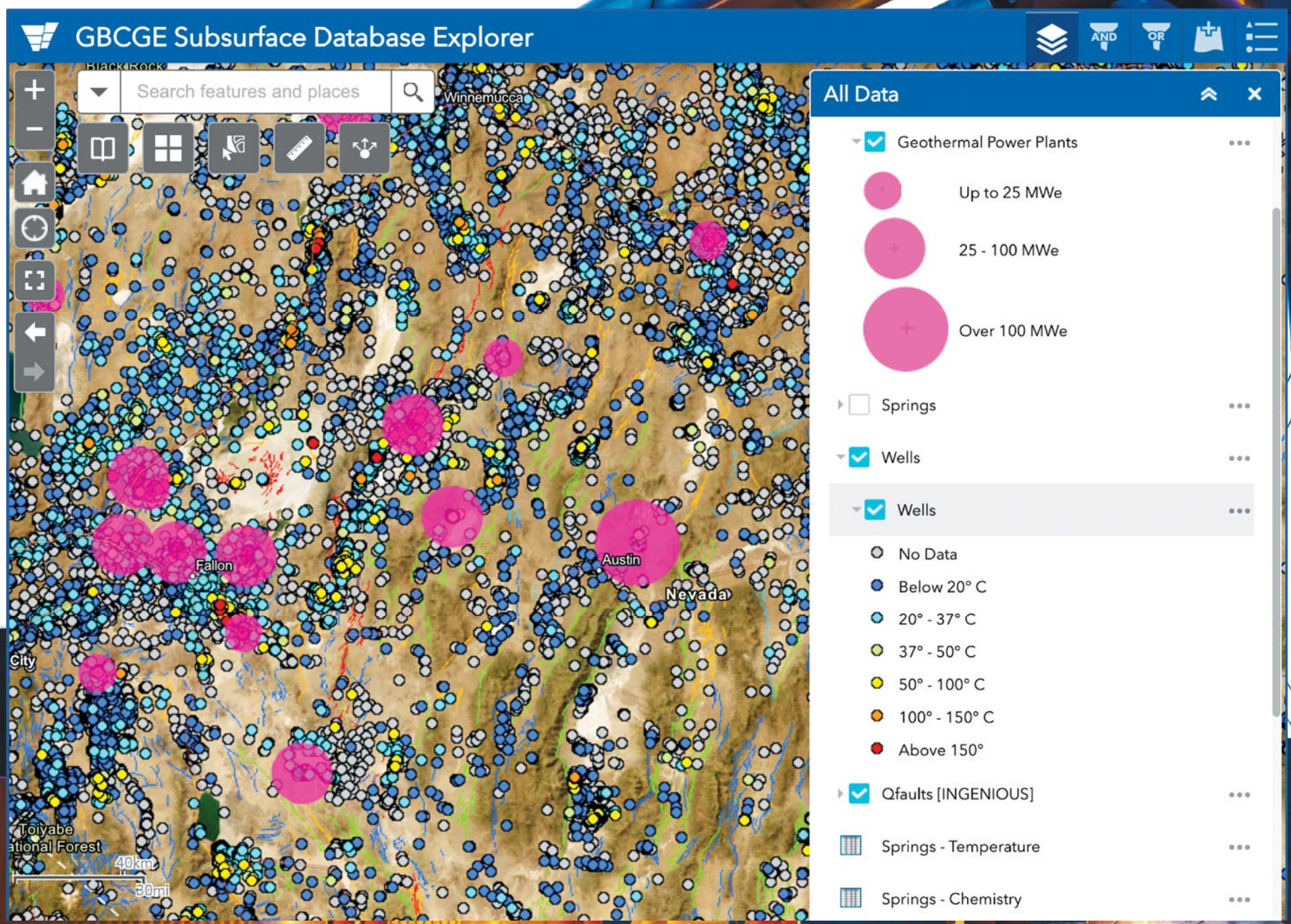
Researchers at the Great Basin Center for Geothermal Energy (GBCGE) at the Nevada Bureau of Mines and Geology, University of Nevada, Reno, use the open-source database PostgreSQL, ArcGIS Enterprise, and ArcGIS Online to organize this information and share it with the scientific community, resource exploration professionals, and the public. Integrating relational databases with GIS technology ensures the smooth interoperability and synchronization of online feature layers, distributed databases, and web apps. A complementary, public-facing web mapping app allows users to visualize, filter, and export data in an easy and accessible way.

Pioneering Geothermal Systems Research

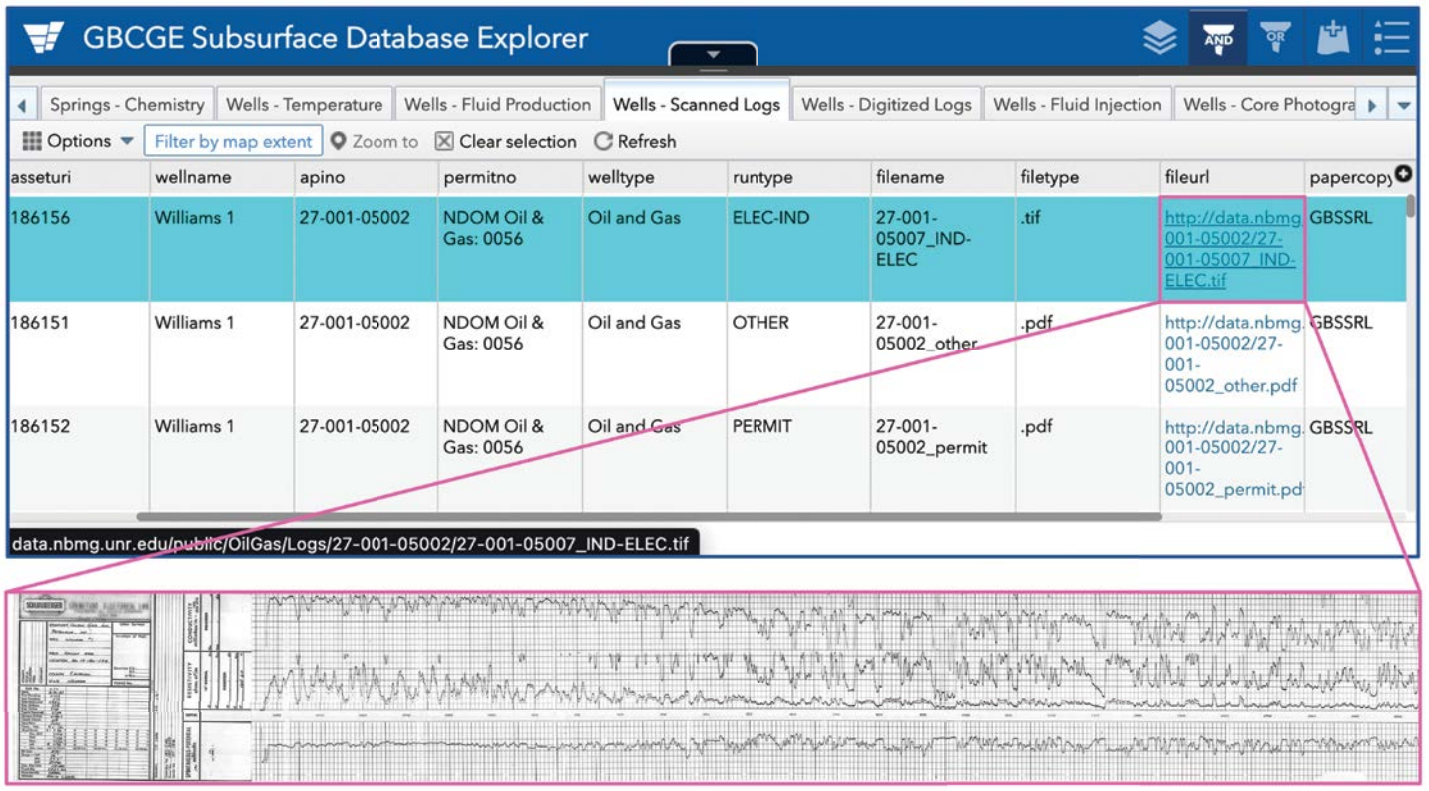
With advances in technology and growing demand for renewable energy, the US Department of Energy has funded several large-scale geothermal systems exploration projects. One project—Innovative Geothermal Exploration through Novel Investigations of Undiscovered Systems, or INGENIOUS—is led by the GBCGE. Its goal is to identify hidden geothermal systems and develop methods for exploration.

Established in 2000, the GBCGE has been actively involved in research leading to the successful development of geothermal projects in Nevada and elsewhere. The center's previous research, such as the Department of Energy-funded Nevada Play Fairway Analysis, has led to the leasing and development of multiple geothermal sites.

Now in its third year, the multiorganization INGENIOUS project combines insights from the Play Fairway Analysis research with new machine-learning techniques to uncover hidden geothermal systems. The project's data and models are publicly available to encourage further research and development in geothermal energy and aid in mineral resource assessments and carbon sequestration projects.



↓ The GBCGE Subsurface Database Explorer web app is a public data portal for exploring well and spring features, geothermal power plants, and other information about the Great Basin region.



← Leveraging relationships between foundational features and dependent data tables, users can locate a wealth of subsurface geoscience information and export legacy documents that relate to well drilling.

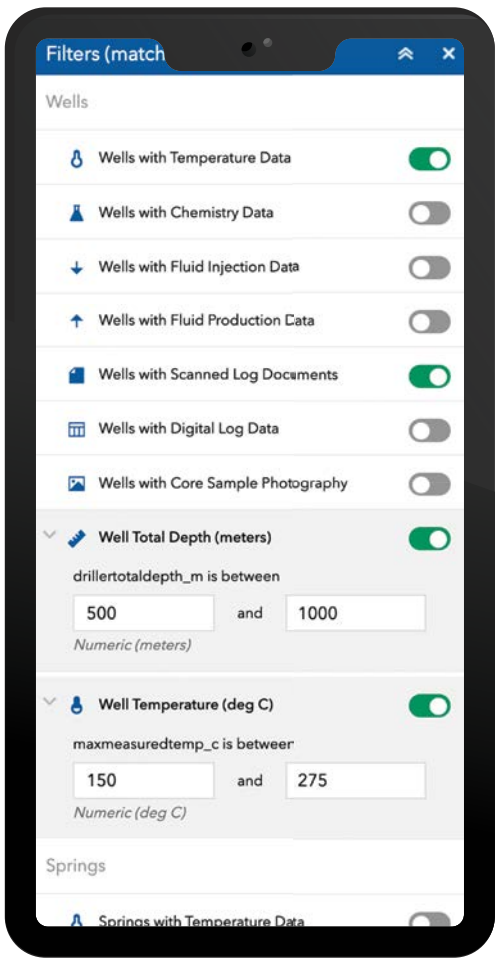
The aim is to make data accessible while relieving users of the burden of downloading large data compilations and reducing the strain on their own machines. With more than 200,000 wells in the Great Basin region database, and other feature sets and related tables, the ability to filter and export specific selections of data is essential.

Seeing into the Future

The ability to efficiently filter and visualize features online plays a crucial role in the collaborative efforts for the INGENIOUS project. The project's approach involves predicting the likelihood that there's a geothermal system in a particular area by using inputs that describe various factors such as geophysical surfaces, seismic activity, fault traces, and volcanism. These inputs are then compared to labeled examples of positive and negative geothermal energy potential, such as known geothermal systems or deep cold wells, allowing the team to generate a predictive grid of conditions favorable for geospatial systems.

With these tools, the GBCGE identified several prospect sites in the Great Basin region. Team members are currently acquiring additional data for these sites to further refine their models. Ultimately, they plan to drill shallow thermal gradient holes to validate the accuracy of their models. The data gathered from drilling can be combined with geophysical data to make conceptual models of the system, strengthening the likelihood of finding hidden geothermal systems.

The GBCGE, the INGENIOUS project, and collaborators are making significant strides in uncovering hidden geothermal systems with advanced data management and visualization solutions. Using the power of GIS technology, they are advancing geothermal energy exploration and development and paving the way for a more sustainable and renewable future.



↑ Preconfigured filters allow users to quickly locate data that matches their desired criteria. Users can also configure detailed custom filters based on table attributes.

Streamlining Data Organization

To effectively carry out the INGENIOUS project, advanced data management and visualization solutions are crucial. The GBCGE has developed the Subsurface PostgreSQL relational database, which seamlessly integrates with ArcGIS Enterprise and ArcGIS Online.

This database serves as a hub for organizing tables with one-to-many relationships, automating tasks, and aggregating data into views that can be easily accessed by the public. These views are integrated with ArcGIS Pro via a database connection, where they are assigned geometry, symbology, and other properties before being published as REST services on the ArcGIS Enterprise site, for those who want to use the web services in their own apps.

By registering the PostgreSQL server as a data store, the web services maintain a dynamic link with the underlying database, ensuring that the views and linked services are automatically updated every night and providing a low-maintenance, single source of truth.

Enhancing Data Accessibility

The GBCGE built a connected app—the GBCGE Subsurface Database Explorer, available at gbcge.org/current-projects/subsurface—that's hosted on ArcGIS Online. This app serves as a user-friendly portal for visualizing, filtering, and exporting well, spring, and power data from the subsurface database. The database relationships persist at the app level, allowing users to explore one data table by querying attributes from another.

The app includes several preset filters for common queries related to temperature, depth, and data availability. Users have the flexibility to define custom queries using complex expressions, guided by drop-down attribute and value lists. For example, it's easy to select wells based on specific depth and temperature criteria and retrieve all related well logs on file. The GBCGE is also digitizing scanned-to-PDF legacy log documents to create machine-readable and accessible tabular and .las file counterparts.

About the Authors

Elijah Mlawsky is the geoscience data manager for the Nevada Bureau of Mines and Geology at the University of Nevada, Reno. His work focuses on database design, automation of data pipeline processes and GIS workflows, and web dissemination. Dr. Cary Lindsey is a research geoscientist at the Great Basin Center for Geothermal Energy in the Nevada Bureau of Mines and Geology at the University of Nevada, Reno. Her work focuses on geostatistical and machine learning applications for geothermal resource assessment.

Geospatial Web App Helps Manage Water Resources in Montana

By Seth Johnston, GCS Holdings, Inc., and Matthew Norberg, Montana Department of Natural Resources and Conservation

The Montana Department of Natural Resources and Conservation (DNRC) is responsible for ensuring the sustainable development of the state's land, minerals, natural gas, oil, timber, water, and other resources. This government agency is committed to providing high-quality hydrologic data to support the management, administration, and beneficial use of Montana's water resources.

Effectively managing and distributing water depends on getting accurate real-time measurements of streamflows. For a few years, the state relied largely on the United States Geological Survey's (USGS) stream monitoring network to do this. But about nine years ago, the DNRC concluded that it needed to implement more of its own streamgages that could relay data in real time. Once the new streamgages were in place, the department wanted a way to easily share this information.

Working with Esri partner GCS Holdings, the DNRC set up an ArcGIS technology-based web app to help water managers and even members of the public monitor stream levels. Called the Stream and Gage Explorer (StAGE), the app allows users to easily examine Montana's surface water locations and get detailed reports about streamflows so they can make more informed decisions about water distribution and conservation.

A New Plan to Help Manage Water Supplies

In 2015, the DNRC adopted the Montana State Water Plan, which said that the state needed to develop a network of real-time streamgages on streams and tributaries that were not part of the USGS's streamflow monitoring network. The plan noted that expanding Montana's own streamgages network would improve the state government's ability to manage water supplies, meet demand, and plan for climate variability.

For about five years after that, the DNRC collected surface water data every 15 minutes and transmitted it via satellite every hour. This data was then appended to AQUARIUS, the DNRC's time series analytics software designed to acquire, process, model, and publish water information. With AQUARIUS, staff at the DNRC were able to put together structural time series models that allowed them to forecast water availability.

To put the Montana State Water Plan into full operation and ensure that more people could access its data, the DNRC needed a solution that could provide detailed streamflow data and information to a publicly accessible website. The solution would need to enable DNRC staff to collect, analyze, and present accurate, high-quality, real-time streamflow data from Montana's rivers, streams, and other critical surface water locations to stakeholders that help manage, distribute, and allocate local and regional water resources. Additionally, the solution would need to accommodate the installation and ongoing maintenance of up to 100 permanent real-time streamgages across the state by 2025.

Meeting the Needs of Water Managers and the Public

In 2020, the DNRC contracted with GCS—a Missoula, Montana-based geospatial IT services company that specializes in working with state and local government agencies—to design, develop, and implement StAGE. The GCS development team worked closely with DNRC hydrologists to ensure that the web app met water managers' demands while remaining accessible to the public.

The team designed a multicomponent system to extract, store, and display streamgage data from AQUARIUS. Using the AQUARIUS Python API, the team designed a series of automated tasks to capture real-time stage, discharge, temperature, and field measurement data. This data is processed and stored in a geoenabled database optimized for ArcGIS Server web services in ArcGIS Enterprise. Any manual corrections that DNRC staff apply to the time series data in AQUARIUS are automatically detected and processed in the geodatabase. The real-time process runs every 15 minutes to ensure that the latest data is available in StAGE. Additionally, ArcGIS Server web services provide API-level data access that enables app users to download the time series data and see detailed charts of the streamgage report data.

