ArcNews

Esri | Spring 2024 | Vol. 46, No. 2

Briefly Noted

Autodesk Integrates ArcGIS Basemaps and Imagery
Industry leaders rely on the interoperability of GIS and building information modeling to reduce costs and boost efficiency across construction projects. To help with these efforts, effective November 2023, Autodesk entered into an agreement with Esri to provide ArcGIS Basemaps and ArcGIS Living Atlas of the World data in Autodesk products.

In March 2024, AutoCAD 2025 became the first Autodesk product to have these new capabilities. They will provide AutoCAD users with a geographic foundation for design projects based on a global collection of basemaps with localized languages and geographies. This will also provide additional value to AutoCAD users via authoritative maps that will help architecture, engineering, and construction professionals deliver projects more quickly and sustainably. With Basemaps, Autodesk users can enrich computer-aided design and building information modeling with real-world context.

For more information, see links.esri.com/basemaps-la.

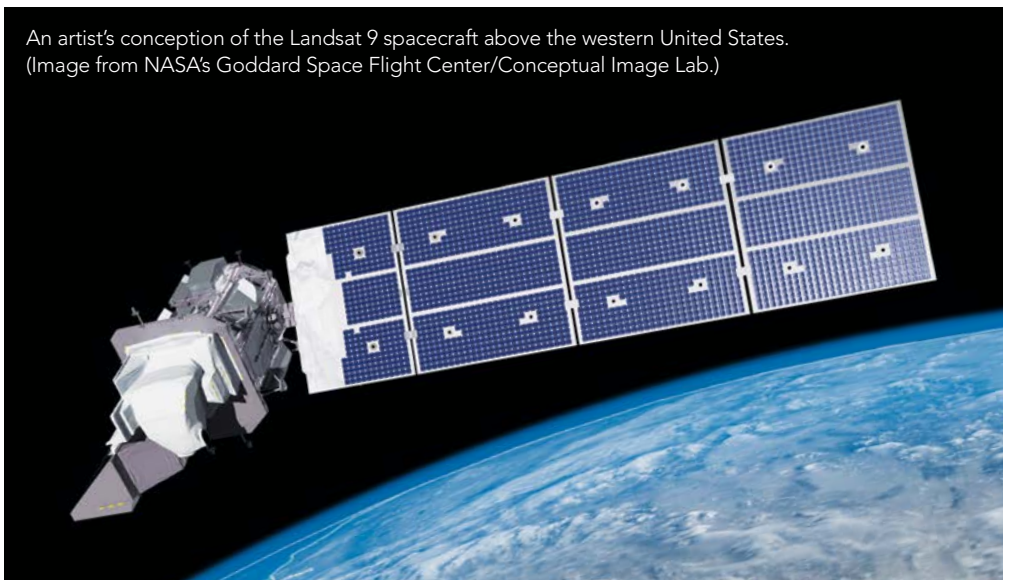
Esri Launches Maps.com
In January 2024, Esri officially launched Maps.com, a website for showcasing and celebrating beautiful, remarkable, and insightful maps. The site, accessible to anyone online, is focused on sharing and discussing visually engaging maps across a wide variety of topics and formats including analyses, dynamic visualizations, videos, and 3D models.

The Maps.com editors encourage mapmakers, cartographers, and the GIS community to submit their own distinctive and visually engaging maps. The maps featured so far have included a 3D view of Mars, a look at where Christmas trees grow in the United States, and a cross-section of an active volcano.

To submit a map for consideration, go to maps.com/submit-map.

Landsat Explorer: Traversing Time and Geography with Remote Sensing

The Landsat Explorer app in ArcGIS Living Atlas opens Landsat satellite data to everyone.



An artist's conception of the Landsat 9 spacecraft above the western United States. (Image from NASA's Goddard Space Flight Center/Conceptual Image Lab.)

Picture a world where the hidden becomes visible and our planet's unseen layers are revealed in a new light. This is the world that scientists began to explore in the mid-20th century, transcending human vision to uncover Earth's secret patterns and phenomena. From physicists to agricultural scientists, these pioneers ventured into the realm of new wavelengths, opening a window to a previously invisible world. Their quest for deeper understanding of landscape features led to the Landsat satellite program, an initiative that transformed our view of Earth from space.

The Multispectral Imagery Revolution

Multispectral imaging, a key tool for the Landsat program, marked a leap in how we observe our planet. It captures data in wavelengths that are

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A Visionary CTO Leaves a Legacy of Collaboration, Equity in Tacoma, Washington

Grace Brosnon

Grace Brosnon, chief technology officer of Tacoma, Washington, isn't interested in technology for technology's sake. That was why, years after developing her IT expertise, she dived into GIS and was instrumental in growing a prototype equity index into a sustainable and integrated GIS product.

Powered by GIS, Tacoma's Equity Index Map (tacomaequitymap.caimaps.info/CAILive) is used to help make equitable decisions regarding asset management, budget proposals, new policies, department goals, and racial equity action plans for the city's 18 lines of business.

"For me, it's about understanding how I can use technology to help do something," she said. "Sometimes the technology is very simple. Sometimes it can be more complicated, like GIS or SAP. But it's the outcomes that I'm interested in, more so than the technology itself."

Collaboration in Pursuit of Equity

To support the city's Vision 2025 initiative, the Equity Index Map was developed. The ArcGIS technology-enabled equity index started as a proof of concept and is now integral to the city's strategic planning goals and data analysis.

Brosnon credited her team and several others for the city's effective use of ArcGIS, noting that the

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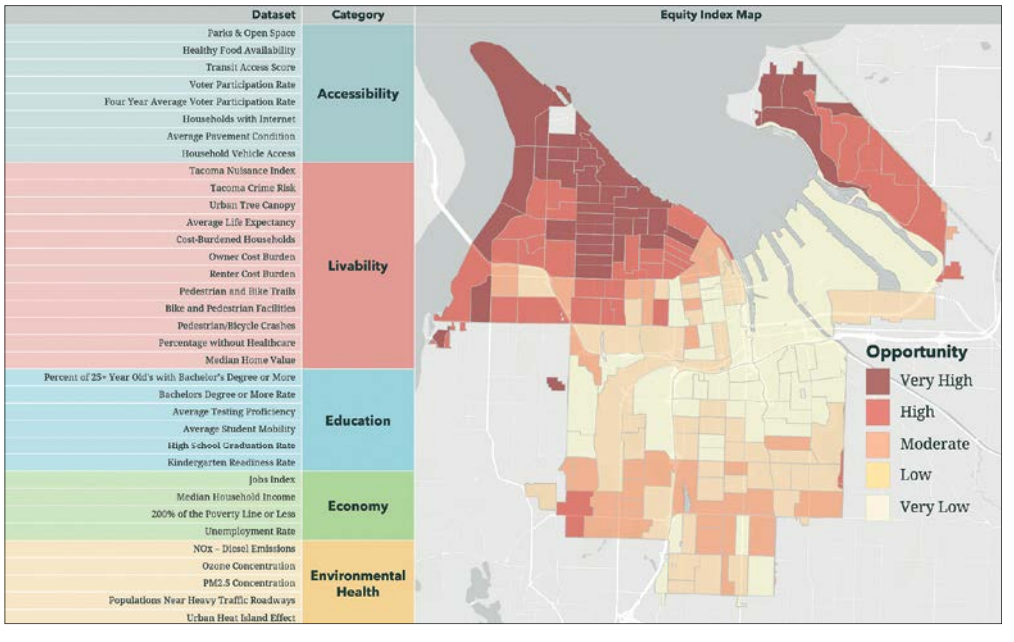

→ Tacoma's Equity Index Map compares race and ethnicity with accessibility, livability, education, economy, and environmental health.

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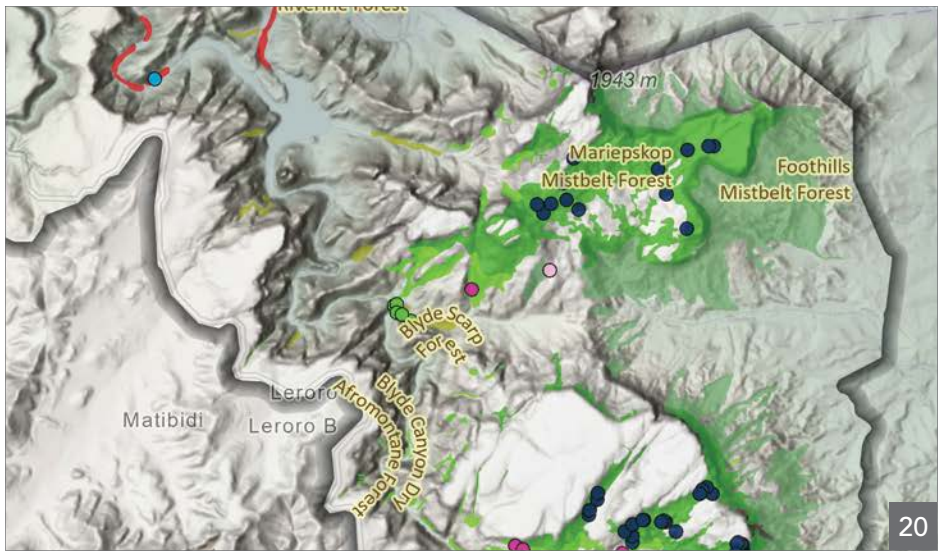
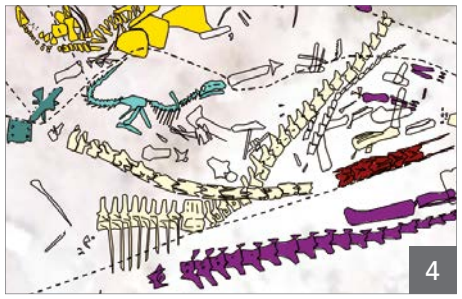
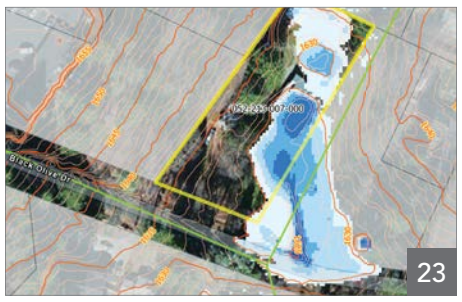


The Mpumalanga Tourism & Parks Agency in South Africa is using ArcGIS Survey123 and ArcGIS Field Maps to help support species conservation in Mpumalanga's extensive nature reserves.





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Humans as a Species

Have Been Highly Successful

By Jack Dangermond

Let's face it, as a species, humans have been highly successful. Our innovations and achievements in science, technology, and culture have supported the overwhelming success that has also led to an exponential growth of the human population, currently estimated at more than 8.0 billion.

The impact of this ever-burgeoning population has also led some people to call the current era the *Anthropocene Epoch*. This domination of the planet is now threatening Earth and our collective existence. Human-induced climate change is stimulating ecological instability.

It's my sense that we humans are living recklessly—that we're living beyond our means and our collective actions are substantially altering our Earth's surface, atmosphere, and oceans. This simply isn't sustainable. Some say we may not even have a future.

But I believe humanity is at an inflection point. We must choose to stand up and create a sustainable future. We must take collective responsibility for imagining, designing, developing, and implementing solutions that sustain the planet.

However, we need to move quickly. There is no time for political polarization or ceaseless discussion. We have very little time to choose before there will be no choice available.

Fortunately, we already have a powerful tool: the geographic approach. It's the key to holistically solving problems and the foundation for positive action. Sustainability starts with geography—it begins with seeing the world as a single ecosystem.

The technology for implementing the geographic approach is GIS and it is advancing rapidly. The work of organizations using GIS is becoming interconnected into a geospatial infrastructure of distributed servers—a system of systems. This is making information pervasively available and expanding the capability for action.

GIS furnishes the tools for integrating and analyzing data; devising and evaluating solutions; and collaborating and communicating the information that can guide the actions that create a sustainable future. As GIS professionals, we will continue to have an essential role to play in creating this future.

Let us strengthen our shared commitment to the planet. It is more important than ever.

Overcoming Many Challenges . . .

. . . Advancing and Evolving Civilization

. . . Creating the Age of the Anthropocene

About the Author

Jack Dangermond is the president of Esri and is recognized as one of the most influential people in the field of GIS technology. Along with his wife, Laura, he founded Esri in 1969 based on the vision that geographic analysis and computer mapping could help design a better future. That vision has continued to guide Esri in creating cutting-edge GIS and geodesign technologies used to help people in every industry be successful.

Creating a Modern, Interactive Fossil Map for a Colorado Museum

A rowdy rivalry over dinosaur bones involving spies, sabotage, stealing, and sloppy science? It sounds like a madcap movie plot, but it's a case of history being stranger than fiction. Colorado's Bone Wars, also known as the Great Dinosaur Rush, is one of paleontology's wildest stories—and one that lives on in a new interactive map that was commissioned by a Colorado city and created with ArcGIS Experience Builder in ArcGIS Online.

From 1877 to 1892, scientist Othniel Charles Marsh at Yale University (known as Yale College until 1887) and his nemesis, Edward Drinker Cope at the Academy of Natural Sciences of Philadelphia, raced to see who could acquire the most dinosaur bones. Bribery, theft, and even the destruction of bones were among the approaches they used to outdo each other.

Marsh and Cope were financially ruined by their efforts, but they made important contributions to paleontology, including leaving behind many boxes of fossils after their deaths. Their work led to the discovery of more than 130 new dinosaur species and raised public interest in dinosaurs, helping fund fossil excavation across North America and beyond in the decades that followed.

A Quarry, a Museum, and a Map

The Marsh-Felch Quarry in Cañon City, Colorado, was a rich source of fossils for Marsh, providing hundreds of boxes' worth of bones. The Garden Park Fossil area, where the Marsh-Felch Quarry is located, is one of the largest sources of Jurassic period fossils in Colorado, making Cañon City a key stop for Colorado's fossil tourists. A wide range of dinosaur species has been found in the quarry, including examples of Colorado's official state fossil, the stegosaurus.

A plan to modernize the visitor experience at the Royal Gorge Regional Museum & History Center, commissioned by Cañon City and funded by the US Bureau of Land Management, shows Cañon City's passion for being a paleontological host and educator. In the museum's *Digging It! Fossil Finds of Fremont County* exhibit, an upgraded GIS-based map—navigable by touch screen—shows additional information about fossils discovered in part of the Marsh-Felch Quarry.