The GCS team also used ArcGIS Online to provide various features for the DNRC's web app. Some of the notable features include selectable maps; symbolized selectable streamgage layers with data sourced from the USGS and DNRC; easily accessible and interactive map symbology that communicates information such as site names, site IDs, and hyperlinks to report pages; detailed report pages with relevant data, including stage, discharge, and temperature readings for the previous seven days; and a data downloader that allows DNRC staff to query and download streamgage data and statistics as needed.

A Range of Water Data Made Available

StAGE officially went live in April 2021. When completed, the geospatial web app enabled water specialists and managers to make decisions about water distribution based on real-time information.

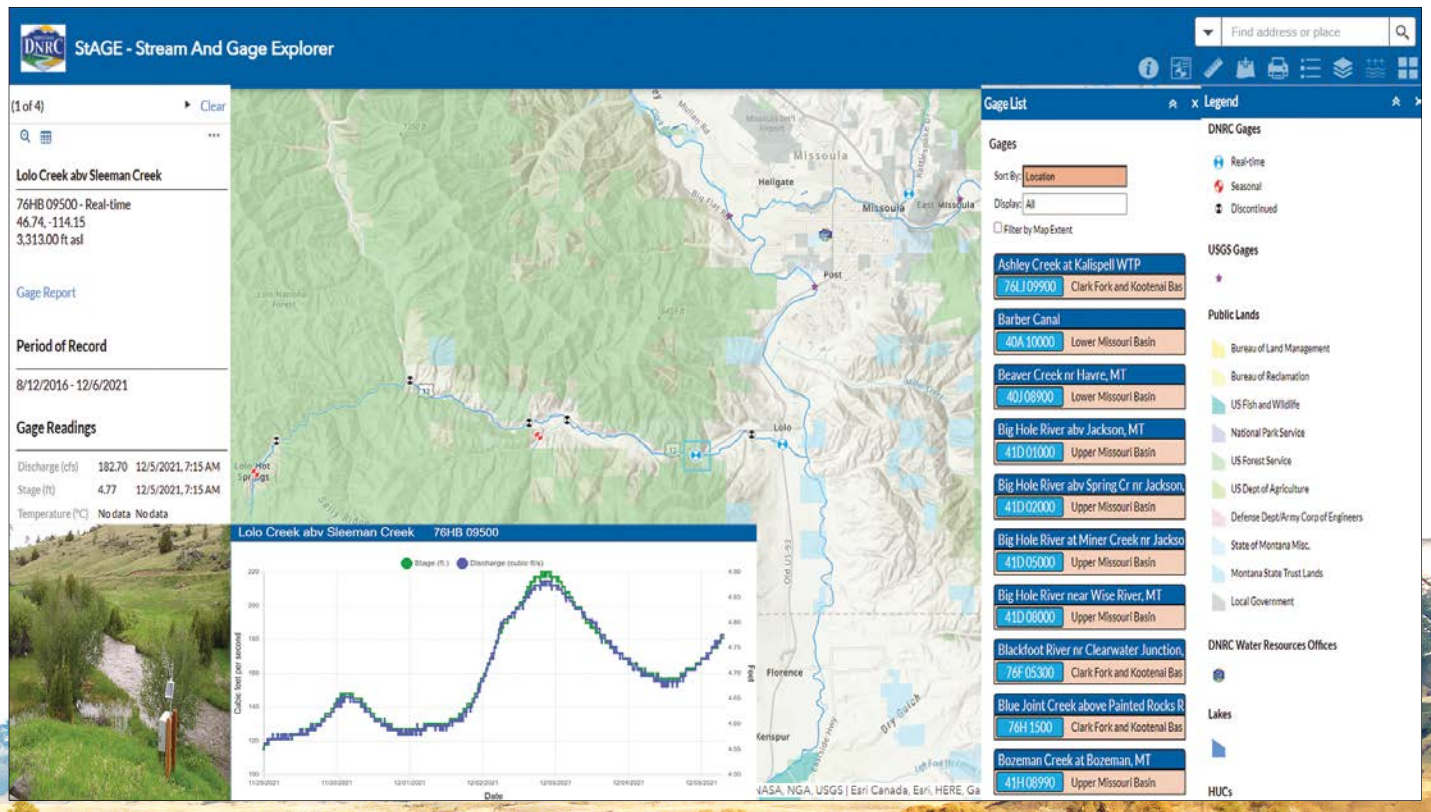
Designed for optimal performance on mobile devices, StAGE dynamically displays surface water data collected from 29 DNRC streamgages across the state and allows DNRC personnel and the public to access river stage, discharge, and water temperature data. For water managers, StAGE has expanded their ability to conduct short- and long-term water resource planning, including developing basin water budgets, evaluating local and regional water supplies, and assessing opportunities to increase water storage.

The web app can be used to support water commissioners in distributing water rights. Furthermore, StAGE has supported the efforts of Montana's residents to develop and implement local drought management plans while promoting public awareness of Montana's water resources for recreation, tourism, irrigation, fisheries administration, and flood management.

In addition to providing data from the DNRC's streamgage program, StAGE gives the public access to data from seasonal and historical streamgages that the DNRC is using or has used in past projects. The app also provides data from surface water measurement sites at state-owned dams and canals, as well as groundwater elevation and water-quality data for select sites.

"This is a great example of connecting water management professionals, recreationists, and the people of Montana to valuable data they need on a daily basis, whether for work or play," said DNRC director Amanda Kaster.

Visit and explore StAGE at gis.dnrc.mt.gov/apps/stage. For more information on this project, email Seth Johnston at sjohnston@yourdatasmarter.com.



← The app gives users detailed reports about streamflows throughout Montana, enabling data-driven decision-making about water distribution and conservation.

About the Authors

Seth Johnston is a technical sales representative with GCS and has been with the company since the fall of 2021. Matthew Norberg is a hydrologist with the Montana DNRC and served as the DNRC point of contact during the development of StAGE.

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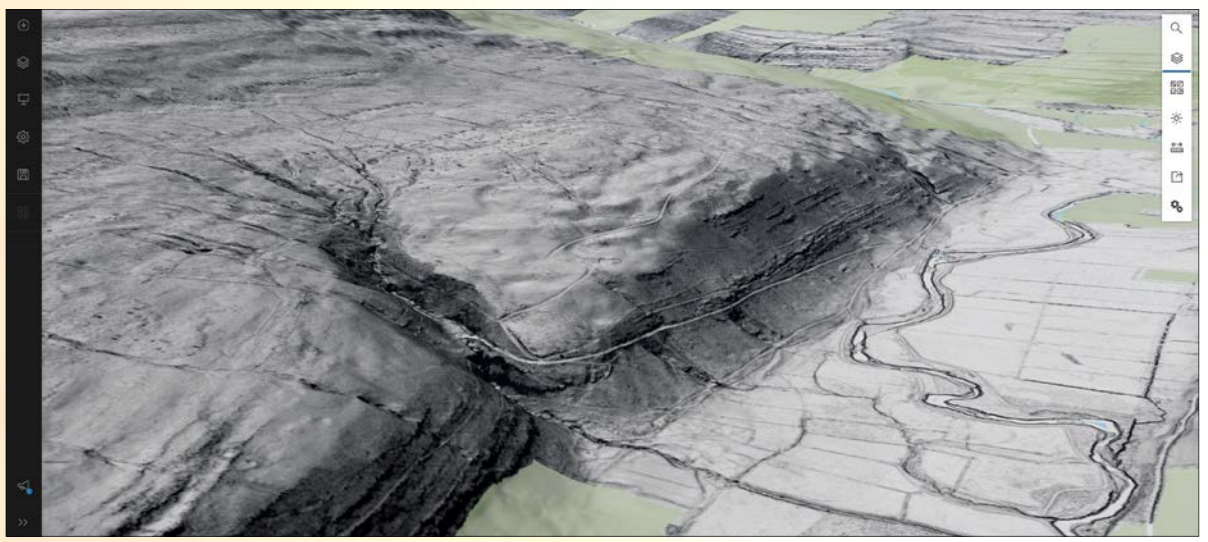
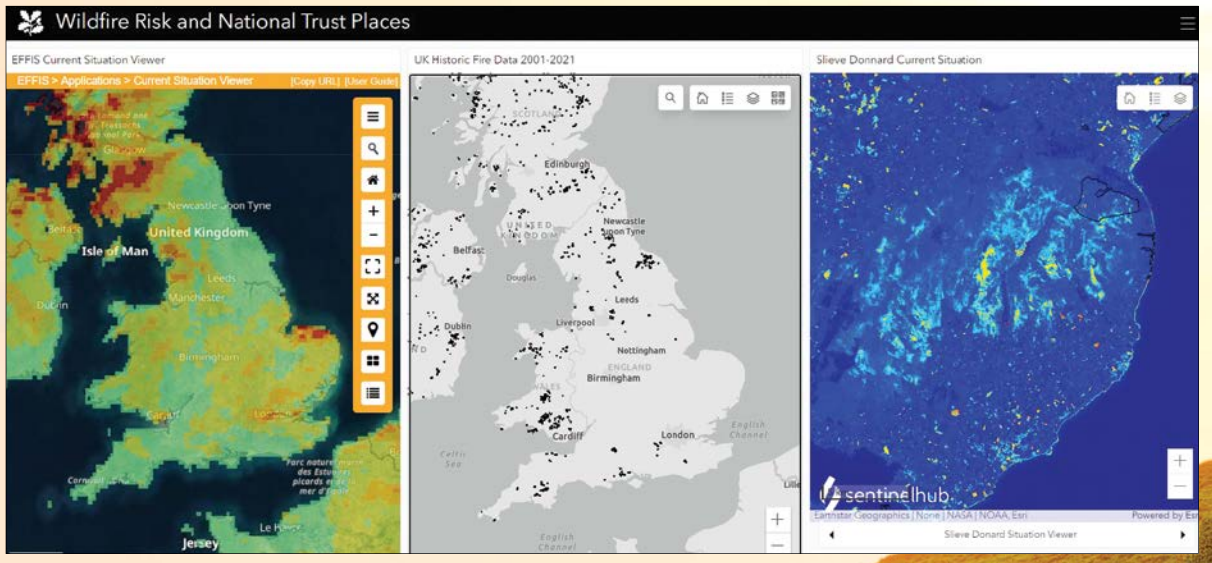
Cloud-Based Imagery Sharing Helps UK Preserve Land, Historical Sites

↑ Lidar and aerial photographic surveys can be combined and presented to an organization's non-GIS specialist users in a simple user interface.



↑ The National Trust regularly commissions lidar surveys of its properties, such as Wharfedale, near Leeds. A 3D view, provided by Scene Viewer in ArcGIS Online, highlights the area's microtopography and the broader landscape setting.



↑ Wildfires affect many National Trust places during the spring and summer fire seasons. Using dashboards, the organization brings together real-time data from the European Forest Fire Information System, analysis of the latest Sentinel-2 imagery, and other active fire data to analyze relevant wildfire risks.

In the United Kingdom, the government has designated many buildings and heritage assets—such as monuments, parks, and gardens—as structures of architectural and/or historical interest. Dedicated organizations, such as the National Trust, safeguard these sites for current and future generations to enjoy.

Founded in 1895, the National Trust is Europe's largest conservation charity dedicated to preserving nature and history for everyone to appreciate. The organization protects and maintains more than 250,000 hectares (nearly 1,000 square miles) of land throughout England, Wales, and Northern Ireland—including miles of coastline, woodlands, and countryside as well as hundreds of historic buildings, gardens, and works of art. The National Trust is composed of nearly 12,000 staff members and 46,000 volunteers and is financially supported by the contributions of its 5.7 million members and more than 20 million annual visitors to the sites it manages.

Archaeologists who work for the National Trust examine a variety of data to assess landscape change over time as well as the features and objects within the trust's protected land. Imagery is an essential part of this work.

Historically, archaeologists reviewed and analyzed imagery in PDFs. But this approach for processing remotely sensed data and sharing imagery was time-consuming and presented technical challenges. The National Trust needed a new solution that would allow staff members to better share imagery throughout the organization. ArcGIS Image for ArcGIS Online fit the bill. This software as a service allows users to host, stream, and share imagery in the cloud, enabling internal staff and external partners to easily access imagery, interact with the data, and visualize heritage sites in new ways.

High-Tech Solutions Are Hampered by Inefficient Processes

To help map potential archaeology sites, National Trust archaeologists bring together datasets, paper maps, lidar data, and historic and modern aerial imagery. The organization's volunteers and staff members then visit these sites to do additional assessments, and the data they collect helps support decision-making.

"Datasets can be very informative for identifying archaeology, but archaeology involves human activity layered over time," said James Brown, an archaeologist with the National Trust. "It is only with multiple datasets and images that we can attempt to build our understanding of the archaeology."

Lidar data enables archaeologists to remove an area's vegetation canopy to see the underlying surface. This allows archaeologists to thoroughly examine areas that haven't been surveyed and identify new archaeological sites, features, and remains. Additionally, lidar data-based digital elevation models can promote efficiency by allowing archaeologists to digitally review a site rather than dispatch site inspectors.

The way that the National Trust previously processed remotely sensed data was very time-consuming, according to the organization's remote sensing coordinator, Keith Challis, who was largely responsible for responding to individual requests. Each request required Challis to manually generate a document based on the imagery that he had acquired or create a new map and send it to the requester. If the requester wanted to see a different area or zoom in on a specific region, Challis had to create another map.

↑ The National Trust protects hundreds of historic buildings, such as Lindisfarne Castle in Northumberland, England. (Photo courtesy of National Trust Images/John Millar.)

It was also challenging for the National Trust's GIS team to share this data. The only ways for staff to access data in the organization's GIS were for them to have a physical copy of it on their hard drive, share a portable hard disk, or gain server access. This limited employees' ability to get near real-time views of sites.

Challis and his colleagues wanted a new solution that would allow them to quickly mobilize all their imagery data—whether lidar, aerial photography, or drone imagery—and provide more efficient access to it throughout the organization.

A New Way to Mobilize Data Across the Enterprise

As a longtime Esri technology user, Challis stays up-to-date with the latest developments in ArcGIS products. When he learned about ArcGIS Image for ArcGIS Online, he knew it would help streamline the sharing and usability of imagery. Not only would he be able to use it to mobilize imagery across the organization, but it gave him the flexibility to stream data into various apps and devices.

"Being able to mobilize our data across our charity is essential if we are to increase accessibility and efficiency," Challis said. "If we can't access the data, we can't make decisions and be an agent for change."

To share imagery in ArcGIS Image Online, Challis used ArcGIS Web AppBuilder to create a uniform front-end experience—largely to help non-GIS users at the National Trust access data. He built a standard web app template with a web map that contained data from ArcGIS Image Online and offered some basic tools and views. This enabled users to look at imagery in a familiar environment and access the maps themselves.

"Everything's in the web app, and all they've got to do is look," Challis said.

A typical workflow for Challis now starts with a colleague, such as an archaeologist or a ranger, requesting information about a specific area. Together, Challis and the colleague determine the type of imagery that's needed. An external imagery provider then flies over the area and collects the data. The provider sends a large volume of data electronically to Challis and the National Trust's GIS team for them to download, process, and share using ArcGIS Image Online. Once the layers are shared, Challis and his team can use them to build web maps for the requestor. Challis can also easily share the data with specific groups in ArcGIS Online using a URL.

"They can see the data in their web browser," he said. "Or if they're an ArcGIS Pro user, once they know *[the data is]* there, they can search for it…and bring it into their desktop."

A Solution That Enhances Collaboration and Works for Everyone

The National Trust has been using ArcGIS Image Online since 2022. The solution has allowed staff at the organization to not only share imagery data more intelligently and efficiently but also to replicate the process consistently when assessing different properties.

One reason that the product works for the National Trust is that thousands of staff members and volunteers with different skill sets can use it. ArcGIS Image Online and the web apps all cater to individuals who are not familiar with GIS and who just want to view a map, as well as to those who are experienced in working with data and need a tool to perform deeper analysis. The apps also give Challis and his team more control over what users see.

"It's like putting a simple frame around your data, which gives a limited set of tools and ways of looking at the data and makes it easy for people to interact with the data," Challis explained.

The use of ArcGIS Image Online has enhanced collaboration at the National Trust, enabling staff in the office or field to view and interact with the same data during meetings. It has also helped create more effective partnerships with universities, commercial organizations, and other external partners that also use Esri software. Staff at the trust can simply set up a project in ArcGIS Online for these partners to view.

Now that staff members can do many imagery-related tasks themselves, efficiency has increased as well. As the person responsible for new requests, Challis's engagement with a project was often ongoing. Now, it only takes a few days for him to process survey data and upload it to ArcGIS Online, where users can view and analyze the data as needed. The solution has improved turnaround times and the trust's ability to respond to a range of requests with confidence.

"I'm not irrelevant, but I'm not as in demand as I was. *[The imagery layers]* are doing what they're meant to do," Challis pointed out. "*[They are]* now free to be used within our charity to make decisions and to create change."