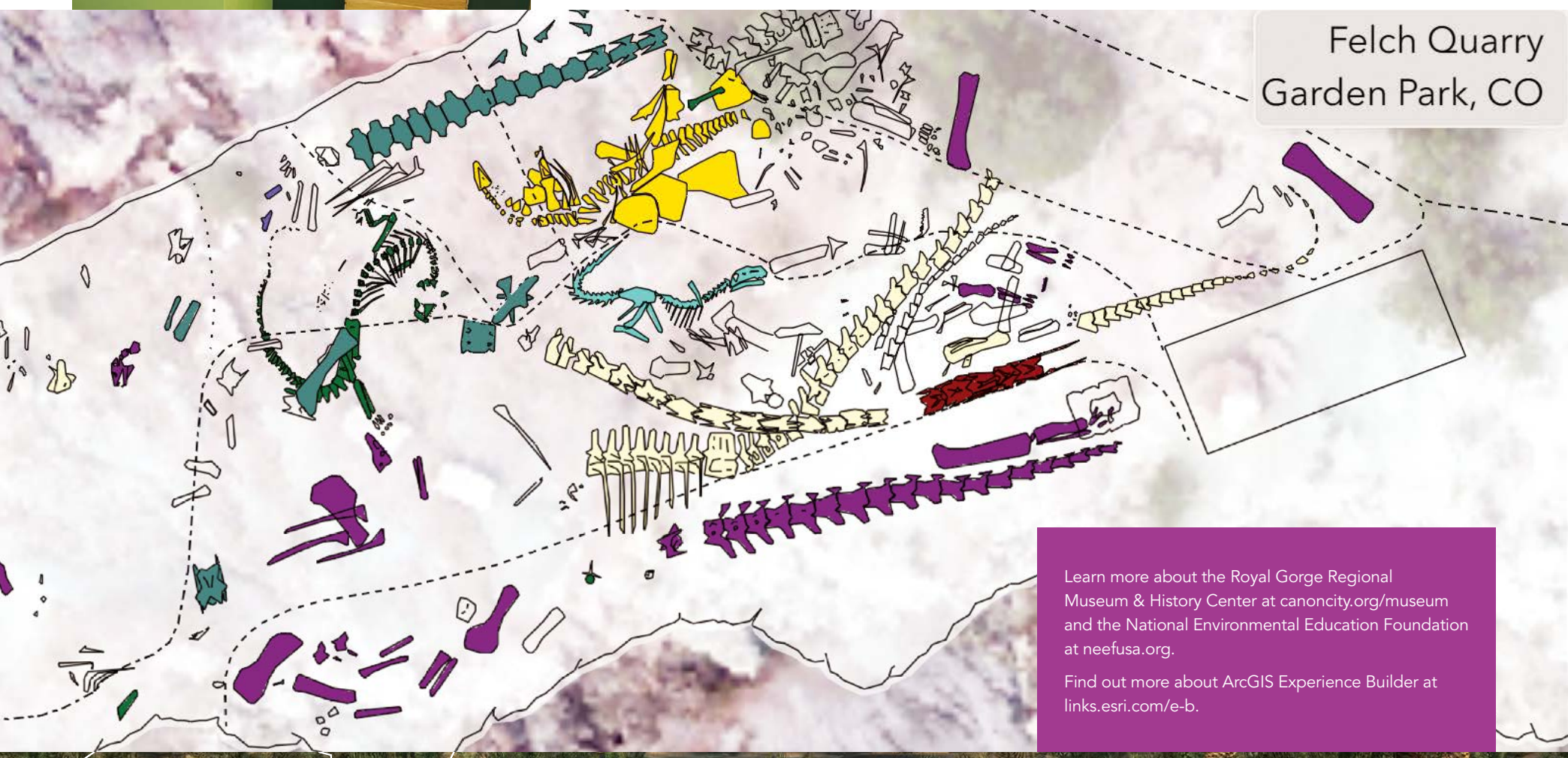
Partly based on an original source map created by quarry property owner Marshall Felch and paleontologist Ken Carpenter in 1994, Esri partners Argis Solutions (argis.com) and Platte River Analytics (platte-river.com) built an accessible, interactive map using Experience Builder in ArcGIS Online. It replaces a map that used outdated software. ArcGIS Online was recommended for the project due to the stability and scaling it offers for public access.

From the source map, four different maps were created for fossils in the exhibit. When a fossil is selected, the user can view information about the current location of the fossil (for example, the Smithsonian Institution in Washington, DC), an image of the dinosaur the fossil is from, the year the fossil was located, and drone imagery showing the fossil's original location in the Marsh-Felch Quarry. Thematic colors and shades that are compliant with the US Americans with Disabilities Act were chosen for optimal visitor accessibility.

"The major goal for the Royal Gorge Regional Museum & History Center with this project was to provide a better understanding of the importance of the paleontological resources found in the Royal Gorge region related to the science of paleontology," said museum director Lisa Studts. "What better way to do that than to design a layered interactive map of a historic fossil quarry?"

There are plans to add the interactive map to the museum's new website as part of its updated Hands on the Land pages, which were originally produced by the Bureau of Land Management Royal Gorge Field Office and the National Environmental Education Foundation. These pages were archived in 2020. The new website is scheduled to launch in spring 2024.

←↓ Colorado's Royal Gorge Regional Museum & History Center provides new, interactive maps of a nearby archaeological site.



Learn more about the Royal Gorge Regional Museum & History Center at canoncity.org/museum and the National Environmental Education Foundation at neefusa.org.

Find out more about ArcGIS Experience Builder at links.esri.com/e-b.

Streamline Data Integration with ArcGIS Data Pipelines

ArcGIS Data Pipelines is now available in ArcGIS Online.

Data is essential for making informed decisions, but it can be a challenge to integrate and transform data into a usable format. For use cases where data preparation consumes a significant amount of time, when there are issues with cleaning and preparing data, or when datasets need to be combined from multiple sources, ArcGIS Data Pipelines can help with data integration and preparation.

Accessed from the app launcher in ArcGIS Online, Data Pipelines provides a new data integration capability in ArcGIS Online that makes it faster and easier to access, prepare, and maintain data for mapping, analysis, and reporting. It streamlines a user's extract, transform, and load (ETL) workflow in ArcGIS Online by going beyond traditional ETL tools. With its drag-and-drop interface and task scheduling functionality, users can create data pipelines without writing any code and automatically keep data up-to-date. Data Pipelines enhances data-driven decision-making in ArcGIS Online and enables users to maximize the value of their geospatial data.

Benefits of Using Data Pipelines

By streamlining data integration for ArcGIS Online, Data Pipelines centralizes data from various sources into a single, accessible location. This saves time and effort so that users can focus on deriving valuable insights from the data rather than on data preparation and cleaning tasks.

Data Pipelines also expands access to data stores by supporting data from cloud-based data storage options such as Amazon S3, Azure Blob, Google BigQuery, and Snowflake. Users can leverage previously inaccessible or difficult-to-integrate data to enrich analysis and decision-making capabilities. They can also bring in files from their local drive or via a URL, or feature layers from ArcGIS Online. Access to a broader range of data sources can help foster data-driven decision-making across an organization and between organizations.

The application's data transformation tools enable users to get data into an ideal state for mapping, analysis, and reporting. Users can clean, transform, and enrich data to ensure accuracy, consistency, and completeness.

An intuitive graphical interface eliminates the need for specialized coding skills by enabling users to build and manage data pipelines via a drag-and-drop authoring experience. This low-code approach allows users of all skill levels to construct and manage data pipelines.

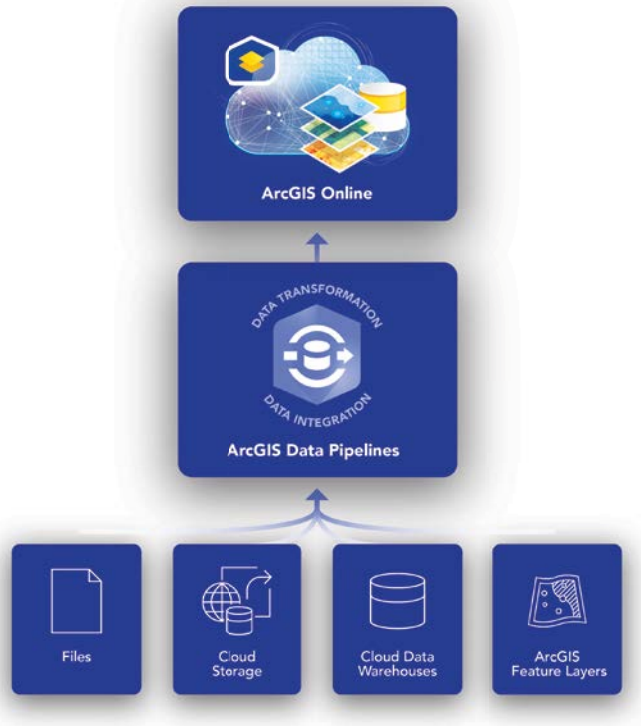
Automation is another key advantage of Data Pipelines. Its scheduling functionality facilitates running data pipelines on a recurring basis, keeping datasets up-to-date and synchronized with the latest changes in the source data.

Data Pipelines offers a comprehensive set of benefits for ETL processes, including streamlined data integration, expanded data access, data transformation tools, democratization of data management, and workflow automation. By leveraging these capabilities, organizations can unlock more insights with their data, helping with data-driven decision-making and gaining a competitive edge in today's datacentric landscape.

Key Use Cases

While Data Pipelines was in beta, organizations used the application to streamline data integration in exciting and innovative ways, such as the following:

- Bringing data in from external sources and keeping it up-to-date with ease: Data Pipelines allows users to bring data into ArcGIS Online from files stored locally, on the web, or in a cloud store with support for various formats including GeoJSON, CSV, and shapefiles. For example, users can add a download URL to a file that is maintained on a public data website and add that URL as an input to a data pipeline. Additionally, if the source data is changing, users can schedule a data pipeline to run on a recurring basis, ensuring that the dataset is kept up-to-date.
- Visualizing tabular data on a map: Users can enhance tabular data by geospatially enabling it. For instance, in a table with ZIP code information, Data Pipelines can match those fields to corresponding polygons from a layer in ArcGIS Living Atlas or one of the boundary layers that an organization maintains. Datasets can be joined based on matching attributes, spatial relationships, or temporal relationships.
- Transforming datasets to fit unique requirements, without impacting the source: With Data Pipelines, users can modify an input feature layer such as changing attribute values or adding and calculating new fields while keeping the original source unchanged. This allows users to maintain a copy of a feature layer and adjust it to suit specific requirements without affecting the data source or the teams that maintain it.
- Getting a unified view of the data: Users can merge features from multiple inputs into a single source with Data Pipelines. This is particularly useful when there is a need to consolidate data from separate sources into a unified layer with a consistent and predictable schema. For example, users may have subsets of data being maintained by different individuals, teams, or organizations; with Data Pipelines, those multiple input datasets can be combined into a single feature layer for use in a web map, web app, or dashboard.



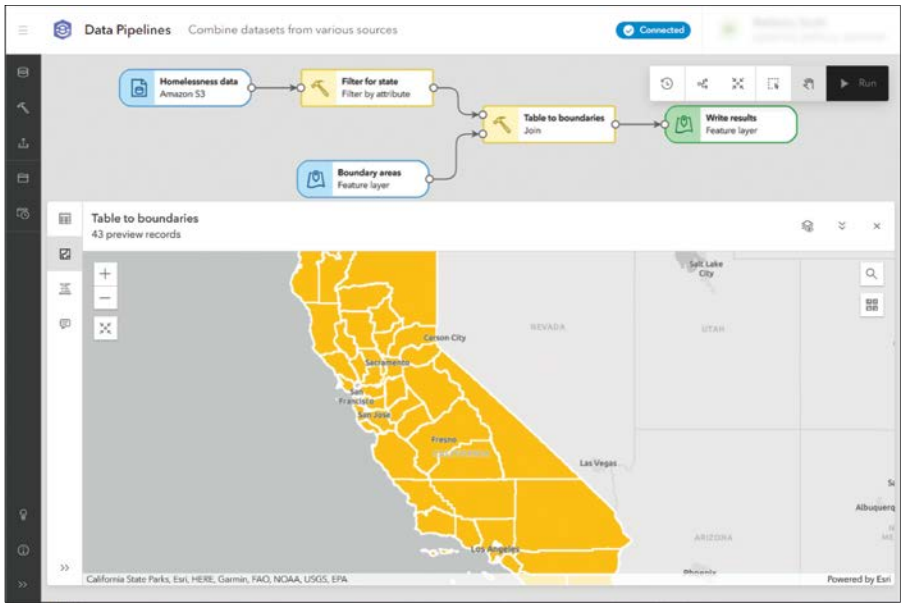
↑ ArcGIS Data Pipelines provides data integration and data transformation capabilities for ArcGIS Online.

These are just a few of the workflows that ArcGIS Data Pipelines can help users achieve. By leveraging its capabilities, users can streamline data management processes and enhance geospatial workflows without writing a single line of code or relying on repetitive, manual efforts.

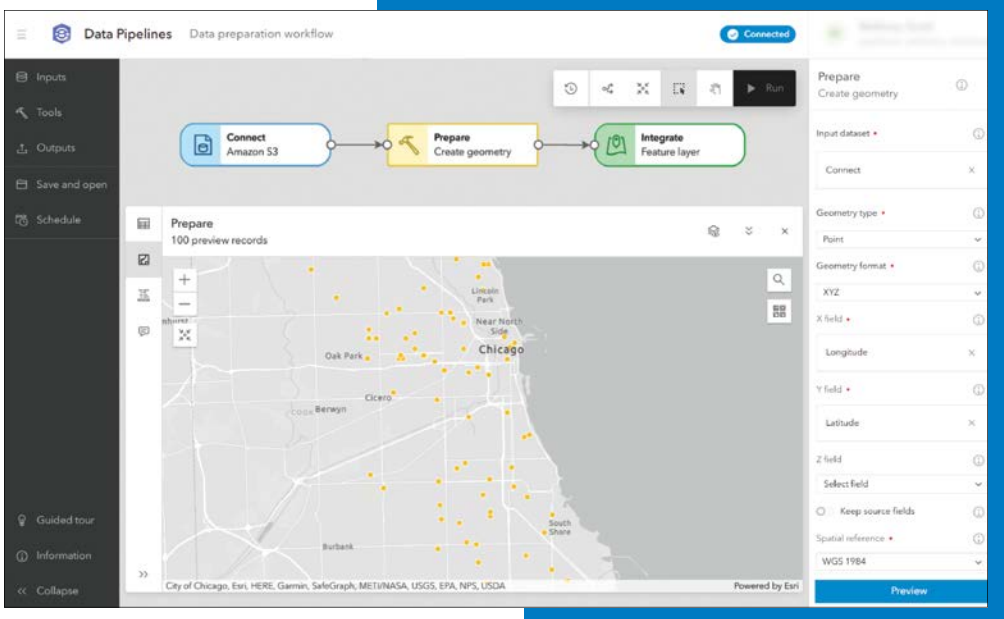
Getting Started with ArcGIS Data Pipelines

For organizations that are looking for a tool to streamline data management and integration workflows in ArcGIS Online, Data Pipelines is available now. It does not require an additional license. Instead, it consumes credits based on the amount of time spent working in the app.

To get started with Data Pipelines, go to the Data Pipelines product documentation (go.esri.com/dp-intro). Submit any questions you have to the product team and other users via the Data Pipelines Community (go.esri.com/dp-community).



↑ With Data Pipelines, users can geospatially enable a subset of tabular data using the Join tool and then write the results out to a feature layer.



↑ Access, prepare, and maintain data for mapping, analysis, and reporting with Data Pipelines.

ArcGIS Online Imagery Capabilities Help Detect and Analyze Land Subsidence in Arizona

The earth's surface is in a constant state of change, and one reason for this is land subsidence. More than just a reason for localized sinkholes, land subsidence can cause entire agricultural areas, river deltas, and even urban areas to sink.

A global problem with far-reaching effects, land subsidence is caused by a range of factors, including mining activities, water saturation of sandy soil, soil compaction, and thawing permafrost. Exacerbated by factors ranging from drought to sea level rise, land subsidence can damage roads, building foundations, and subsurface infrastructure such as water and wastewater pipes and utility conduits.

In the United States and many other countries, groundwater extraction is often the main culprit. According to the US Geological Survey, long-term pumping of groundwater for irrigation and other purposes accounts for more than 80 percent of land subsidence throughout the country.

To help detect and analyze land subsidence, researchers are using ArcGIS Image for ArcGIS Online to host the bulk of radar satellite images.

More than Nine Feet in 60 Years

Located in southeastern Arizona, the Willcox Groundwater Basin extends across more than 1,900 square miles, mostly in Cochise County. With depths of up to about 5,000 feet (1,524 meters), the aquifer that underlies the basin provides irrigation water for municipal, agricultural, residential, and livestock uses. According to the Arizona Department of Water Resources, agriculture in the basin contributes significantly to regional and state economies. For example, Cochise County produces almost all of Arizona's pistachios. Other common crops grown in the basin include alfalfa, corn, and cotton.

Tom Buschatzke, director of the Arizona Department of Water Resources, said water extraction has caused the aquifer's water levels to drop up to seven feet (about two meters) per year for the past several years.

It's no coincidence that the Willcox Groundwater Basin has undergone the most land subsidence in Arizona, according to Dr. Danielle Smilovsky, a researcher in Texas State University's Department of Geography and Environmental Studies. Smilovsky said parts of the basin have dropped more than nine feet during the past 60 years due to groundwater pumping.

"In some cases," Smilovsky said, "water wells have gone completely dry, and earth fissures caused by land subsidence extend as far as 42 miles within the basin. The natural recharging of the aquifer has also been impacted by climate change and the resulting drought. It provides a stark example of the conflict associated with the ongoing need for water amid a time of dwindling water resources."

Detecting and Analyzing Land Subsidence

Smilovsky used ArcGIS Image for ArcGIS Online to host her satellite-based image results generated from interferometric synthetic aperture radar (InSAR) to detect and analyze land subsidence in the Willcox Groundwater Basin. The resultant imagery provides unique visualizations of ground-level change, which helps scientists better understand the complexity and impact of land subsidence. With ArcGIS Image Online, Smilovsky can group the images by different spatiotemporal resolutions, apply symbology and raster classifications to each collection, and extract cross-sectional profiles.