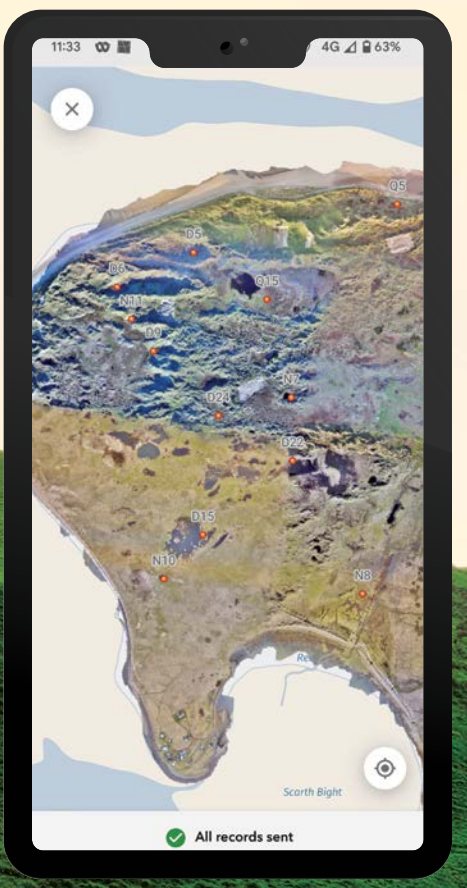
Being able to access real-time data in the field, using ArcGIS Field Maps and ArcGIS QuickCapture, is an additional benefit that has allowed the National Trust's GIS team to explore new ways of using imagery.

Staff and volunteers at the National Trust have given the GIS team positive feedback about ArcGIS Image Online, noting the easy access to imagery. They have already employed ArcGIS Image Online in other work, including restoring moorland peat bogs and counting seal pups in coastal colonies. Being able to bring lidar, aerial photography, and satellite earth observation data together in ArcGIS Image Online means that National Trust staff get immediate context and insight.

"Making the data widely available across the organization to help people with their decisions so that they can make those positive changes for the landscape and the environment—that's what it's about for us," said Challis.

↑ National Trust heritage ranger volunteers survey Bronze Age burial mounds at Newtimber Hill in West Sussex.

↓→ The organization safeguards nearly 1,000 square miles of land in England, Wales, and Northern Ireland. (Photo at right courtesy of National Trust Images/Chris Lacey.)



→ Image data from a detailed drone survey of vegetation at Sandscale Haws on the Cumbrian coast is combined with field observations made using bespoke apps developed with ArcGIS QuickCapture.

How a Passion for People, Nature, and GIS Inspired an Innovator's Career

Breece Robertson

Whether, as a child, she was constructing stick forts or scaling trees while wearing her Sunday best, the natural forest around Breece Robertson's hometown of Hamlet, North Carolina, kindled her early love for the sciences and ignited a lifelong curiosity to understand how the world works.

Robertson—the creator of the ParkScore database, which scores park accessibility, amenities, and quality—has helped countless people discover the natural beauty of their surroundings and inspired city officials to create more of those spaces.

Robertson's adoration of science led her to pursue an undergraduate degree in exercise physiology and math at Lenoir-Rhyne University, in North Carolina, with the goal of becoming a doctor. Before plunging into medical school, she and her dog, Maggie, set out on a yearlong trip across the western United States. While traveling through various national parks and camping in different communities, Robertson observed the impacts of urban growth and development as well as oil and gas exploration on natural spaces. This inspired Robertson to redirect her career path toward conserving natural areas. "I thought there had to be a better way to balance growth and sustainability that was more resilient for communities and nature," she said.

Eager to combine her passion for nature and people, Robertson returned to North Carolina to get a master's degree in geography and planning from Appalachian State University. During her master's studies, she learned about GIS with ArcInfo 6.0. She found it difficult to make maps at first because everything had to be coded. "But once I got the hang of it, it was incredible to see what information I could get by overlaying data layers and running a simple buffer analysis," said Robertson. "I got hooked and just never looked back."

After graduating, Robertson began her GIS career as an instructor for Allpoints GIS, teaching US Forest Service employees how to use the company's technology. She also taught local governments how to use scenario-planning software to make better decisions about people and conservation. Though she enjoyed teaching others to use GIS, she wanted to do more. During this time, she taught staff from the Trust for Public Land to use GIS for public planning.

This was when Robertson found her calling. "I thought it was interesting at the time that an organization whose business was land conservation didn't have GIS at that point," she said. "I saw an opportunity to grow a geospatial program for *[the organization]*."

A year later, Robertson said, she found herself working as a consultant for the Trust for Public Land as the "lone girl in the back room making maps." During the next 18 years, she built out the Trust for Public Land's geospatial program to include research, planning, and geospatial capabilities to support the organization's mission. Robertson grew her team to 20 people plus consultants scattered across the United States, all working together to help communities site parks and develop comprehensive plans with conservation in mind.

One key project for Robertson was working with New York City school districts and communities to convert parking lots into green schoolyards and public parks. These parks can absorb storm water and were designed to include local gardens to teach children about planting food, along with providing playground structures and other recreation amenities. "Green schoolyards are really inspiring to me because the schoolkids and the community came together to design them," Robertson said.

Robertson received a Special Achievement in GIS Award from Esri in 2006 and the Esri Making a Difference Award in 2012 for her work at the Trust for Public Land. But she is proudest of building ParkScore (parkscore.org), an index that compares US park systems and ranks parks in the largest 100 US cities. Launched in 2012, ParkScore uses GIS to map parks' pedestrian access, acreage, and facilities, along with cities' average spending on parks per year. It then identifies where people have good access to a park and where they don't.

Robertson recalled that, while attending a recent National Recreation and Park Association conference, the mayor of Dallas, Texas, shared in his keynote presentation how ParkScore enabled the city to improve each year based on the metrics provided. "That made me feel so good, knowing that ParkScore is still inspiring communities to really care about their ranking and improving access to parks," Robertson said.

After working for the Trust for Public Land, Robertson joined the Lincoln Institute of Land Policy in 2020. The organization studies and teaches about how land is used, managed, and governed, with the goal of promoting fairness and sustainability in land policies. There, Robertson helped the organization launch the Center for Geospatial Solutions. The center aims to use geospatial data and technologies to inform land, water, and climate policy.

In 2022, Robertson took on a new challenge as chief impact officer at One Tree Planted, a global reforestation organization. There, she helped improve that organization's monitoring, reporting, and verification systems and develop GIS-based impact assessment tools.

More recently, Robertson has been volunteering for boards and committees. She currently serves on the National Park Service's Advisory Board and the National Recreation and Park Association Board, and she was recently appointed to the National Geospatial Advisory Committee. "It's been exciting to do this work through appointments to bring GIS data and technology to the table where a lot of these organizations haven't had someone from our sector who brings geospatial thinking before," Robertson said.

With a career spanning more than 25 years, Robertson has seen firsthand the creative ways that communities have used GIS to advance conservation goals. "It's been gratifying to me throughout my career to see people using geospatial data and applications to make good decisions that balance the needs of people and nature," she said.

Robertson has found her career to be incredibly rewarding, leading to expanded opportunities as a leader and innovator. In 2019, her first book, *Protecting the Places We Love: Conservation Strategies for Entrusted Lands and Parks*, was published by Esri Press. In the book, Robertson shares her experiences, case studies, and resources and offers step-by-step guidance for conservation leaders who want to use GIS to create meaningful change.

"I was really excited to hear from people that this book helped make GIS more accessible to them," Robertson said, adding that the book was a great opportunity to "reflect on my career in GIS and sort through those touchpoints that catapulted the work that we are collectively doing in conservation." In that spirit, the book reflects conservation efforts around the globe.

Robertson is optimistic about conservation, believing that advancements in ArcGIS Hub, ArcGIS Experience Builder, remote sensing, artificial intelligence, and machine learning are making GIS more accessible to communities. This provides the opportunity for people to share their stories and use innovation to protect the places they cherish. "While there's been trepidation with these technologies, I feel like the storytelling and visualization aspects in GIS have leveled the playing field for everyone to use technology to do something about the complex issues we face today," Robertson said. "It's inspiring."

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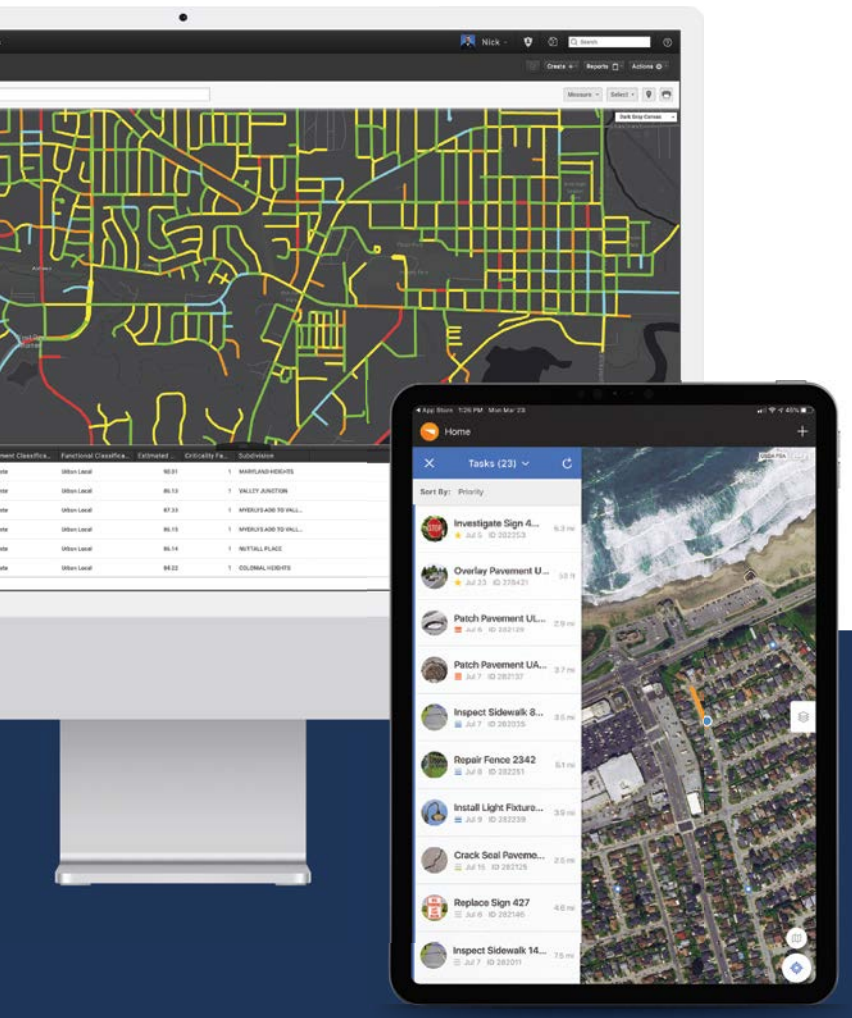

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Using Mobile GIS to Transform Pest-Detection Workflows in Napa County

With its famed wine country and rare Mediterranean climate, California's Napa County is one of the most biologically diverse counties in the San Francisco Bay Area. The climate, topography, and soil provide an environment that's suitable for growing crops such as grains, nuts, and grapes, as well as for supporting livestock. A recent Napa County crop report showed that the county's agriculture production had a gross value of more than $894 million in 2022, a 19.9 percent increase from 2021.

To promote and protect this valuable industry, the Napa County Agricultural Commissioner's Office implements a variety of federal, state, and local regulatory programs. It's a big job. The Agricultural Commissioner's Office regularly surveys more than 46,000 production acres, works with more than 700 local growers, and monitors thousands of properties.

One of the programs to support this effort is pest detection. The county's pest-detection program helps prevent the spread of exotic pests in commercial agriculture by catching the pests in detection traps and identifying them early—before they become established.

For years, this process was slow and cumbersome. Paper-based records were kept in different systems, and there was often overlap in work. To streamline workflows and improve data integrity, the commissioner's office has implemented ArcGIS Field Maps to collect data and report on pest-detection results.

Replacing an Inefficient System

Mobile crews, or "trappers," are a critical part of this program. Until recently, these crews, who place and maintain pest traps, would manually complete a map card with details—by drawing the location of what they were inspecting (such as a tree), documenting GPS coordinates, and placing traps to catch invasive pests. Each trapper would then put the map cards in a binder. According to Anna Norton, Napa County deputy agricultural commissioner and sealer of weights and measures, having the crew working with these individual paper records led to a costly lack of efficiency, as trappers would spend hours on record-keeping every day.

This manual process extended to daily trap summaries, which each trapper is required to complete. The summaries included a handwritten record of every trap serviced. Staff would also use field data to conduct preseason planning and complete mandatory federal reports, requiring the transfer of the handwritten data to other forms and increasing the likelihood of data transfer errors.

In addition, due to inefficient route-planning, multiple employees would often service the same property for different traps. "We'd have one project in one type of binder and another project in another type of binder," Norton said. "There was no way to integrate and overlap those projects without having some sort of electronic tool where everybody could see live what traps were in action."

Slowing this system even further, every year hand-drawn maps would have to be re-created and updated for new pest-monitoring locations and changed priorities. And when a dangerous pest was found for the first time, the discovery would trigger strict regulatory and auditing requirements that held up commercial shipping.

Because of changes to priorities and conditions every year, Norton said, "we would have multiple full-time staff going through all of those binders of trap cards, hand-drawing all of the updated maps to then plan where our traps were going to go for the next season."

To streamline these processes, the Agricultural Commissioner's Office turned to Esri technology for an all-in-one mobile data collection and reporting system. The new solution has improved field data collection processes and electronic reporting and helped protect local agriculture more efficiently.

Staff initially tested ArcGIS Field Maps by having a trapper use it in the field for one season and report results. The trapper's feedback was excellent, and the office transitioned full-time to Field Maps in 2020. Norton and her team also developed in-person annual Field Maps training, how-to videos, presentation slides, and offline documentation that trappers can access in the field.

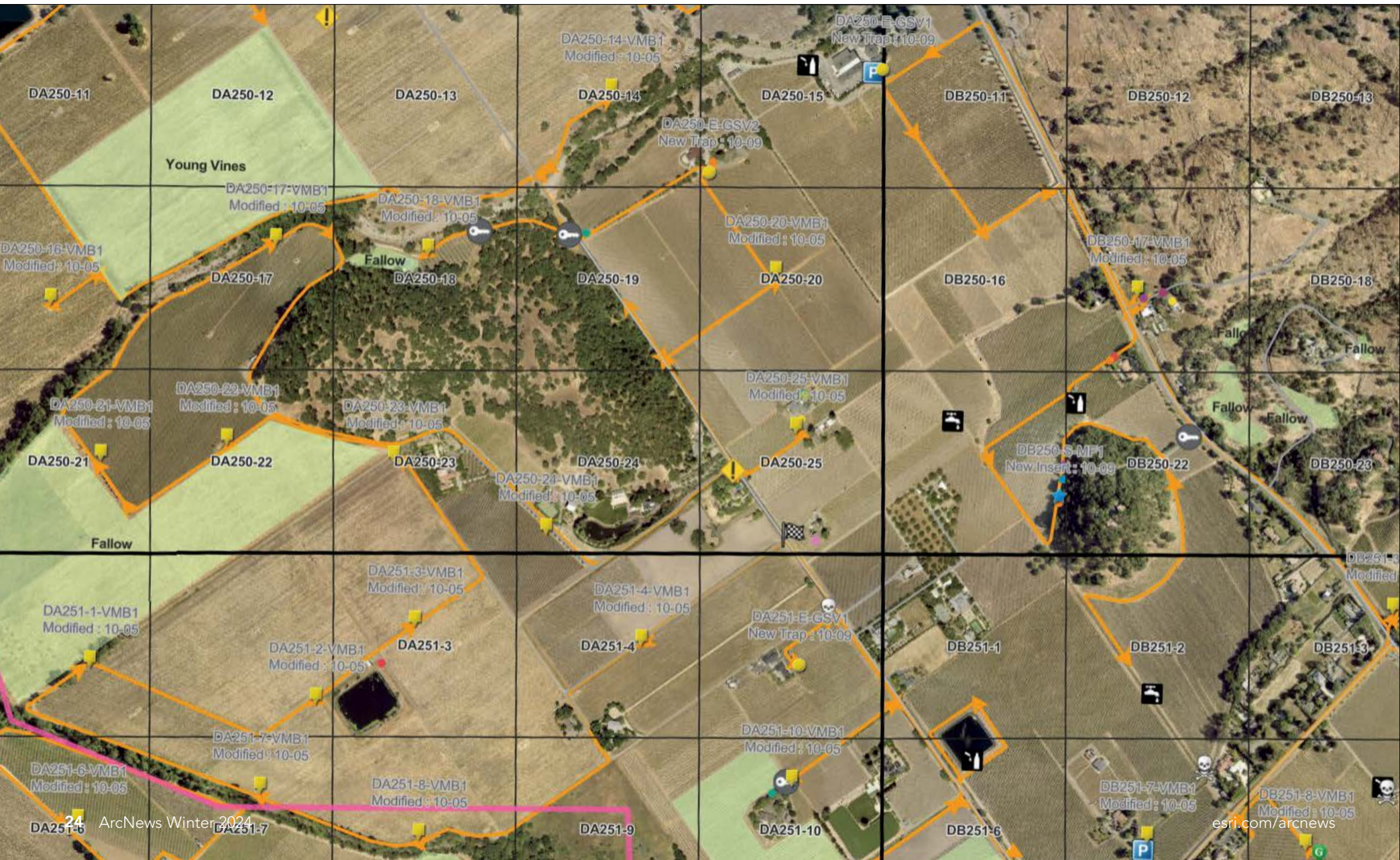
At the beginning of each season, a week is dedicated to hands-on training, including presentations on the revamped process. Each trapper has an Apple iPad with Field Maps installed. The second week is set aside for field training, which usually takes only two days because of how easy and intuitive Field Maps is, Norton said.

The Benefits of a Digital Transformation

Field Maps has helped reduce work time and increase data accuracy while enhancing staff collaboration and work satisfaction. For example, the preseason planning process, which used to require four staff members to work nearly full-time on it from October through February, now takes two people a week or less. As a result, annual time and labor costs for this process fell from $106,000 to about $5,000.

This system is also more accurate, as is the distribution of daily work for staff. Much of the data is now prepopulated in digital smart forms

↓ Exotic-pest trapping routes in Napa County are easily visible using ArcGIS Field Maps.



rather than hand-written every day on trap cards, so there are fewer fields to complete—and fewer errors. Trappers can use voice dictation on their iPads to record their observations, and it's easier for them to find their route assignments. And instead of data entry that "would have been a nightmare," according to Norton, "now you drop a beautiful little point on the map and move on." The office's error rate is now less than 1 percent, she added.

While trappers are placing or maintaining the invasive-species traps, they now have access to all available trap history in one mobile app. This enables them to know who has serviced it and when and—more importantly—what they need to do next. They also use a function in Field Maps called Markup to share the areas that have been covered or are outstanding, as well as the routes they take from trap to trap.

"Even just simply sharing and covering routes was almost impossible on paper. *[Now]* everybody knows exactly where everybody is at any given time," explained Norton. "And because of the symbology, it's super easy for other staff to then jump into other people's routes."

Improved reporting should also help in instances of quarantine. If a dangerous pest is found in the county, there are strict regulatory requirements to follow to ensure that it doesn't spread. Data must be readily accessible by federal and state agencies so that they know how the dangerous pest is being eradicated. According to Norton, auditors previously had to be in the Napa office and spend days looking through trap books for data.

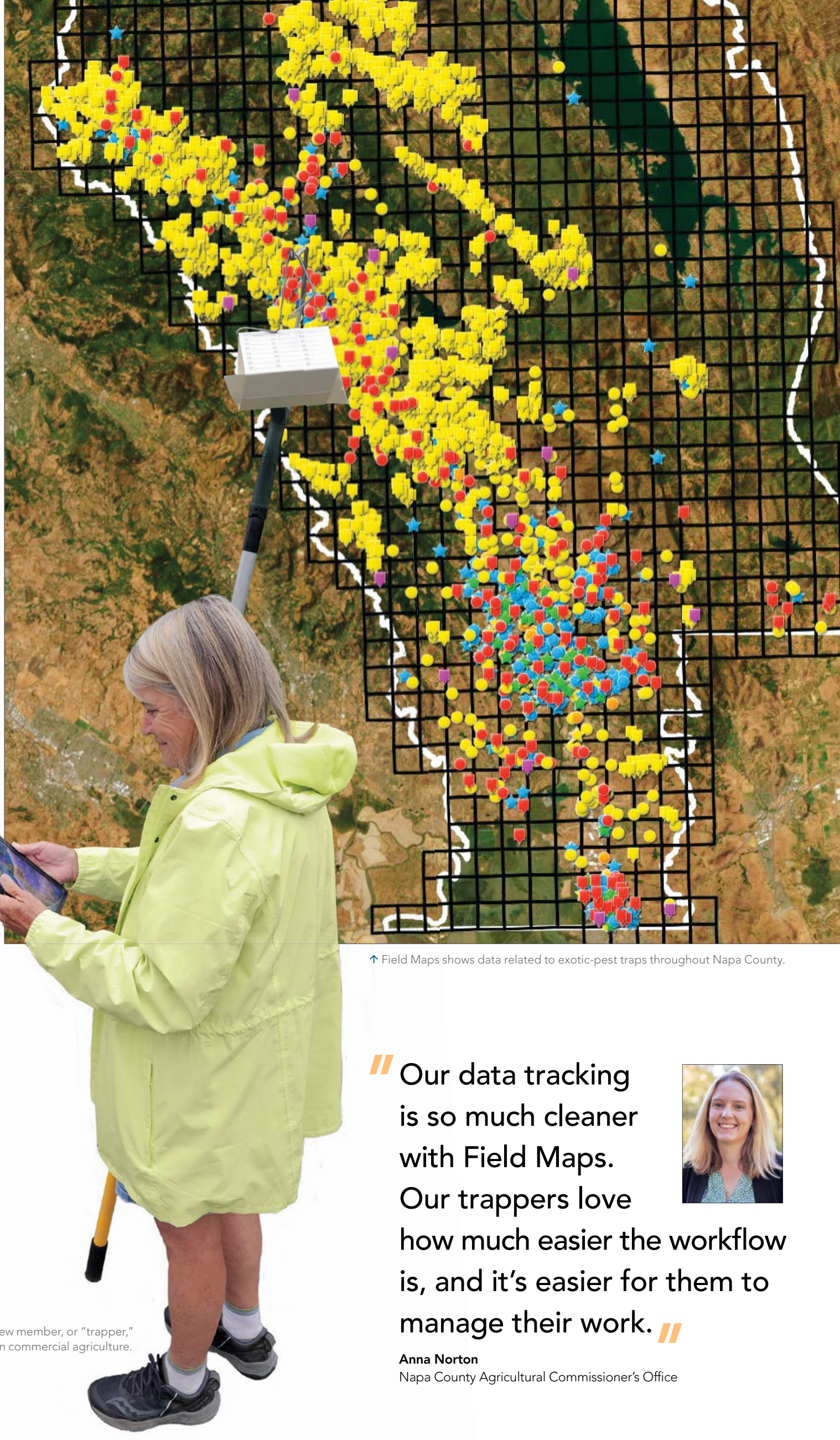
"Our international partners aren't going to let us continue to ship anything until we prove, through this laundry list of scientific methods, that we have executed everything perfectly and sent them that data in an auditable fashion," explains Norton.

With all these changes, Norton said that mobile crews are happier workers.

"Our data tracking is so much cleaner with Field Maps," she said. "Our trappers love how much easier the workflow is, and it's easier for them to manage their work."

As for the office staff, the data is right at their fingertips. "Everybody knows exactly where everybody is at any given time," Norton said. "And we can put reports together in a matter of hours, which is incredible."

Developing Field Maps solutions for the Agricultural Commissioner's Office mobile crews has been Norton's favorite part of her career. "We want them to be successful and show them that we care and that we're working hard to create solutions for them," she said.



↑ Field Maps shows data related to exotic-pest traps throughout Napa County.

→ An Agricultural Commissioner's Office mobile crew member, or "trapper," uses Field Maps to check for exotic pests in commercial agriculture.

> "Our data tracking is so much cleaner with Field Maps. Our trappers love how much easier the workflow is, and it's easier for them to manage their work."
>
> **Anna Norton**
> Napa County Agricultural Commissioner's Office

Scientific Currents

By Dr. Dawn Wright
Chief Scientist, Esri

Why AI Needs to Be Digitally Resilient

Artificial intelligence (AI) is dominating discussions everywhere. Specifically, the rapid rise of generative AI—AI that can create new data, such as text, images, videos, audio, and 3D models—from platforms such as ChatGPT has led to a lot of debate about the ethics and quality of information used to train AI models. Discussions extend to predictive and insight capabilities, as well as whether to integrate these tools for automation in daily workflows. The combination of these questions and the concerning press coverage surrounding AI, including potential security threats, its influence on search engines, and its impact on employment, has created a frenzy.

GIS and geospatial technology are not immune to this discussion. AI and location intelligence have converged to create geospatial artificial intelligence (GeoAI). As explained in "Demystifying GeoAI" (available at links.esri.com/demystify-geoai) from the fall 2023 issue of *ArcNews*, "GeoAI fuses AI with geospatial data, science, and technology to accelerate workflows, uncover valuable insights, and solve spatial problems."

When examining GeoAI and its potential benefits to geospatial professionals, it's necessary to think about the potential dangers and harms that have been encountered by other AI models. For example, facial recognition algorithms have been notoriously unjust to Black women. The rapid evolution of AI and its widespread public use pose a scientific challenge: how to create generative AI without the same biases and damaging effects as general AI algorithms.

As we build and use GeoAI, we must consider who is training it. Who is building the user interfaces and for what kinds of users (for example, only for affluent white male users, or users of all genders, cultural backgrounds, technical abilities, and disabilities)? And how can toxins such as hallucinations be removed from AI?

In truly defining and evolving GeoAI, the scientific research community is seeking to discover whether the technology can do more than just automate tasks or answer geographic questions that we already know or can guess the answers to. Can it provide new insights such as predicting emerging spatial patterns, connections, events, or trends in human systems and nature?

↑ Resilience applies to digital data, tools, and platforms, including in the realm of geospatial artificial intelligence (GeoAI).

↑ Datasets, libraries, and GeoAI models need to be FAIR: findable, accessible, interoperable, and reusable.

I believe that GeoAI is capable of such feats. But to realize these achievements means that GeoAI needs to abide by the principles of digital resilience. Generally, resilience is the ability to deal with change and threats; to absorb disturbance, stress, and catastrophe; and to recover quickly from challenges and return to a desired state. We often hear about the necessity of environmental and climate resilience for our survival on Earth, considering the effects of people's influence on the atmosphere, biosphere, and geosphere. However, digital resilience is also a key factor.

Given GeoAI's potential to bolster community resilience by providing data and evidence-based advice, it's essential to ensure that the geotools, their related approaches, and the data they are based on are digitally resilient as well. Digital resilience means that, to the greatest extent possible, data and tools should be freely accessible, up-to-date, high-quality, interchangeable, and operational. This way, the communities or entities using them can be resilient.

Moreover, given the destructive power of natural disasters caused by human-induced climate change, it is essential that geotools keep pace and be a critical part of 21st-century mapping. If we want to create a more resilient world, we need to ensure more resilient digital technologies. This includes the most promising and yet the most disruptive digital technology of all: GeoAI.

Here are five fundamental principles of digital resilience. In several blog posts, journal articles, and talks (some cited in the sidebar), I've posed up to eight. And of course, many more are possible.

1. **Making data and code "available" is not enough.** If GIS professionals are making data open to access, especially in the name of open science, we need to be transparent about what we are doing with our data and our code, including how it was trained as part of a GeoAI model. Transparency can be achieved by sharing the workflows done with the data in a "virtuous chain" or "virtuous cycle." This chain of GIS processes allows one result to build on the preceding one, leading to continuous improvement, and can be done using tools such as ModelBuilder scripts and models, ArcGIS and other Jupyter-flavored Python notebooks (for example, links.esri.com/python-samples), and even various kinds of process logs. This is akin to sharing scientific methods—especially if rigor is important, since repeatability of an experiment, approach, or algorithm is a hallmark of the scientific method. Can a GIS user replicate the workflow with GeoAI? Can the user reconstruct and understand the scientific process that was used?
2. **Integrate via interoperability.** To ensure digital resilience, we as a GIS community must foster interoperability by utilizing tools that can be translated into other formats. For example, we can use a Python environment that's suitable for scientific computing, we can integrate with scientific tools and software libraries made by the community, or we can incorporate deep learning GeoAI models. No matter the role of GeoAI, following FAIR principles is the best way to enable interoperability. This means that geospatial data is findable when described by rich and accurate metadata, accessible when shared in a multitude of machine-readable formats, interoperable when easily published and shared using international open data standards, and reusable when released with clear and accessible data usage licenses.
3. **Ease leads to exposure, and exposure leads to adoption.** This is especially the case with easy-to-use apps that work on any device, anywhere, at any time. Apps are a great way to practice true interoperability. Such apps can expand GIS and GeoAI concepts, approaches, and code to appeal to broader audiences. Students are embracing apps in droves, as demonstrated by a popular computational art course at Santa Barbara High School that was highlighted during Computer Science Education Week. Courses such as this could spur increased app development. Some see this as an advantage, arguing that geography, GIScience, and data science instruction should teach students to be creators of software tools, not just users. Plus, thanks to the emphasis on app building in these courses, more young women and people of color are being drawn to the tech industry. Greater exposure and adoption can also be accomplished by following self-guided tutorials online, such as this one from Esri: links.esri.com/app-tutorial.
4. **Consider ethics, empathy, equity, and explainability.** This subject is worthy of its own article or even a whole college course. In short, the goal is to develop responsible GeoAI, build trust, and shape policy. Users and developers of GeoAI must consider ethical issues such as location privacy and cartographic integrity alongside issues of empathy such as data representativeness and proper inference. (For details, see the last resources in the sidebar.) Developers of responsible GeoAI must also consider equity issues such as the use of geospatial technologies for social justice and democratizing access to these technologies. Ensuring that GeoAI is equitable means that AI must be explainable, with a set of processes and methods that allows human users to comprehend and trust the results and output created by machine learning and deep learning algorithms. Further, explainable AI should check GeoAI models and training data during the planning stages to make algorithms more responsible before the results are computed. It should also assess GeoAI results after they are computed.
5. **Promote a culture of sharing, engagement, and collaboration.** This means enabling people to securely share data, apps, and GeoAI tools across all teams and networks and helping people understand their role in and use of GeoAI. Furthermore, this is not just a stated principle or a onetime occurrence; it's a critical, natural part of how people do their GIS work every day, and it stems from their attitudes about that work. Importantly, people in an organization should be regularly rewarded—with praise, recognition, and promotions—for embracing digital resilience. They should also be encouraged to publish or speak about how these principles of digital resilience have been implemented.

For more information about digital resilience as it pertains to GeoAI, check out the following resources:

- "GeoAI and the Future of Mapping: Implications for 21st-Century Digital Resilience," a meeting of the National Academy of Sciences' Geographical and Geospatial Sciences Committee (which inspired this column), available at links.esri.com/geoai-mapping
- "Toward a Digital Resilience," my 2016 paper featured in *Elementa: Science of the Anthropocene*, available at links.esri.com/digital-resilience
- My slide deck from the American Geophysical Union's 2015 Greg Leptoukh Lecture, called "Toward a Digital Resilience (with a Dash of Location Enlightenment)," available at links.esri.com/digital-resilience-slides
- The Geography According to ChatGPT YouTube playlist, from the University of California, Santa Barbara's Spatial Data Science webinar, available at links.esri.com/geography-chatgpt
- "Challenges of Integrating Explainable Artificial Intelligence into GeoAI," by Dr. Jin Xing and Dr. Renee Sieber, featured in *Transactions in GIS* and available at links.esri.com/integrating-ai
- "Accelerating Ethics, Empathy, and Equity in Geographic Information Science," by Dr. Trisalyn Nelson, Dr. Michael Goodchild, and me, featured in *Proceedings of the National Academy of Sciences* and available at esriurl.com/3e

At Esri, we acknowledge the important role that GeoAI will play in the future of GIS, and we choose to embrace it. But we want to do it with good understanding, responsibility, and transparency. Ensuring the longevity and effective use of the data, tools, and platforms that we develop is a critical part of our work. This is an undertaking that involves the whole geospatial community, not just Esri.

Let's all leverage these new advances in geospatial science and technology to build greater digital—and, ultimately, community—resilience to the shocks and disruptions that will occur in a world facing accelerating change. If we want a resilient world, we need to start with resilient data.

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 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.

Digital Twins Improve Sewer System Inspections

By Josh Ford and Kris Popovich, Burgess & Niple

Many utility owners struggle to obtain a comprehensive overview of their sewer networks. This is because they often only have access to static documents that give no context for the condition of their pipes or where the pipes are located in the network.

National engineering firm and Esri partner Burgess & Niple (B&N) has built a dynamic tool in ArcGIS that, when paired with the company's artificial intelligence (AI)-powered pipe inspection app, creates a digital twin of a utility's entire sewer system. The result is that utilities get a complete overview of their networks, along with access to inspection videos and images. This allows utilities to make data-driven decisions about their pipes, including when and where to invest in asset rehabilitation or replacement.

The Town of Newburgh, Indiana, recently used B&N's AI software platform, called PipeAId, to help with the annual inspection and cleaning of its sanitary collection system. In addition to saving staff time and capital, the digital twin is helping Newburgh's sewer department level up its pipe inspection processes.

Accurate Observations and Unbiased Assessments

To examine sewer pipes, inspectors can send closed-circuit television (CCTV) cameras through them to record pipe conditions. Inspectors typically document their observations in the field and again while doing quality assurance/quality control (QA/QC) of the video back in the office. They use codes from the Pipeline Assessment Certification Program, established by the National Association of Sewer Service Companies (NASSCO), to standardize their observations. There are more than 230 NASSCO observation codes to choose from, and they are often paired with additional data.

Despite this push for standardization, observation accuracy remains an issue. Human subjectivity can also be a problem. For example, inspectors must differentiate between cracks, fractures, and breaks; determine the severity of root interference; understand whether a tap is defective; and address other issues. An experienced inspector is more likely to accurately document these observations than someone new to the job would be.

PipeAId is designed to help utilities process their CCTV video in a way that's more accurate and less subjective than manual processes are. It examines the video and extracts data on sewer pipe obstructions such as cracks, roots, and taps. When a defect is present, PipeAId maps where the defect was recorded in a computer vision and machine learning environment, and the AI model determines which NASSCO defect code applies.

All this inspection data—along with the supporting images and videos—is provided to utilities via a digital twin in a desktop ArcGIS environment, such as ArcGIS Pro. To achieve this, when working with a client, B&N's development team leverages geoprocessing tools in ArcGIS Pro to create a geodatabase of the client's sewer conditions. Relevant images (stored in a geodatabase) and videos (stored in the cloud) are linked to each observation and pipe segment. When all the observation data is paired with B&N's data hosting solution, staff and contractors at the utility can access the inspection information in the office or out in the field with just a few clicks or taps on their devices.