ArcGIS Pro was also used for deformation modeling and mapping, including optimized hot spot analyses. This tracked clusters of deformations and determined where land changes corresponded with water extraction wells and earth fissures. Smilovsky also created space-time cubes, which show how phenomena change over time within geographic space, to visualize land disturbances over time in 3D.

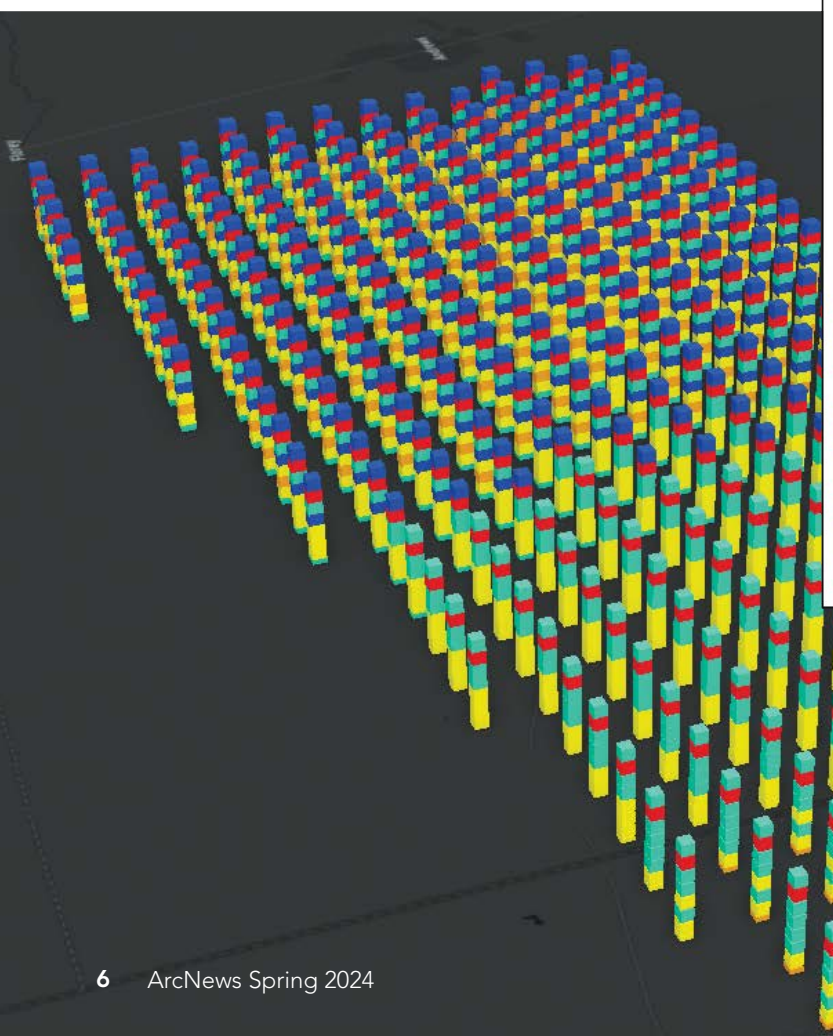
To develop the space-time cubes, a centroid point for each pixel was applied to each InSAR deformation raster on a quarterly basis, Smilovsky said. "This was repeated 20 times to essentially build pillars of deformation values for each pixel across time and space," she said. "These cubes are also interactive, so you can toggle different time periods on and off to examine them more carefully."

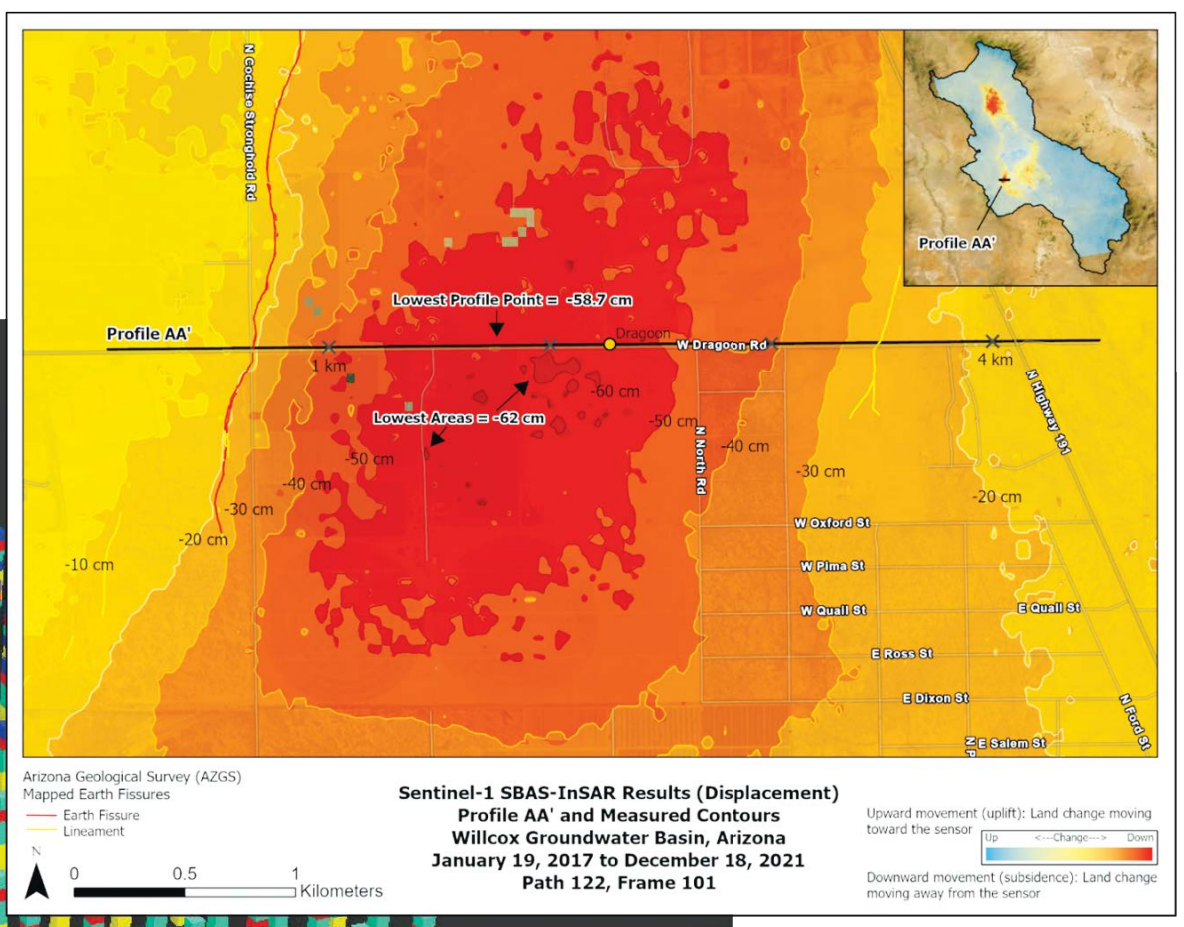
Helping with Mitigation Plans

The space-time cubes show how Willcox Groundwater Basin subsidence continues to expand and provides insight into future land degradation. This helps decision-makers when considering mitigation efforts, such as reduced groundwater pumping, to slow the process, and potentially reverse its harmful effects.

"The analytic and visual capabilities of ArcGIS allow us to tell a compelling story about land deformation in the Willcox Groundwater Basin," Smilovsky said. "The resulting maps and charts from the collected data can be included in reports and presentations to inform decision-makers about the urgency of groundwater depletion in the basin. This will hopefully raise more awareness and encourage corrective action."

> "The analytic and visual capabilities of ArcGIS allow us to tell a compelling story about land deformation in the Willcox Groundwater Basin."
>
> **Dr. Danielle Smilovsky**, Texas State University





↑ Satellite data helped researchers quantify land subsidence of up to 24.5 inches (62 centimeters) over nearly five years and a nearby earth fissure in an area of the Willcox Groundwater Basin in Arizona.

← Space-time cubes show land displacement values from 2020 to 2021.

Rochester Hills Streamlines Delivery of Fire Education and Community Resources

Established in 1984, the city of Rochester Hills, Michigan, is a suburban community located north of Detroit. The Rochester Hills Fire Department supplies fire, search and rescue, and emergency medical services. The department's Community Risk Reduction Division provides critical fire safety education to the community.

Jenn Whitbeck, the department's fire and life safety educator, manages the department's community education by visiting schools, senior care facilities, and homes. She also installs safety aids such as free smoke alarms, carbon monoxide alarms, and bed-shakers (designed for hearing-impaired individuals) provided via a state-run program. Details of these installations and any on-site visits, such as geographic location and device information, are recorded and reported to local leadership and state officials.

Streamlining Processes with ArcGIS Survey123

To capture these details and track her visits, Whitbeck used to record data with spreadsheets—a time-consuming and inefficient process. She collaborated with Rochester Hills GIS manager Doreen Groth to transform this workflow with ArcGIS Survey123.

"The paperwork took away from all the time that I could have been spending in the community or with our seniors or with our school-age kids," Whitbeck said.

Groth selected Survey123 because it enables users to create, share, and analyze smart forms and surveys. She used a variety of resources when preparing for the project, such as online videos, Esri tutorials, Esri User Conference sessions, and Esri's ArcGIS Survey123 Community. She also learned about fire department operations and community risk reduction.

Centralizing Operations with ArcGIS Dashboards

To facilitate this transition, Groth determined the data structure, the workflow, and what data to capture. She then created a form for a one-way point of entry to collect information, accessible via mobile devices. Using ArcGIS Dashboards, she created a dashboard to help the Community Risk Reduction Division solicit requests from the public, manage appointments, and monitor program administration. Now, residents can make a call, send an email, or fill out a third-party form on the website to set up appointments for educational presentations or alarm installations.

By using Survey123, the new process streamlined data recording, saved time during visits, reduced errors, and allowed Whitbeck to serve the community while efficiently measuring advances in risk reduction.

Whitbeck also uses Survey123 forms to track smoke and carbon monoxide alarm installations and conduct comprehensive fire and life safety surveys. With Survey123, residents can also easily sign waivers required for home visits. Once on-site visits are completed, the report is automatically created, the dashboard is updated, and both are ready for Whitbeck to review.

"The process with this is much more streamlined and straightforward," Groth said. "Your information gets updated in the dashboard. Everybody sees it right away."

Data Access Improves Efficiency

The division's team has been using Survey123 for its new workflow since 2021. According to Whitbeck, the time it takes to enter data has declined from 30 percent of her total weekly work time to less than 10 percent. Whitbeck can now see the locations she has visited, which helps her determine where she still needs to go. She then compares this information to the department's community data and incident maps to understand where incidents occur and how to better target outreach efforts.

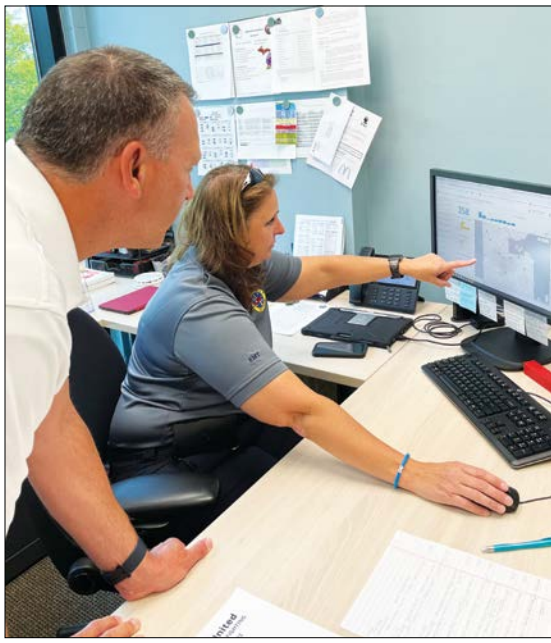
As a result, according to Nathan Mueller, the city's senior adviser for strategy and communications, "I think in Michigan we're either second or third in terms of the number of smoke alarms that we give away for free in the state."

Using dashboards has also enabled leadership to easily view related data. When the Rochester Hills fire chief needs to know how many events Whitbeck attended or how many people came to an event, he can access the data quickly and share it with stakeholders. This data can also help the fire department when asking for additional funding, personnel, or crew training. Reporting is also much easier with revamped digital workflows. Submitting state-required reports is now done with the click of a mouse, and stored electronic data makes producing reports much faster.

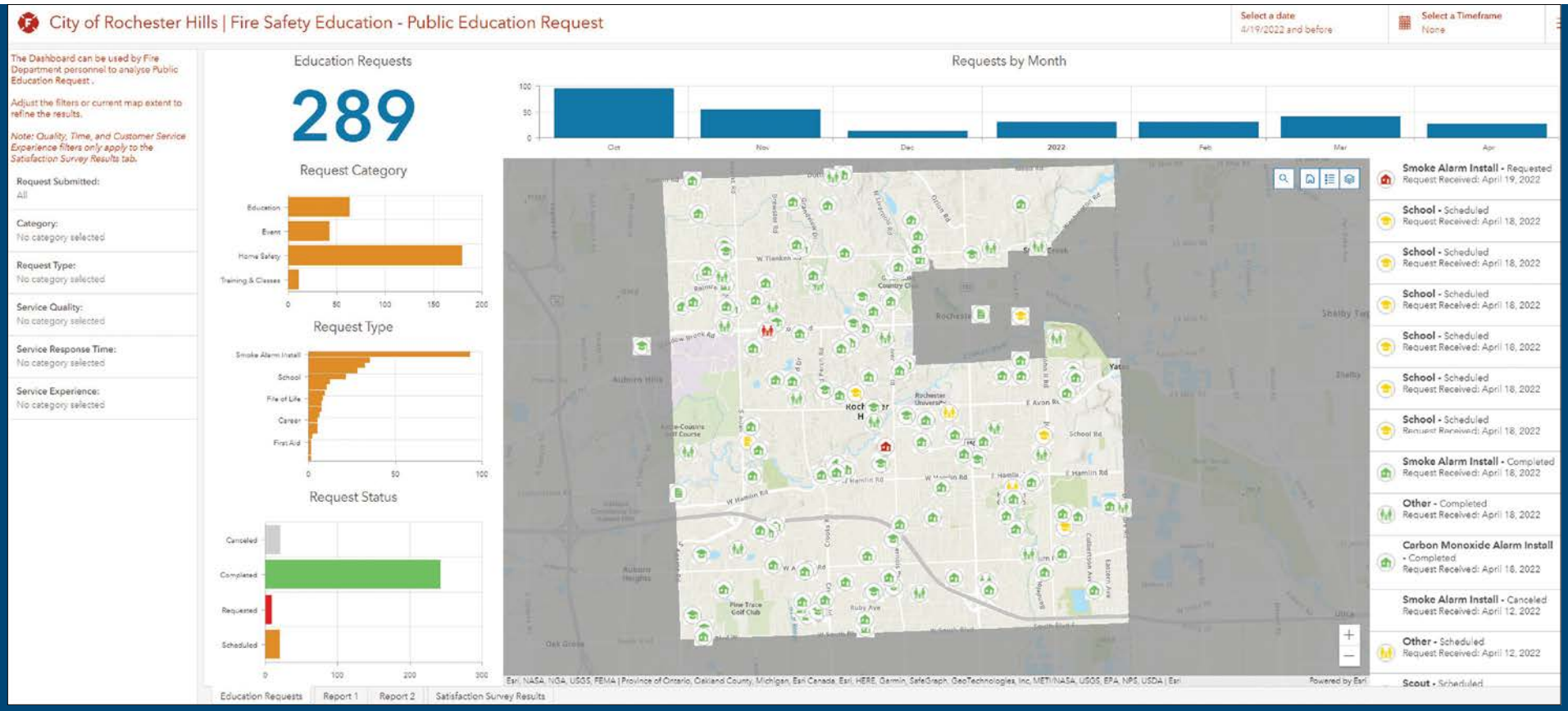
On-site visits are also more efficient with Survey123. Whitbeck can record details on her iPad during a visit and later send a follow-up email survey to the resident for feedback. Easier recording during the visit means less time spent on recordkeeping in the office. The digital survey has also increased participation, with an estimated 85 percent of residents returning post-visit forms.

Groth said the department has received positive feedback from Rochester Hills residents about the new digital process, and other fire departments have expressed interest in similarly transforming their workflows. In partnership with the state, Whitbeck and Groth have exchanged ideas, best practices, and lessons learned that will help other fire departments share data and report more efficiently to the state in the future. The ability to better track outreach efforts has helped the Community Risk Reduction division better provide education and fire safety tools to the community.