PipeAId is designed as an out-of-the-box solution for ArcGIS users, so utility owners don't necessarily need to invest in new software. Instead, they can leverage their own GIS deployments without relying on other third-party software to store data. B&N can also deliver the solution with Esri's AEC Project Delivery subscription service, customizing the data to clients' unique needs while setting them up for future growth.

Increased Transparency for Newburgh

In Newburgh, staff members in the town's sewer department inspect and clean portions of the sanitary collection system annually. In 2023, they used PipeAId for the first time to process inspection data for 40,000 linear feet of the town's pipes. This has allowed staff members to get an unbiased condition assessment of the town's buried assets, enabling them to maximize their pipes' life span and either rehabilitate or replace them before failure occurs.

Additionally, staff members leveraged the PipeAId-generated digital twin, which can be integrated with the town's GIS to show the pipes' size, material, inspection date, and condition, along with the location of each observation and defect. This provides a high level of transparency for each pipe's condition and gives leaders in the town's sewer department reliable information so that they can make data-driven decisions on Newburgh's pipe maintenance strategies. Having all this information available on maps—even on mobile devices—also helps mobile staff members facilitate conversations with residents and better inform stakeholders about the town's proactive pipe maintenance program.

"This AI system is taking our sewer pipe assessment program to the next level, and we look forward to a far more efficient and cost-effective sewer inspection process," said Steve Shoemaker, the sewer commissioner for the Town of Newburgh. "By using the CCTV data that we're already gathering and translating it into a more useful format, it's making the utility's efforts more valuable, providing a high level of service to our customers."

Keeping Community Members and Stakeholders Informed

Using GIS to design a digital twin of a sewer system, complete with easy-to-understand maps and dashboards, is helpful for when utility staff members need to explain complex sewer system concerns to community members and stakeholders, as staff at Newburgh have done. People get a big-picture view of their area's sewer systems, along with highly detailed information that shows how utility owners are making informed decisions about which pipes to rehabilitate and replace, and when.

"GIS is able to take thousands of pieces of information and put them into a usable format so utilities can take advantage of the information they already have to complete cost-effective maintenance," concluded Brenton Hasenour, B&N's water and wastewater section director in the firm's Evansville, Indiana, office.

← PipeAId helps utilities process closed-circuit television (CCTV) video and assign observation codes to pipe sections that need to be repaired or replaced.

About the Authors

Josh Ford, an engineer at B&N, led development of the firm's AI technology, PipeAId. For 17 years, Ford has been involved in all phases of sanitary sewer evaluation studies, including contractor oversight during cleaning and inspection and CCTV QA/QC. Kris Popovich, who specializes in GIS and cartography, is the geospatial technology leader for B&N. His experience ranges from transportation planning and bridge inspections to utility infrastructure and environmental reporting.

For Mariners, ArcGIS Field Maps Enables Real-Time Hydrography

National hydrographic offices produce and maintain Electronic Navigation Charts (ENCs), which are essential to mariners and for navigational safety. They are used by marine freight operators to circumnavigate the globe, maritime pilot organizations to plan and optimize services and port entry, and coast guards and navies to support disaster response and law enforcement activities.

Many hydrographic offices are also now being asked to go beyond making charts and provide additional services, such as furnishing data for ocean research and monitoring and reporting on vessel traffic. Offices that already use ArcGIS Maritime for ENC production are well positioned to take on these challenges not only because the software supports a wide variety of product specifications but also because it seamlessly integrates with other ArcGIS products.

In particular, ArcGIS Maritime now integrates with ArcGIS Field Maps, an all-in-one app for mobile work that allows staff at hydrographic offices to take ENC production out of the office and onto the water. The pairing of Maritime with Field Maps enables survey crews to quickly report new information that is important for navigation, like dangers or obstructions. It also unlocks new capabilities for ENC end users, such as real-time alerting.

Maritime supports the creation, maintenance, visualization, and distribution of ENC data. When Maritime is used with Field Maps, users can inspect and update ENC data in real time or near real time. Moreover, Field Maps can leverage the services-based architecture of ArcGIS Enterprise, or it can be used offline in low- or no-bandwidth environments.

Providing Real-Time Updates to Chart Services

In their jurisdictional waters, port and inland water authorities rely on ENCs to ensure navigational safety for mariners, port pilots, and other people who navigate ports. The authorities frequently update ENCs to reflect changes to navigational aids and obstructions, and these updates need to be delivered quickly.

Traditionally, updating a navigational chart could take several weeks. Today, by using the ENC as a service maintained by national hydrographic offices, staff can make updates in real time.

For example, staff at an inland waterway authority can use Field Maps to update buoy locations with just a few taps on a tablet while they complete other inspection routines. The changes are then immediately available to everyone who uses that service. Likewise, after a natural hazard such as a hurricane, a port authority survey crew can help with cleanup efforts and accelerate a port's safe reopening by using Field Maps to indicate new obstructions.

Giving Users Real-Time Proximity Alerts

Hydrographic offices can provide additional value to their end users by combining ENC layers and the geofencing capabilities in Field Maps to enable real-time proximity alerts. Using Field Maps on their mobile devices, trusted users can access the geofence-enabled maps that hydrographic offices produce and host. When these maps are used with an electronic chart display information system, users on marine vessels can get real-time alerts on any of their devices that run Field Maps, which is available for free in the Apple and Google Play app stores. Depending on specific hydrographic offices' requirements and regulations, access to these enhanced charts can be sold to generate revenue as well.

Shipping and commercial fishing companies that use ArcGIS Online or ArcGIS Enterprise can also employ the ENC services provided by organizations such as the National Oceanic and Atmospheric Administration to create geofence alerts for features on ENCs and their own configured overlays. For example, if a commercial fishing crew has identified a particularly rich fishing ground, the crew members can use Field Maps to mark that location on the chart and set up an alert to notify them of their proximity to the location on future expeditions. Additionally, while continuing to follow International Regulations for Preventing Collisions at Sea signals—which are maneuvering and warning signals designed to prevent collisions—commercial fishing, dredging, and diving vessels can set alerts for themselves or others for when a hazard is nearby or they reach a particular location.

Enabling Offline Editing for Survey Crews

Ideally, survey and inspection crews have constant internet connectivity via onboard broadband mobile services so that they can submit timely survey updates. However, given the nature of coastal and ocean work, including variable offshore distances and weather conditions, this is not always possible.

Field Maps allows users to take the Maritime Chart Service data that drives ENC displays offline and into a mobile geodatabase. This enables survey crews to use ENCs as basemaps and edit locations and feature attributes even when they don't have internet connectivity. Features that are important for navigational safety, such as the locations of wrecks and other obstructions, can be added to the ENC database without having to wait for Maritime to process point clouds.

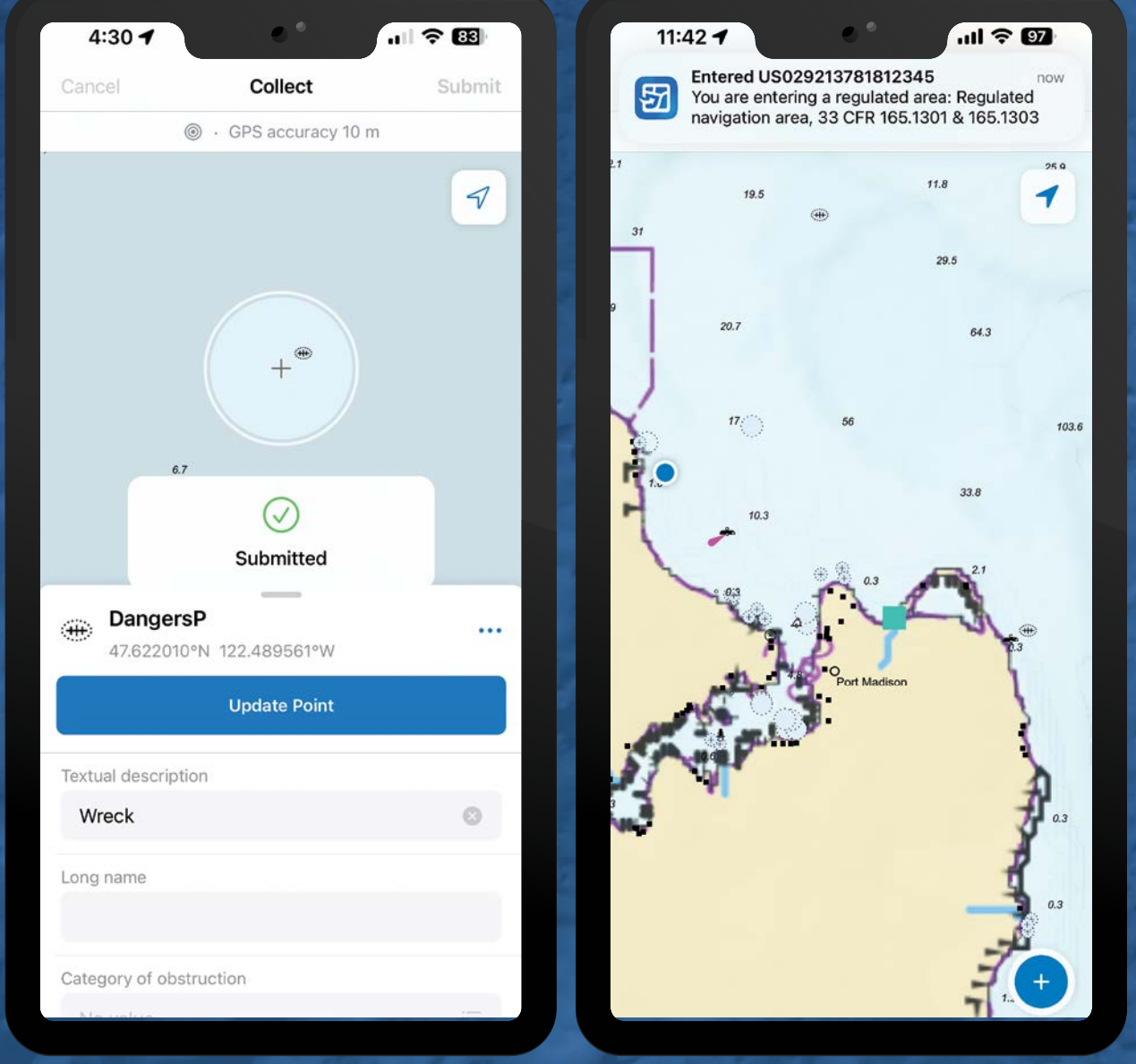
Crews can then update data and post changes when they get back to port. When an internet connection is reestablished, updates are processed nearly instantly, which boosts efficiency in chart production.

The Potential Beyond Producing Charts

Because hydrographic offices are being asked to provide more value to their end users, the ability to leverage more ArcGIS capabilities via mobile app integration is essential.

Apps such as Field Maps provide that integration right out of the box. Field Maps supports online and offline workflows, so survey crews can provide chart updates with or without network connectivity. And the Field Maps app's geofencing capabilities can enhance ENCs with real-time proximity alerts.

Integrating Maritime and Field Maps opens the door for hydrographic offices to realize their potential beyond producing charts.



↑ Using ArcGIS Field Maps enables marine shipping and recreational vessels to receive real-time alerts when they're near known obstructions or regulated areas.

From the Meridian

By Dr. Adriana E. Martinez
Associate Professor, Southern Illinois University Edwardsville

Elevating the Discipline: Raising Geographers' Voices as Guides

I grew up in Eagle Pass, Texas, along one of the world's great rivers, the Rio Grande—a river that has captured people's imagination and prompted headlines over the years.

To me, the Rio Grande area is home. I often crossed the river via the international bridge to our sister city, Piedras Negras, Coahuila, Mexico—the place where, in 1940, the nacho was invented. This river inspired me to become a scientist.

But the landscape of my hometown river has changed since my childhood. In 2008, the first federal sections of border fence went up. Empty train car containers, concertina wire, and reinforcements of state and federal guards followed.

Then, in July 2023, the State of Texas ordered 1,000 feet of fluorescent orange buoys to be placed in the middle of the channel. These buoys not only threaten immigrants and asylum seekers, but they also disrupt the river's natural flow, leading to erosion and deposition that can damage infrastructure downstream.

As a fluvial geomorphologist, I work to understand the interactions between rivers' physical shapes, their water and sediment transport processes, and the landforms that they create. I also strive to understand the influence of human activity on rivers. I've recently expanded my research to factor in the ecological and social costs of immigration control along the Rio Grande between the United States and Mexico.

Seeing the social and environmental destruction along my beloved river has inspired me to raise my voice, go beyond publishing scholarly papers and into the public realm, and help people know what's at stake for our climate and our communities.

Helping the Public Understand

When it comes to the Rio Grande, there's no single geographic research specialty that covers its physical and ecological dimensions and its social and cultural realities. As my work has advanced, I've found myself looking for new ways to communicate with the public about immigration policies and their implications.

I'm also interested in the river's caregivers—the people who have organized to protect the Rio Grande and the people who are trying to cross it for a better life.

Unfortunately, the traditional skills that I learned in graduate school have not helped me share my work—in the news, on social media, or in presentations for nonscientists. Yet sharing my work in these ways is more pressing and urgent than ever before.

When the American Association of Geographers (AAG) launched its Elevate the Discipline program (links.esri.com/elevate) in 2023, I was eager to learn about media relations and advocacy. Before then, my border work had already attracted some media attention. But I felt that with better skills, I could do the story and my community more justice. I saw a chance to dispel the myth that geographers just do maps and capitals.

The yearlong program was just what I needed to amplify the work of local organizations along with my findings on river border control impacts. During the Elevate program, I learned alongside 14 talented academics who shared my climate science and human concerns. From studying urban heat patterns and island agriculture to examining how colonization has affected climate change, our approaches were very different. Now, we serve as a resource and sounding board for each other as we present our work to the world.

Because my particular work involves a marginalized community, being a public scholar lets me showcase how such communities do this work themselves, as well as their role in this type of geographic research. I also wanted to become a public scholar in order to increase representation of marginalized groups in geography—which is low, particularly among physical geographers. If I'm visibly doing this work, it encourages minoritized students to pursue a job in this discipline.

Training to Be a Better Guide

The Elevate program offers media and advocacy training via webinars, check-ins, and remote learning experiences—such as a weeklong in-person intensive training that includes in-studio interview practice. During this training, we learned techniques for communicating complex topics in succinct phrases, practiced in a real TV studio, and were taught how to understand the landscape for local advocacy. I used these new skills almost immediately, when I did a live interview with Scripps News (an American news channel formerly known as Newsy) just a few days later.

The Elevate program and others like it can help counteract scientists' frustration that our work can't or doesn't have a large impact. I am here to say: Our work has an audience. It's just a matter of connecting with advocacy groups and reporters who want to know more.

In Eagle Pass, I've found the locals to be inspiring. For example, the Eagle Pass Border Coalition fights for justice along the Rio Grande—from helping immigrants to saving the river itself.

The Eagle Pass Border Coalition wants to tell immigrants' stories so that people far from the border understand that this area is not simply in unlawful chaos; it's an place that's rich with history and culture with people who want to be heard as the area's problems are addressed.

When I stand on the Rio Grande's banks and listen to the quiet sounds of the river valley, I feel a profound sense of peace and solitude. But I know that the river is surrounded by bustling human communities with members who have supported each other in times of need and celebrated in times of joy.

I've found that, as a scientist and a person, the more I embrace the communities and complexities here, the more I comprehend—and the more I can share with people who misunderstand this area and what it means.

Eagle Pass and the Rio Grande exemplify what geography can do: It crosses cultural divides, connects people and their landscapes, and brings together the sciences and the humanities—all to create a more just world that is grounded in geographic principles and methods.

Through my work and my public profile as a geographer, I hope to illuminate border issues and show a younger generation growing up in border areas that they, too, can be geographers—and that geography will open the world to them.

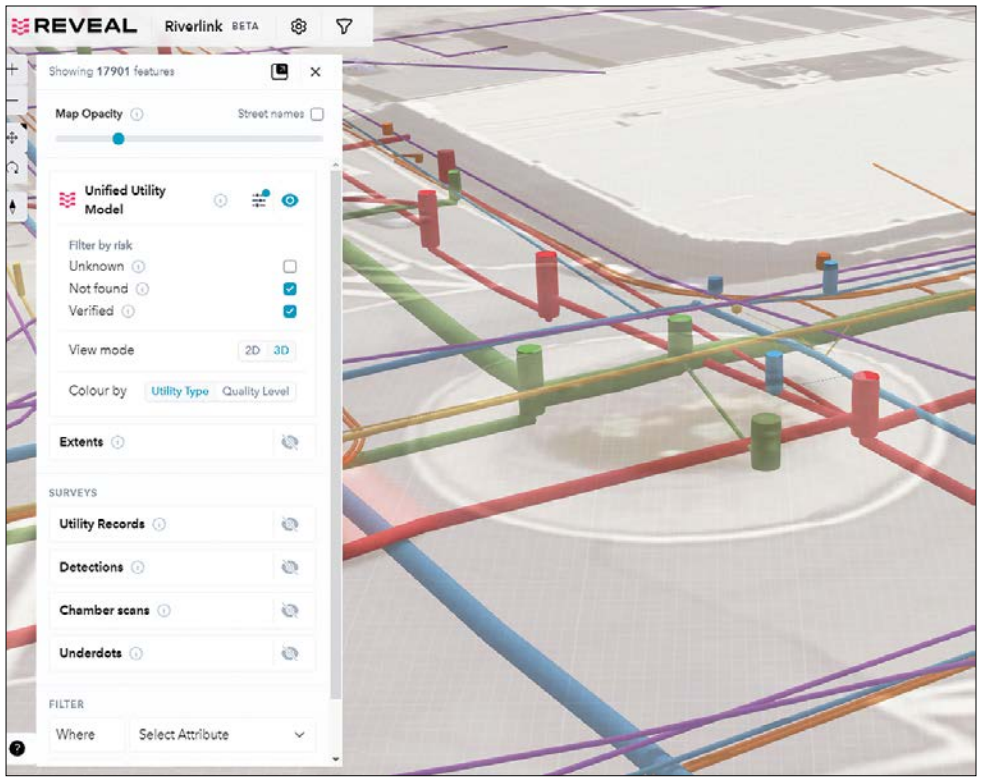
The environmental, ecological, and social landscape of the Rio Grande has changed over the years.

About the Author

Adriana E. Martinez is a geographer and associate professor at Southern Illinois University Edwardsville. Her current work examines the US-Mexico border wall's influence on flooding and the fluvial geomorphology of the Rio Grande. She was part of the first cohort of geographers to take part in AAG's Elevate the Discipline project.

From the Meridian is a regular column from the 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 the AAG's programs and membership at aag.org.

Startup Builds Unified Utility Models in 3D for Civil Infrastructure Growth



→ Reveal's ground-penetrating radar survey was used to update modeling from 2D to 3D, providing better understanding of subsurface infrastructure by adding depth measurements.

↓ Reveal provided underground utility risk visualizations for the RiverLink project riverscape, shown here as an artist's rendering.

The residents of any city rely on dependable performance from utilities to keep their lives on track. But when construction or new asset installation damages underground utilities such as gas, water, or power lines, the consequences can be disruptive and expensive—even deadly.

A utility strike occurs when a crew accidentally encounters and damages underground utility pipes or wires during excavation. In the United States, a utility strike occurs every 60 seconds on average. By some estimates, inaccurate location information about underground infrastructure causes a $50 billion to $100 billion cost to the US economy every year. These costs include project delays due to redesigns and approvals, overtime for utility employees, and insurance premium increases for large contractors and asset owners.

In December 2022, when Greater Wellington, New Zealand, initiated the Te Wai Takamori o Te Awa Kairangi (RiverLink) project to perform vital flood protection improvements, transportation upgrades, and urban revitalization efforts for the area of Te Awa Kairangi ki Tai (Lower Hutt), planners knew they needed to avoid utility strikes. They turned to Esri startup partner Reveal (reveal.nz) for help.

Understanding What's Underground

Reveal, a New Zealand-based utility locating technology company, is breaking new ground in the visualization of underground utility risks. The company uses ArcGIS Online, ArcGIS Pro, and ArcGIS Maps SDK for JavaScript to power what it says is one of the largest and most accurate subsurface utility models ever created.

Reveal started as a traditional "boots-on-the-ground" utility locating service business, but CEO and founder Sam Wiffen was eager to build a foundation of technology and innovation in an industry where modernization has not come easily. "If we could ensure that contractors and project owners could accurately and easily implement subsurface data, we could reap huge efficiency gains at every stage of the project life cycle, from *[the]* concept and design phase through to construction," Wiffen said.

The Te Wai Takamori o Te Awa Kairangi project team engaged Reveal to complete a comprehensive utility model that could be used to plan further investigations and inform partners on the status of the underground utilities within the planned project footprint.

Combining Field Expertise with Groundbreaking Technology

The most accessible information on underground utilities has been historical utility plans, often provided by asset owners on request to contractors who need to do swift construction or make immediate repairs. The plans were often only available via paper or PDFs—or by simply making physical markups on the ground. The downside of this information is that it is often inaccurate or incomplete, leading to the risk of utility strikes and project delays.

In response, the field of utility locating has emerged to provide more accurate location and survey data, but the output from these manual geophysical investigations is expensive to procure and requires high levels of expertise to interpret. Worse still, these valuable deliverables are sometimes shelved by the asset owner or lost on completion of a project.

What has been needed is a holistic approach, one that combines existing utility plans with modern survey methods and applies a layer of verification and authentication to the location data. Also needed is an intuitive, cloud-based platform to visualize and share the results.

Accurate Mapping of Unseen Utility Equipment

Mapping underground assets poses an unusual challenge for mapping software—the objects being mapped are often concealed or detected using probabilistic techniques rather than direct observation. The temporal data (when an object was detected) and chain of evidence (what techniques were used and how accurate they were) are also unfamiliar metadata layers that need to be displayed intuitively to users interested in the subsurface. Finally, mapping the depth element is especially critical for water utilities, which necessitates mapping objects in three dimensions relative to an ever-changing surface elevation.

Underground utilities are composed of a large number of types, components, shapes, and other metadata, from utility access holes and chamber lids to telecommunications cables, grates, sumps, and more. Distinct symbology and color codes for utility types are understood throughout the industry, and any technology platform needs to be able to accommodate different styling and displaying of these objects in three dimensions while maintaining smooth performance for large project areas.

"One of the most significant benefits of using the Reveal model is its potential to reduce the need for invasive investigations," said Samantha Smith, utilities project manager for the Te Wai Takamori o Te Awa Kairangi project. "By highlighting unknowns and higher-risk areas, the model allows for targeted investigations and utility relocations planning. This approach minimizes disruptions and costs associated with more invasive methods."

Reveal chose to build its platform in ArcGIS Online for its ease of use and wide industry acceptance. "*[JavaScript Maps SDK]* and ArcGIS Online allow developers to deliver the most complete range of data types via the browser, with a reasonably low amount of custom code creation," said Reveal CTO Tim Rastal.

Reliable Insight and Versatility

The work at Te Awa Kairangi ki Tai was completed in two stages, with the first stage involving a comprehensive 2D desktop study. Reveal's team compiled information from various sources, including utility providers, to make sure the data was up-to-date. This initial step ensured that the foundation of the model was built on accurate and reliable information.

Following the desktop study, Reveal performed a ground-penetrating radar survey. The survey data was processed and used to update the model from 2D to 3D, providing an even more comprehensive understanding of the subsurface infrastructure by adding crucial depth measurements to the model.

"One of the standout features of Reveal's model is its versatility," said Smith. "The model can be exported in various formats, making it compatible with our design software. This compatibility enabled seamless integration of the model into our planning and design processes, making it an invaluable tool. The visual presentation of the model is impressive, and the user interface is intuitive and easy to navigate."

The Reveal team took only three months from project inception to delivery of a full-fledged unified utility model in a web-based platform for RiverLink's designers and engineers.

"Reveal has proven to be innovative and forward-thinking in their field of subsurface utility investigations," said Smith. "Their diligent and thorough approach, coupled with the creation of a visually appealing and user-friendly model, has enabled us to plan further investigations and inform our relocations design with confidence."

Esri Partners Help Customers Improve Processes for Better Understanding

When organizations need to analyze geospatial data to craft efficient solutions, Esri partners can help. Read on to find out how three partners helped a botanical garden, an infrastructure company, and the State of West Virginia develop and improve their GIS-based workflows for greater accuracy and insight.

Growing a Digital Twin at Arizona's Desert Botanical Garden

Located in Phoenix, Arizona, Desert Botanical Garden is a 140-acre living museum with more than 50,000 specimens of 4,500 native and nonnative plant varieties. With more than 500 rare and endangered species and an estimated 870,000 visitors per year, the nonprofit garden is a hub of education, research, exhibition, and conservation for desert plants, especially those of the Sonoran Desert.

Until recently, staff at the garden managed the property and its specimens by using paper-based mapping workflows. Garden staff reached out to Esri partner **Bad Elf** (bad-elf.com), initially seeking survey-grade Global Navigation Satellite System (GNSS) receivers to help manage the botanical collection.

Now, the garden has gone digital, improving efficiency and helping keep the collection healthy. Assisted by Bad Elf, Desert Botanical Garden has migrated from its paper systems to a GIS-based digital twin.

Garden staff wanted to increase their digital collection of plants and assets. Previously, the collection was only partly digitally mapped, and the goal was to digitally map the entire garden. By going digital, staff hoped Desert Botanical Garden would improve efficiency, particularly by mapping facility infrastructure such as water lines and similar assets for maintenance purposes.

The Bad Elf team went on-site to demonstrate how Bad Elf GNSS receivers could work in the garden's high-density planting conditions, unique to species in the US Southwest. Using ArcGIS Field Maps, the team demonstrated practical data collection techniques that met all of the staff's requirements. Bad Elf also trained the staff in high-accuracy geospatial field data collection, emphasizing workflows and helping ensure that all the data collected uses GNSS metadata.

In addition, the Bad Elf team taught garden staff how to construct field layers using appropriate projections to ensure that all data would be properly referenced. Staff learned how to deploy field data collection layers and web maps in Field Maps and how to use ArcGIS Pro as their primary geodesign management tool. Combining Field Maps and Bad Elf Flex GNSS receivers, training concluded with staff constructing and deploying Field Maps layers designed for individual duties such as maintenance, planning, and research.

Moving away from paper maps enabled garden staff to have a complete digital twin of Desert Botanical Garden's plants. Now staff can run plant health reports; assign maintenance and monitoring tasks to high-density plantings; and keep track of plant species' health, location, and quantities.

The garden's geodatabase also supports data collaboration with the US National Seed Strategy, a Bureau of Land Management program that guides the development, availability, and use of seeds needed for restoration efforts. Participation in this program gives the botanical garden access to federal funding to create and manage a national revegetation plan for federal and nonfederal land.

In the future, the garden's Esri-based digital twin will not only help staff keep the garden healthy but also provide data that could aid conservation efforts in desert areas far from Arizona.

↑ The high-accuracy Global Navigation Satellite System (GNSS) receivers provided by Bad Elf can map individual specimens to within an inch of their actual size.

← Bad Elf's GNSS receivers helped Desert Botanical Garden staff create a geodatabase of the garden's diverse specimens.

Closing the Distance Between Small Communities and Fiber Backbones

Infrastructure company Arcadian Infracom builds and operates long-haul fiber routes through rural and tribal lands in the United States, enabling improved broadband access and economic development in underserved communities. Developing unique routes that support Arcadian's broadband access and diversity objectives is complex and requires considering many location-based elements.

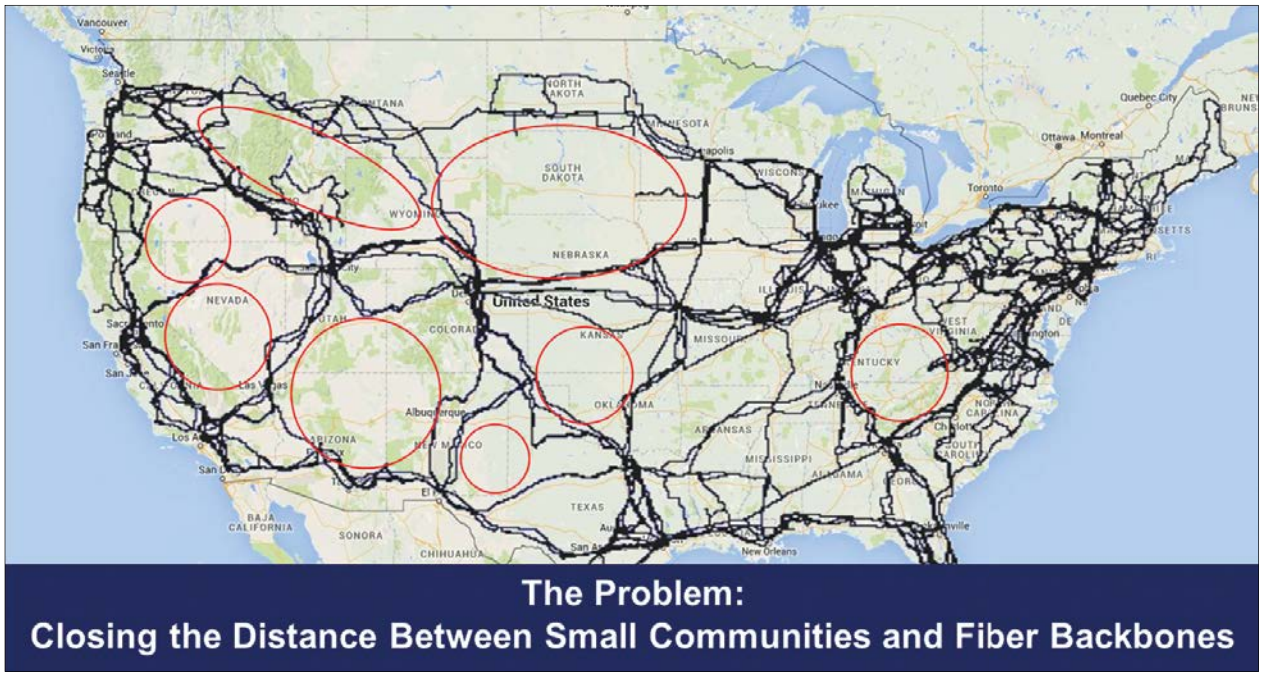
Enterprise GIS became critical for staff at Arcadian to analyze, create, and manage rights-of-way. But implementing and administering ArcGIS Enterprise was complex from resource and cost perspectives. So Arcadian management reached out to **CyberTech Systems and Software** (cybertech.com) to help get ArcGIS Enterprise up and running and ensure that its use met the infrastructure company's key business objectives.

The CyberTech team acted quickly, first engaging with the Arcadian Esri account representative. Esri approved Arcadian's application to join the ArcGIS Telecom Management enterprise agreement program, which provides the organization with key GIS capabilities, plus discounts on training and additional licensing.

CyberTech also set Arcadian up with the CyberTech Managed ArcGIS Cloud Services offering. This security-first managed service subscription for ArcGIS Enterprise provided Arcadian with a cloud computing environment, ArcGIS Enterprise implementation, and end-to-end service-level agreement-based administration. From start to finish, CyberTech completed Arcadian's ArcGIS Enterprise implementation and setup in just six weeks.

With an ArcGIS Enterprise environment fully functional and accessible, Arcadian's broadband planners use the power of location for right-of-way analysis, creation, and management. Now that Arcadian employs the power of integrated information about areas under consideration from a location perspective, staff are able to analyze the geographic elements of each project and how they might impact routes, which saves the company time and resources.

CyberTech continues to provide Managed ArcGIS Cloud Services to Arcadian, ensuring that the company's spatial resources are fully functional, up-to-date, and available. In addition, CyberTech's engineers assist with streamlining processes and automating right-of-way-related functions. Today, the partnership between CyberTech and Arcadian remains mutually beneficial, driving success for both companies.



← CyberTech's Managed ArcGIS Cloud Services offering helped Arcadian staff identify underserved communities in need of improved broadband access.

Improving Internet Connectivity with Ookla Speedtest Data and ArcGIS Survey123

Internet connectivity is necessary for education, economic growth, and quality of life, so ensuring universal access to fast and reliable internet is a priority for state governments. In 2021, West Virginia governor Jim Justice announced the Billion-Dollar Broadband Strategy, a plan to invest more than $1 billion in public and private funding to improve broadband connectivity to homes and businesses throughout the state.

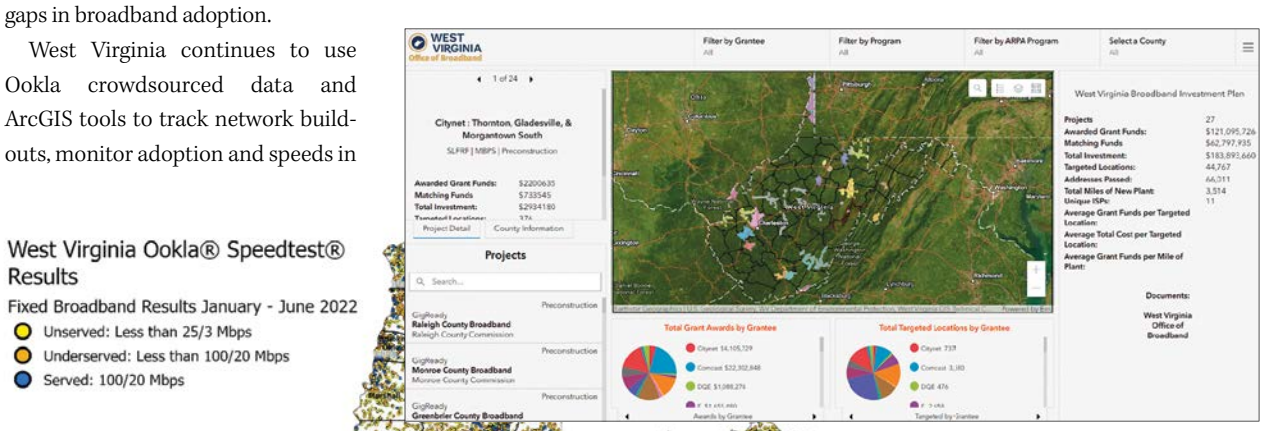
In 2023, the cost of this plan—the largest broadband investment in the state's history—exceeded $1 billion and prompted the West Virginia Department of Economic Development and the West Virginia Broadband Enhancement Council to prioritize funding allocation. However, a lack of network performance data, along with West Virginia's varied Appalachia mountain topography, interfered with determining where to focus connectivity improvements.

While federally published maps such as the Federal Communications Commission's *National Broadband Map* help visualize connectivity needs, their data does not always reflect constituents' true, everyday internet experience. With a need for comprehensive, unbiased network performance data, project managers leveraged **Ookla**'s (ookla.com) crowdsourced Speedtest data to better understand the state's broadband availability and performance. They based their research on the many West Virginia residents who use Speedtest to monitor their internet performance.