"With this system, it gives me my time back, plus it's giving me actual accurate data," said Whitbeck. "And it makes me feel so good that I'm actually spending time out in the community."



↑ Rochester Hills Fire Department personnel review a dashboard that helps staff solicit requests from the public, manage appointments, and monitor administration of educational programs across the community.



↑ Created using ArcGIS Dashboards, a dashboard helps the fire department manage public education requests.

continued from cover

A Visionary CTO Leaves a Legacy of Collaboration, Equity in Tacoma, Washington

knowledge and creativity of the city's GIS analysts led to the platform that allowed her and others to expand and promote the equity index.

"It really takes a whole team and the business all around it to be able to do something like the equity index, and for us, that's how we ended up having, in my mind, one of the greatest things that I've done in my career," said Brosnon.

Integral to that team was Tacoma's GIS division, led by James Osundwa. The timing was optimal, he said, noting that the years spent building the tool aligned with the city's racial equality goals.

Brosnon agreed, adding, "Having that history with the tools and the capabilities is great, but what we did with the equity index really began by having clear business goals we wanted to achieve and assembling those with the passion to see it through."

To build the original index as a one-off analysis, Tacoma's Office of Equity and Human Rights partnered with the Kirwan Institute for a study on race and ethnicity at Ohio State University. City leadership and GIS analysts have kept the index going for the past five years, enhancing it with geographic representation, more equity measures, updated census data, and other data, for the benefit of community members, customers, and business owners.

The index was recognized at the 2023 Esri User Conference with a Special Achievement in GIS Award. Osundwa has since developed a strategic plan to enhance the city's assets and view these investments through an equity lens. He also hopes to advance and expand the city's GIS programs. He wants to implement self-service options that will allow for a greater number of GIS users in the city in the future.

How Tacoma's Equity Index Works

The equity index scores 153 census block groups in Tacoma by 32 different indicators sorted into five categories—accessibility, livability, education, economy, and environmental health—to show the disparities in residents' access to services and opportunities. It's used for everything from equitably distributing small business loans to making utility upgrades to planning affordable housing.

"The index has definitely grown collaboration, not just within the city but with different municipalities in the region asking us for advice on how to do something similar," Osundwa said.

A Career of Connection

Throughout her 25-year career, Brosnon has advocated using technology to connect business needs and people. Her interest in science, technology, engineering, and mathematics began during her time as an electrical engineering student at Harvey Mudd College in Claremont, California, and was further fueled by an internship that prompted her shift toward technology consulting.

Her early career was driven by her passions for travel, technology, and working with people. During this time, she held multiple positions where she implemented software systems internationally and eventually ran her own consulting company. "Seeing technology *[as]* having a specific purpose and goal, rather than just being a product, has always been a source of inspiration for me and why IT was a good fit for me as a career," she said.

In 2000, Brosnon took a sabbatical to spend more time with her growing family. "I was lucky that I financially could take that time," she said, "As long as you're dedicated and passionate about your career, you can always find your way back to it."

As her sabbatical drew to a close, Brosnon explored different career options that would allow her to balance having school-age children and work. This led her to a remote position, working in IT for a private technology company. However, Brosnon wanted a job where she could assist and engage with others in person and have more opportunities to serve the community. This led to her work for the City of Tacoma, where she has been employed for the last decade. She plans to retire in May.

Finding Strategic Opportunities to Help People

As the city's CTO, Brosnon said, she takes on many roles depending on the city's needs. "Sometimes I'm trying to negotiate big contracts and ensure fiscally and technically responsible road maps that align with business strategies like other CTOs do," she said. "Other times, it's that 'other-duties-as-assigned' bucket that gets quite large but is most rewarding, like sponsoring the Asian/Pacific Islander affinity group or helping college students with their résumés."

According to Osundwa, "One of the things I think Grace does so well as a leader is focusing on people and engaging with them at a personal level, optimizing their strengths and motivations so we deliver excellence in our work for the city. Grace is passionate and tenacious about our work, particularly in finding strategic opportunities, like where we can integrate better or improve processes to outlive us when we're gone and make an impact. It's been a fun and intense journey to work with her on high-impact and high-value projects for the city."

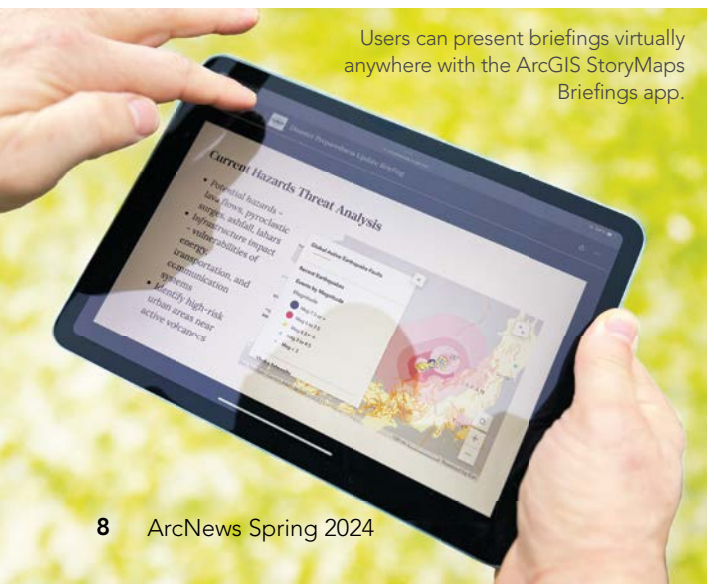
Whether helping a department set goals and enhance operations via technology, creating internal presentations, helping new executives get acclimated, or making budget requests, Brosnon prioritizes her work through the lens of doing "the right thing for the city and community," she said. "If I can use technology to directly help people, like the equity index did, that's even better."

GIS Hero

South Carolina National Guard Boosts GIS Work with Briefings in ArcGIS StoryMaps

Consider this scenario—a GIS specialist needs to present the results of a critical geospatial analysis to an important audience. The audience members are unfamiliar with geospatial technology, and their meeting time is limited. To make things even trickier, the presentation will take place with limited internet access.

Kevin Haynes routinely faces these situations as the environmental GIS manager for the South Carolina National Guard. Integrating complex quantitative analysis in the military decision-making process is a large part of his job. Although ArcGIS StoryMaps has enabled Haynes to create captivating multimedia narratives about his GIS work, obstacles such as time sensitivity and the need for offline access remained—until he used briefings in ArcGIS StoryMaps.



Users can present briefings virtually anywhere with the ArcGIS StoryMaps Briefings app.

A new output type, briefings, was released in ArcGIS StoryMaps in ArcGIS Online in February, with planned availability in ArcGIS Enterprise 11.3. With briefings, ArcGIS StoryMaps now provides a slide-based presentation-style format (shown at links.esri.com/bia-sm) to share dynamic geospatial work using popular ArcGIS StoryMaps blocks. Authors control colors and fonts, enabling the creation of a briefing that meets brand guidelines and accessibility requirements. The briefings builder is easy to learn, intuitive to use, and requires no knowledge of digital design or web development.

Benefits of Briefings

Briefings became available at a crucial time for Haynes, as senior leadership was preparing a presentation for other military leaders about cybersecurity. Using briefings, Haynes transformed a verbose report into a briefing that made an impression. The presentation was a success, and Haynes was officially recognized by the state adjutant general for his storytelling efforts.

"This experience solidified my belief in the power of ArcGIS tools to evolve and cater to the dynamic requirements of military and strategic communication," he said.

Two briefings qualities have particular impact for Haynes:

- A slide-based presentation format—Prior to briefings, Haynes said, integrating interactive content such as web maps; 3D scenes; and apps such as ArcGIS Dashboards into presentations was a cumbersome process. With briefings, users can include dynamic or interactive items from their ArcGIS ecosystem and embed most other outside content.
- Offline accessibility—With the ArcGIS StoryMaps briefings app, available on iOS and Android tablets and Windows computers and tablets, customers can present a briefing without an internet connection. Authors can also specify how ArcGIS web maps and 3D scenes appear in offline situations. For example, a mobile map package or mobile scene package can be preconfigured to include additional interactivity in the offline version of the briefing.