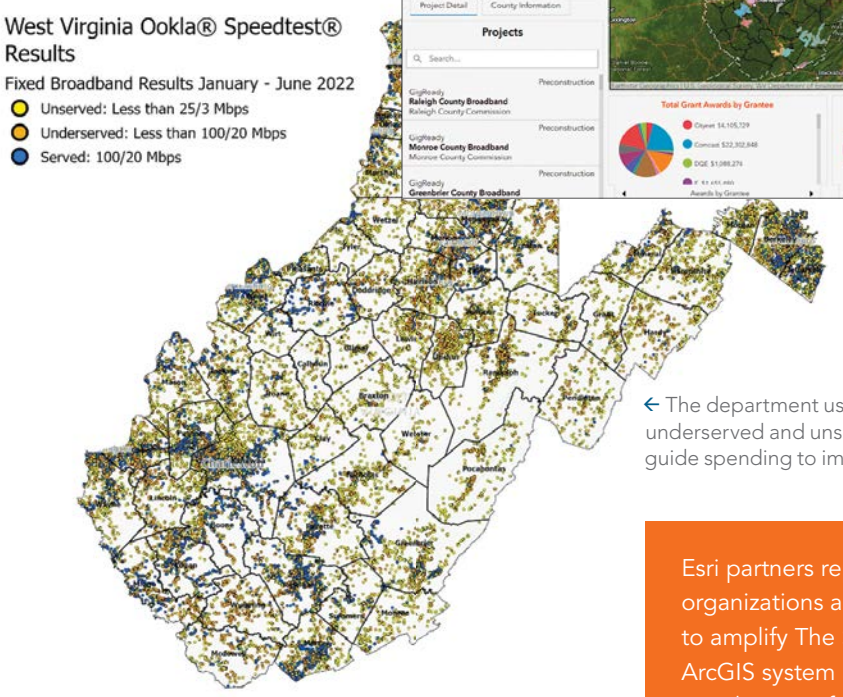
Using ArcGIS Online and ArcGIS Pro, the department conducted a multicriteria spatial analysis using hundreds of thousands of Speedtest results, Federal Communications Commission data, and related layers. This enabled the department to accurately visualize statewide connectivity while analyzing quality-of-service measurements such as upload and download speeds. The department was able to identify more than 271,000 underserved and unserved locations that had not previously been reported, helping target funding where it was most needed.

To enhance crowdsourced Speedtest measurements, the department and the council now encourage residents to continue testing their broadband performance using an integrated Speedtest and ArcGIS Survey123 questionnaire found at broadband.wv.gov/survey. This allows the state to associate Speedtest measurements with ISPs, location type, and service affordability to understand gaps in broadband adoption.

West Virginia continues to use Ookla crowdsourced data and ArcGIS tools to track network buildouts, monitor adoption and speeds in focus areas, and make informed funding decisions as more grants are awarded. Now, Ookla's ArcGIS technology-hosted layers allow government offices nationwide to rapidly map broadband and mobile network performance datasets, analyzing crucial speed and quality-of-experience metrics to help ensure equitable connectivity development.



↑ The West Virginia Department of Economic Development used ArcGIS Online to build a dashboard that highlights broadband projects funded by the American Rescue Plan Act.



← The department used Ookla Speedtest results to identify underserved and unserved locations across West Virginia and guide spending to improve connectivity.

Esri Expands Global Public Health Initiative for Low-, Middle-Income Countries

By Dr. Lance Owen, Esri

For decades, Esri has championed global health work in countries with low- and middle-income economies. In the 1990s, Esri supported several World Health Organization projects by making location analysis and mapping a core part of key global health workflows. In the 2000s and 2010s, the urgency of these efforts ramped up due to two major events. The first was when Esri supplied key technological and personnel resources to the Global Polio Eradication Initiative to help vaccinate all children in countries where polio was still endemic. The second was the Ebola outbreak in West Africa in 2014, which demanded an unprecedented level of Esri support to map case clusters so that responders could prioritize resource allocation and contain the disease.

In the wake of these two major efforts, Esri went a step further to bolster the global health system in 2018 by creating a software grant expressly for ministries of health that are low on resources. This Health and Human Services Grant allowed government health agencies in 75 eligible countries that have low- and middle-income economies to apply to receive a bundle of free software.

These desktop and online GIS offerings equipped successful applicants with powerful foundational geospatial tools that could transform their daily work, whether related to disease surveillance, vaccine microplanning, or health facility accessibility analysis. Additionally, the two-year grant period gave these ministries time to assess their use of the software and engage in necessary budget planning to purchase geospatial resources at the end of the grant period. Once a ministry's two-year period was complete, Esri offered it a low-cost bundle to use to continue to expand its geospatial work.

When COVID-19 brought daily lifestyles around the world to a halt in early 2020, global public health initiatives became unprecedentedly urgent. With the pandemic laying severe inequities bare, it became clear that empowering ministries of health—particularly in low-resource countries—was paramount. The COVID-19 pandemic also clarified how important location data and geospatial analysis are to public health. Map-oriented dashboards—such as the COVID-19 Dashboard from Johns Hopkins University's Center for Systems Science and Engineering—proliferated. This helped public health officials understand that the geographic approach is critical to data modernization.

The ramped-up awareness of global health needs that has occurred over the last few years has led Esri to a crucial next step: reiterating and strengthening its commitment to global public health.

Making GIS More Accessible to Global Public Health Practitioners

Three initiatives are foundational to Esri's updated vision on how to incorporate GIS more thoroughly into global public health work.

First, Esri has rebranded and enhanced its software grant to ensure that it reaches more countries around the world. Now known as the Global Public Health Grant Program (links.esri.com/health-grant), Esri's flagship health award bears a name that reflects its intended goal—to equip ministries worldwide with geospatial technology that can be used to address the most pressing public health challenges. In addition, 36 countries have been added to the eligibility list, bringing the total number of countries with access to the award to 111.

This geographic expansion was driven by a more refined awareness of global health needs. While sub-Saharan Africa, the Middle East, and Southeast Asia remain central to many global public health concerns—whether because of tropical disease prevalence, a lack of public health infrastructure, or humanitarian crises—countries in the Caribbean, Latin America, and eastern Europe also demonstrate need based on health vulnerabilities.

Ministries that secure the grant get access to ArcGIS Pro and ArcGIS Online and receive two GIS Professional user type licenses; three Creator user type licenses; and access to ArcGIS Spatial Analyst, ArcGIS Network Analyst, ArcGIS Geostatistical Analyst, and ArcGIS Insights. This bundle empowers health workers to undertake the full range of geospatial tasks needed to prepare for, monitor, and react to public health crises, including field data collection, mapping and analysis, and internal and external communication.

Second, Esri has reinforced its commitment to global public health by creating its robust Health GIS Curriculum, accessible at links.esri.com/health-gis. Split into six sections, the curriculum leads participants through a series of self-paced tutorials that build GIS skills in the context of specific, fundamental health workflows. With tutorials available in six languages, this curriculum was designed for a global health audience and conceptualized as an integral component of Esri's global health efforts. Taken together, the Health GIS Curriculum and the Global Public Health Grant Program represent a solid foundation for applying the geographic approach to public health work.

Third, Esri has solidified its support of DHIS2, an open-source health information system developed and managed by the HISP Centre at the University of Oslo in Norway. In the last few years, DHIS2 has become a major player in the global health space. More than 90 countries now use the platform in some capacity.

In 2022, Esri began partnering with DHIS2 to ensure that its platform and the ArcGIS system would be interoperable and that DHIS2 platform users would have an easy way to bring data into the ArcGIS ecosystem. To this end, Esri released a GitHub repository that facilitates the integration of DHIS2 content with ArcGIS Online using Koop, a flexible framework designed for building geospatial APIs. The result is a best-of-both-worlds approach that bridges the DHIS2 and ArcGIS systems and gives users optimal flexibility.

Keeping Up with Changing Health Challenges

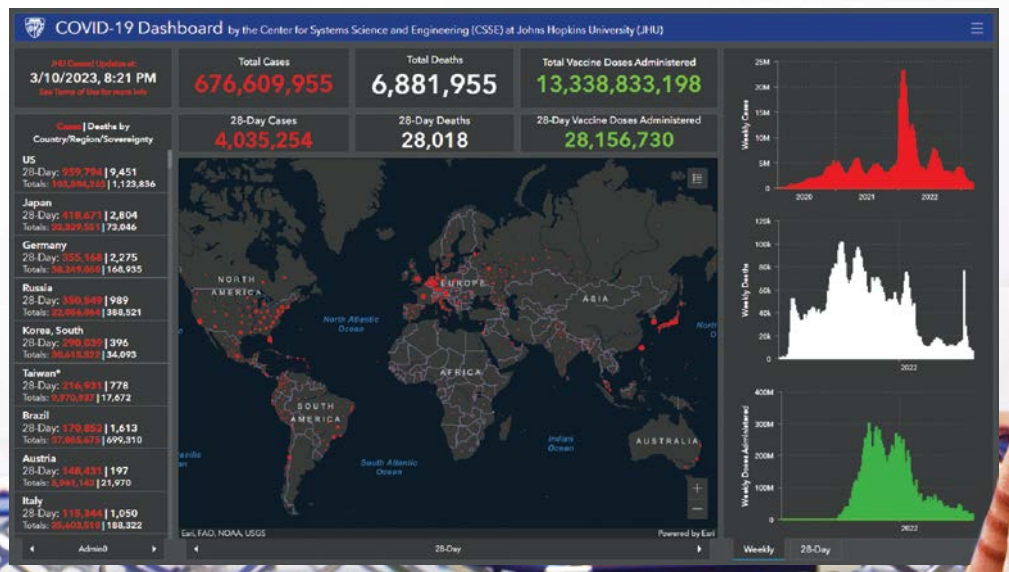
These three efforts resonate with an emerging focus in global health: the impacts of climate change on public and personal health.

Earth's warming is causing many negative health impacts to people around the world. Brutal and unprecedented heat waves are leading to higher death rates for vulnerable populations, such as the elderly and manual laborers. Megacities are enduring more days of extreme air pollution, leading to higher incidence of respiratory illness. In a particularly alarming shift, longer periods of warmth coupled with higher rainfall levels are leading to increases in vector-borne and waterborne pathogens and shifting the habitats of disease-carrying insects such as mosquitoes. Diseases such as cholera, malaria, and dengue fever are resurging and appearing in areas where they had been eradicated.

These shifting conditions demand increased public health resources—especially in the most vulnerable countries and even in countries where growing economic prospects have not led to dependable funding in health technology. With more robust access to Esri's Global Public Health Grant, its curriculum, and the ability to easily pull data from a key health information management system into the ArcGIS system, ministries have a full range of tools to use to confront existing and future health challenges.

Giving ministry of health workers the best GIS tools is a critical step for modernizing health GIS at the national level. By doing this, Esri is demonstrating commitment to supporting global health in a multifaceted, holistic way. This approach enables ministries of health to undertake the critical work of keeping their populations safe from health threats of all kinds.

For more information about this grant or other global health topics at Esri, email me at lowen@esri.com.



← The COVID-19 Dashboard from Johns Hopkins University helped public health officials understand the importance of the geographic approach.

About the Author

Dr. Lance Owen is the global public health portfolio lead at Esri. He administers Esri's Global Public Health Grant Program and works to strengthen the company's support for global health organizations, including the World Health Organization, the Pan-American Health Organization, and Doctors Without Borders. Prior to joining Esri, Owen was a geospatial analyst, cartographer, and project manager for the Geospatial Research, Analysis, and Services Program at the Centers for Disease Control and Prevention. He holds a PhD in geography from the University of California, Berkeley, and completed an MPhil at the University of Cambridge on a Gates Cambridge Scholarship.

How to Help the GIS Profession Thrive

By the Urban and Regional Information Systems Association's Policy Advisory Committee

Lots of components need to come together for a field of practice to be considered a profession. Professionals commonly have advanced training and experience, adhere to a code of ethics, are recognized by peers and the public, demonstrate competence, participate in ongoing education and training, and make lasting contributions to the profession. GIS professionals are typically inclined to pursue these core objectives.

Achieving a GIS Professional (GISP) certification through the GIS Certification Institute is one way that GIS practitioners can demonstrate expertise and ethical conduct in GIS. That said, continued training is paramount—not just to being a professional but also to keeping up with a rapidly advancing technology environment. Following and understanding policies that positively and negatively impact a profession is another important pursuit.

Being a member of the Urban and Regional Information Systems Association (URISA) can help GIS professionals stay engaged with the profession and their professional community. URISA delivers resources that help guide GIS professionals throughout their careers—from its annual GIS-Pro conference, the URISA GIS Leadership Academy, and the new Advanced GIS Leadership Academy (being offered in August 2024 for the first time) to virtual education, local chapters, and a code of ethics.

An often overlooked but impactful focus area for URISA is in monitoring and consulting on government policies that affect GIS professionals. URISA's Policy Advisory Committee (PAC) keeps tabs on policies that are making their way through local, state, and federal government organizations, often offering feedback and influencing outcomes as needed.

The PAC has tracked many issues over the years, several of which are ongoing. That's because, as part of the tech world, GIS moves very quickly—unlike government policy, which tends to move slowly, sometimes causing negative impacts when it doesn't keep up with the pace of change. For anyone who is not up to speed on some of the key issues affecting the GIS industry, here are a few that may warrant getting involved with through the PAC or other URISA committees.

For more information on some of the ongoing issues the PAC is monitoring and working on, read "URISA's PAC Has Your Back," from the summer 2018 issue of *ArcNews*, at links.esri.com/urisa-pac. To join URISA and get involved with the PAC, visit urisa.org.

Surveying and GIS

In the United States, state governments regulate the surveying profession by statute, and some policies and regulatory language in those statutes are outdated. Because of the prevalence of high-accuracy Global Navigation Satellite System (GNSS) and global positioning system (GPS) technology—along with lidar, imagery, and drone data collection—in the GIS industry, GIS professionals often cross paths with land surveyors. For years, the PAC has been working with the National Society of Professional Surveyors and the National Council of Examiners for Engineering and Surveying to help modernize the model laws and rules for surveying (which states often use as a template for their statutes) to clarify which tasks are rightly considered land surveying and which tasks may be performed by GIS professionals.

Broadband Data

The Federal Communications Commission (FCC) is currently in the process of updating its broadband maps that identify where this service is and is not available, especially in rural areas. Broadband availability is of particular interest to the US Congress, which has improved its funding requirements in an effort to ensure that everyone has access to broadband service. The FCC's maps, however—which are now being updated by internet service providers to better reflect the true availability of broadband service—may be contested by local governments if they are still found to be deficient. GIS professionals are uniquely qualified to understand the quality of this data in their communities, and there are opportunities—through URISA and the PAC—to make this knowledge more widely known.

The Census and Redistricting

Following the 2020 US census, the PAC has been active in recommending how the data should be used for congressional redistricting. As can be seen in news reports over the last few years, redistricting is a contentious issue in several parts of the country. To help steer GIS practitioners toward developing equitable and fair legislative boundaries, URISA has published the nonpartisan paper *Redistricting: A Guide for the GIS Community*. It's also never too early to understand what the US Census Bureau is doing with the American Community Survey and how it is preparing for the 2030 Census—both of which the PAC is actively engaged in.

Collaborative Efforts

URISA isn't working alone in any of this. The organization was a founding member of the Coalition of Geospatial Organizations (COGO), a forum for several nonprofit organizations that are concerned with national geospatial issues. One of COGO's focus topics is the National Spatial Data Infrastructure (NSDI) Assessment, which evaluates how far US federal, state, regional, tribal, and local governments have come in working with the private and academic sectors to develop a national spatial data infrastructure for the United States. URISA was instrumental in getting addressing added as the eighth theme of the NSDI and now leads the team that is evaluating the progress of this inclusion.

These are just a few highlights that show how URISA and its members are analyzing and influencing policies that affect GIS professionals. For more than 60 years, URISA has developed and guided GIS and GIS professionals—and getting involved in the PAC is just one of the many benefits of joining the URISA community.

As the GIS profession grows, so must individuals' commitments to their chosen profession. URISA provides a wonderful and inspiring framework and community to support GIS professionals. Consider becoming active in URISA and even joining the PAC. It's the professional thing to do.

Managing GIS

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

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The Relevance of Cartography

A Cartographer's Perspective

By Georg Gartner
President, International Cartographic Association

Maps Matter!

Today, there is more geospatial data being produced than ever before. Countless sensors of all kinds measure values that are stored in databases, which are linked to other databases and embedded in spatial data infrastructures that follow standards and accepted rules. There is also no shortage of other modern data collection technologies, such as unpiloted aerial vehicles; data modeling products, from service-oriented architectures to cloud computing systems; and tools for visualizing and disseminating data, including augmented reality.

With such an abundance of data—including what's known as big data—one major issue is figuring out how to mine data efficiently to find relevant information and link it to a particular scenario. Software and app development typically starts here, with developers trying to work out what to do with so much data. I call this the data-driven approach to making geospatial products.

Additionally, new software, apps, and systems get developed all the time. It seems that just when geospatial practitioners begin to see the potential of a particular type of data acquisition, modeling, or dissemination technology, new technologies are created that need to be considered, evaluated, and—if they're good—implemented. Software and app development also often begins here, with developers trying to figure out how to make something with a new piece of technology. I call this the technology-driven approach to making geospatial products.

But the question of how human users will employ these tools is frequently only taken into account when the data- or technology-driven software, app, or system has already been built. This produces a marketplace full of products that are inefficient or even unusable. If, however, developers begin by considering what human users need to solve the problems they're facing, then more people could apply data and technology to their needs. I call this the user-centered approach to making geospatial products.

How can those of us who work in fields related to geospatial information ensure that spatial data is really applicable for governments, planners, decision-makers, and others through software, apps, and systems that are efficient and easy to use? Maps and cartography play a key role.

Maps enable humans to understand complex situations efficiently. They organize information based on spatial context and help users answer location-based questions, making them the perfect interface between data and human users.

Today, any individual who has even modest computing skills can create and use maps anywhere, for almost any purpose. Often, people produce and use maps to address needs that arise instantaneously when they are in a particular location. Think about searching for a restaurant to go to or analyzing, from the field, where a wildfire is headed next. In these instances, cartographic data in its finalized form is usually delivered to users digitally—sometimes even in real time, as the data is collected.

While these and other advances during the past decade have enabled mapmakers to significantly improve how maps are designed, produced, and implemented, many cartographic principles remain unchanged. The most important one is that maps are an abstraction of reality. Visualizing data means that some features of reality are depicted more prominently than others, while many features might not even be depicted at all. Abstracting reality is a necessary part of making powerful maps, as it helps users efficiently understand and interpret complex situations.

For example, when a natural hazard such as a hurricane or an earthquake occurs, first responders need to see quickly produced, imagery-based maps of the affected area to determine where to direct their resources first. As the disaster management process continues, crowdsourced data, risk maps, and data modeling and visualization become imperative for experts, decision-makers, and members of the public to quickly collect and disseminate crucial information with the goal of fostering widespread understanding of the situation.

In circumstances like these—and countless others—people would be spatially restricted without maps. Knowing the locations of objects and the spatial relationships among various entities is critical to being able to learn about and act in a space and, ultimately, make good decisions.

Information is already available anytime, anywhere. And people are beginning to feel spatially inadequate when they're not using map-based services that allow them to see who or what is near them, search for things based on their current location, and collect accurate and timely data on-site. Soon, data delivery will be even more tailored to each user's context and needs. Thus, cartographic services will be ubiquitous and used daily by even more people all over the world.

But the ongoing successful development of modern cartography requires taking an integrated, interdisciplinary approach to conceptualizing and producing maps. Practitioners in computer science, communication science, human-computer interaction, telecommunication science, cognitive science, law, economics, geospatial information management, and cartography need to come together to ensure that app development centers on what human users need and want. This requires those who are interested in maps, mapping, and cartography to work together on an international level.

That is exactly what the International Cartographic Association (ICA) cultivates. As the world-renowned, authoritative body for cartography and geographic information science (GIScience), the ICA consists of national and affiliate members from various governments, companies, and universities all over the globe. And the ICA has three key messages about the state of cartography today and going forward:

- **Cartography is relevant.** Modern cartography is key to modern society. Having knowledge about where objects are located and the spatial relationships among them is important for enabling economic development, managing and administering land, handling disasters and crisis situations, and simply being able to make decisions on a personal scale about where to go and when.
- **Cartography is progressive and forward-looking.** New and innovative technologies impact what cartographers do. Various ways of acquiring geospatial data, from laser scanning to remote sensing, affect how maps get derived—some of which are now created automatically. Smart models can be built using geospatial data, allowing people to do in-depth analysis of structures and patterns. And a whole range of presentation forms are available nowadays, from maps that appear on mobile phones to geoinformation presented as augmented reality. There is surely more to come, and that can already be seen in how knowledge networks and knowledge infrastructures, cognitive feedback loops, and artificial intelligence are being applied in cartography.
- **Cartography is attractive.** Well-made maps and other cartographic products are striking, captivating, and fascinating. Many people like to use maps, play around with maps on the internet, and simply want to look at them. In the past decade or so, there has been a dramatic increase in the number of map users, and that will only grow as geospatial data and technology continue to advance.

About the Author

Georg Gartner is a full professor of cartography at the Vienna University of Technology in Austria. He is currently serving his second term as president of the International Cartographic Association.

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Addressing Earth's Challenges: GIS for Earth Sciences
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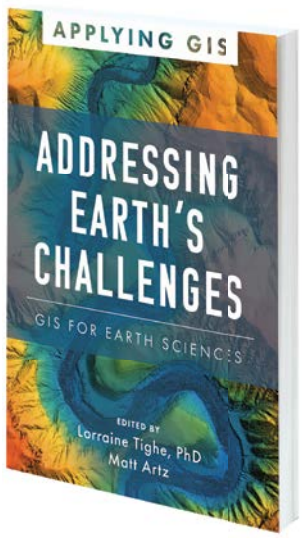
In *Addressing Earth's Challenges: GIS for Earth Sciences*, find out how organizations that work in geoscience, sustainable energy, environmental monitoring, climate science, meteorology, and marine science use GIS to streamline workflows, make decisions, boost operational efficiency, and foster civic inclusion. The book includes a section with ideas, strategies, tools, and actions to help readers jump-start their use of GIS for earth sciences. Online resources, including additional stories, videos, concepts, and downloadable tools, are also available. November 2023, 160 pp. Ebook ISBN: 9781589487536 and paperback ISBN: 9781589487529.



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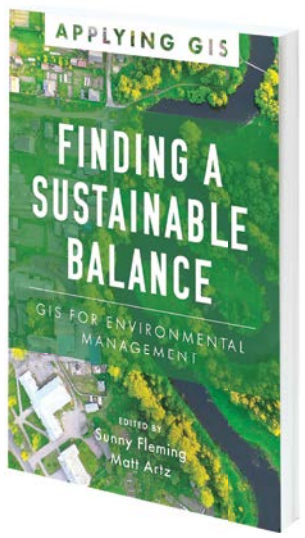
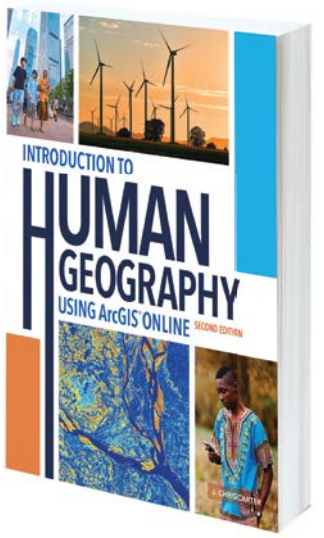
Environmental and natural resource management jobs are becoming increasingly difficult. *Finding a Sustainable Balance: GIS for Environmental Management* shows how GIS can improve operations across land and wildlife management, outdoor recreation, and environmental regulation. The book reveals how several environmental and natural resource management organizations use GIS to monitor environmental assets in real time, prevent environmental hazards from turning into disasters, and provide transparency that produces better outcomes. June/September 2023, 125 pp. Ebook ISBN: 9781589487598 and paperback ISBN: 9781589487581.



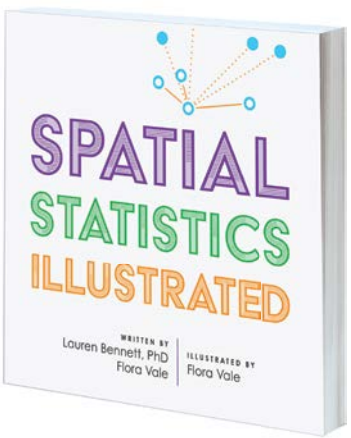
Introduction to Human Geography Using ArcGIS Online, Second Edition
By Dr. J. Chris Carter

Introduction to Human Geography Using ArcGIS Online, Second Edition, brings the essential concepts and theories of human geography to life by integrating web maps into the subject matter. Dr. J. Chris Carter explores topics such as migration, race and ethnicity, food and agriculture, manufacturing and services, and cultural geography via exercises that allow readers to interact with, analyze, and create maps using ArcGIS Online. The book empowers learners to better understand the diversity of people within their environments and their global impact. June/September 2023, 384 pp. Ebook ISBN: 9781589487475 and paperback ISBN: 9781589487468.



Spatial Statistics Illustrated
By Dr. Lauren Bennett and Flora Vale; illustrated by Flora Vale

Data science has permeated nearly every aspect of life. Still, it can be difficult to figure out where to start—and where to go next—when using data to solve complex problems. The good news is, there has never been a more exciting time to learn about spatial statistics, which employs geography to help quantify patterns, trends, and relationships. In a very approachable way, *Spatial Statistics Illustrated* helps readers learn the concepts behind the spatial statistics tools that are part of the ArcGIS system, as well as how they work and when to employ them. June/September 2023, 176 pp. Ebook ISBN: 9781589485716 and paperback ISBN: 9781589485709.



Top 20 Essential Skills for ArcGIS Pro
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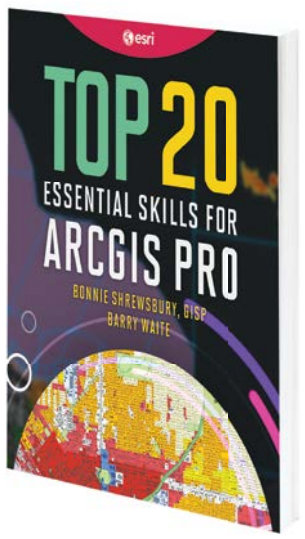
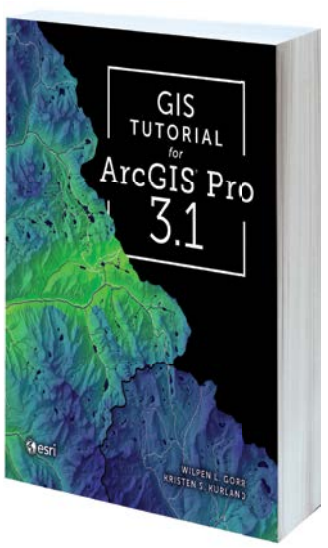
Get on the fast track to using desktop GIS with *Top 20 Essential Skills for ArcGIS Pro*. The book, written at an introductory level, features simple, step-by-step exercises that teach readers how to work with spatial data, create maps, and perform basic analysis. Each chapter introduces a skill, lets readers practice it, and includes a user story to show how these competencies are used to answer important questions and solve real-world problems. By the end of the book, readers understand what ArcGIS Pro is and how to use it and can leverage their newfound knowledge to continue their GIS journeys. May/September 2023, 190 pp. Ebook ISBN: 9781589487512 and paperback ISBN: 9781589487505.



GIS Tutorial for ArcGIS Pro 3.1
By Dr. Wilpen L. Gorr and Kristen S. Kurland

GIS Tutorial for ArcGIS Pro 3.1—the fifth edition in a series—is the book of choice for classroom-based and self-taught learners who seek to develop their expertise with Esri's premier desktop GIS technology. Revised for ArcGIS Pro 3.1, the book features new datasets, exercises, and instructional text to guide readers through the latest tools and workflows. Authors Dr. Wilpen L. Gorr and Kristen S. Kurland use current, real-world scenarios to demonstrate how to make maps and find, create, and analyze spatial data using ArcGIS Pro and ArcGIS Online. May/September 2023, 312 pp. Ebook ISBN: 9781589487406 and paperback ISBN: 9781589487390.



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Rory McPherson, a principal GIS analyst, is a two-time Esri technical certification achiever who believes certification has professional and personal rewards. "Becoming Esri-certified has been immensely beneficial to my professional journey," said McPherson. "It has expanded my knowledge and broadened my career opportunities." Read Rory's success story at go.esri.com/cert-rory.

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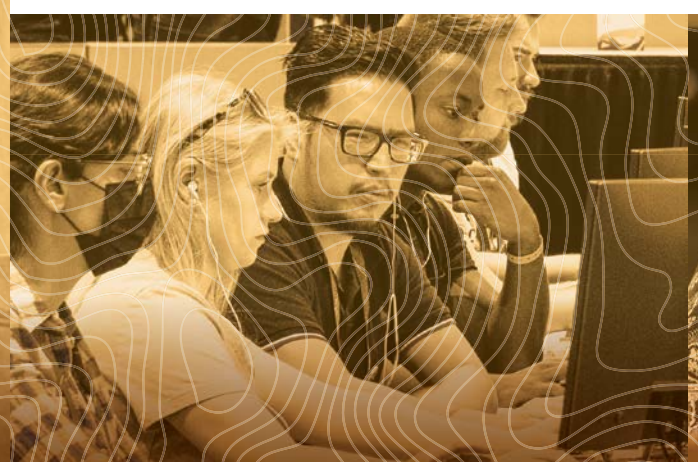

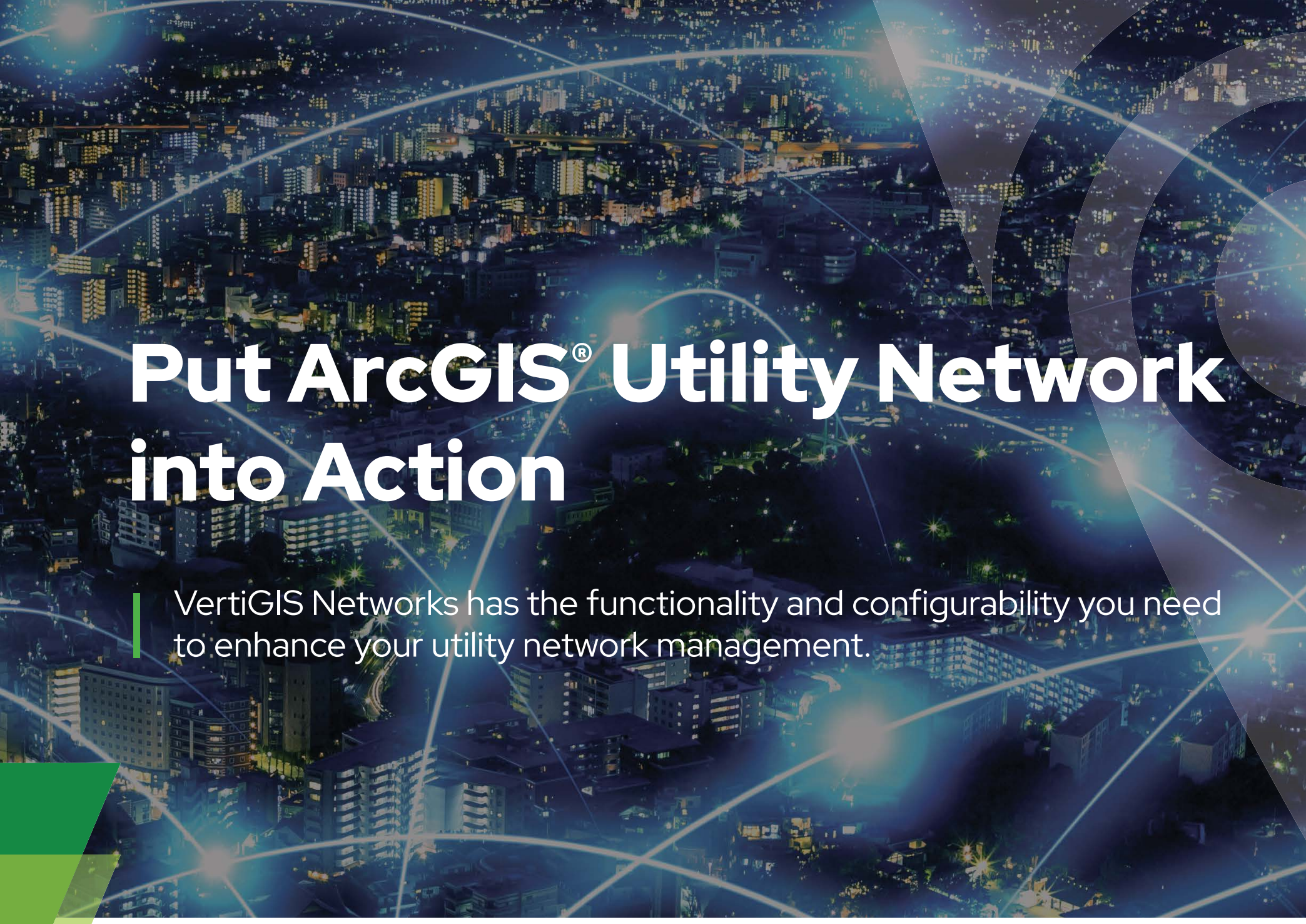

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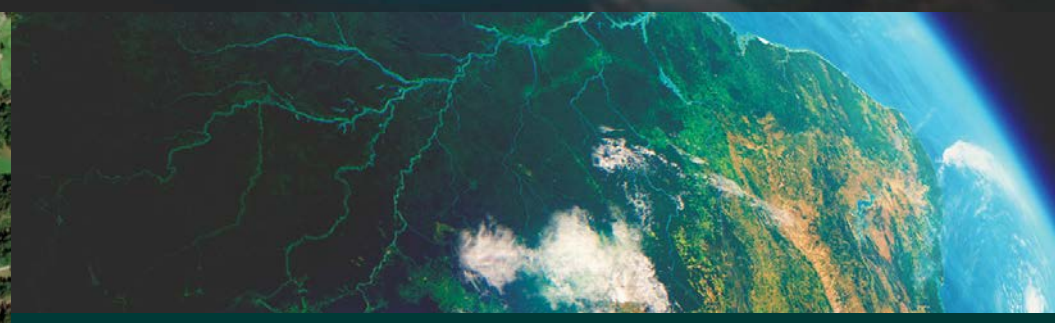

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