One Builder, Many Uses

There are many other situations where briefings can be an ideal solution:

- Updating a recurring report—A briefing can be duplicated so that the same presentation can be used with updated content. Authors can empower additional stakeholders to edit a briefing by configuring permissions for shared update groups in their ArcGIS organization.
- Simplifying a complex topic—A slide-based format presents key takeaways in a timely manner. Each briefing has a built-in table of contents, making it easy to navigate. Briefings can also be packaged together in a collection in ArcGIS StoryMaps if they need to appear together, like chapters in a book.

To learn more about briefings and how to get started, scan the QR Code.

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Full-Service Training Model Supports GIS Users Across a New Jersey Enterprise

Established on the first official Earth Day on April 22, 1970, the New Jersey Department of Environmental Protection (NJDEP) advances strategies to safeguard and enhance New Jersey's air, water, land, and public health. A longtime Esri customer, NJDEP has used Esri's GIS software for decades to support its mission. NJDEP is also a member of the Esri Advantage Program, which provides GIS guidance and collaboration.

The Bureau of GIS, a part of NJDEP's Division of Information Technology, traces its origins to the 1980s. In those days, a handful of staff members used ARC/INFO for research, analysis, and planning, such as for finding the proximity of known contaminants to a stream or an elementary school. By the late 1990s, GIS use at the bureau had expanded and its importance as an analytical tool was recognized.

Since its inception, the bureau has educated NJDEP staff about the value of GIS in data and application development and system administration. What was once an obscure tool used by a few scientists is now a mission-critical enterprise system. Today, NJDEP has almost 3,000 employees, most of whom create or use ArcGIS maps and apps for their work. According to Angela Witcher, manager of the Bureau of GIS, "I'm a 30-plus-year veteran of GIS. I've seen it evolve in many ways and I feel like its impact is now escalating very quickly."

GIS Training Takes Many Forms

The evolution and rising impact of GIS at NJDEP are largely due to training, said Witcher, who was once a GIS trainer. "As the use of GIS grew over the years, training was facilitating that growth and more users required more training, so it all grew together," she said.

Leveraging Esri's Advantage Program, NJDEP deploys ArcGIS Pro, ArcGIS Online, ArcGIS Enterprise, ArcGIS Experience Builder, and ArcGIS apps to support data collection, visualization, research, analysis, and public outreach initiatives.

The bureau is responsible for creating and delivering training to ArcGIS users throughout the department. GIS specialist Jessica Bagtas, who joined NJDEP in 2019, served as the bureau's training coordinator until leaving the department last fall. (Bagtas, now a senior GIS course developer and education specialist at Esri, was interviewed for this article while still at NJDEP.)

"Training comes in a lot of different forms at NJDEP," Bagtas said. "We have our formal, in-house training. We have courses about how to create web maps and apps and how to use ArcGIS Pro. We also have a GIS help desk that's available both to NJDEP employees and to the public. For any type of GIS question out there, we're available to answer it."

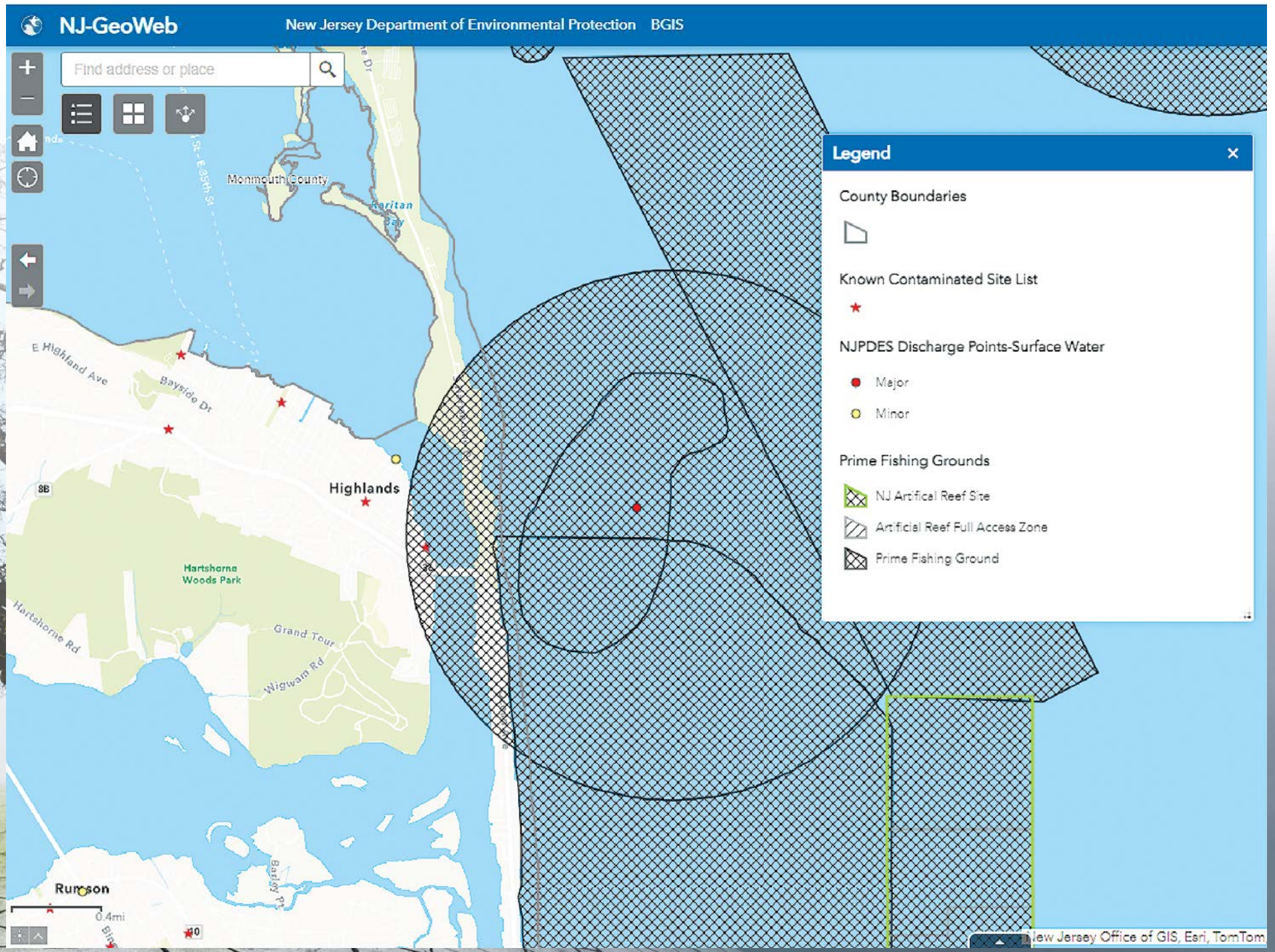
Governance is also a priority for the bureau. "We're teaching staff how GIS works at NJDEP, why they should create an application a certain way, how it will interface with the rest of the enterprise, and things like that," Bagtas said. "We're trying to make sure that folks make software and services that meet all the standards that we have at NJDEP. It's not just GIS education, it's almost like NJDEP education."

If anyone misses an in-house training, or if they're interested in a topic that isn't covered, they're directed to Esri Academy, Witcher said.

"Occasionally, we offer Esri instructor-led courses and have an Esri instructor come to campus. For advanced and specialized workflows, we use Esri training," Witcher said. Recent Esri instructor-led classes provided training on ArcGIS Pro and ArcGIS StoryMaps. Attendees included staff from other NJDEP offices.

A bureau website also provides information on training, data, applications, and standards. On a separate NJDEP open data website, people can find and download the bureau's GIS data to

↓ The New Jersey Department of Environmental Protection uses the NJ-GeoWeb platform to train state employees and the general public in GIS, as well as to show areas of environmental risk. This map shows prime fishing grounds and contaminated sites.



use in their own maps and applications. The bureau also provides an online bureau gallery with dozens of web apps, ArcGIS StoryMaps stories, and dashboards.

Supporting Key Applications

Providing public access to NJDEP's trove of environmental data and GIS information products empowers people, Bagtas said, adding that although most applications can be mastered quickly, some require basic GIS knowledge.

An NJDEP-built web application called NJ-GeoWeb (nj.gov/dep/gis/geowebsplash.htm) is important to many users, Bagtas said, adding that NJDEP has trained staff and stakeholders on this application for years. It's a screening application that allows visitors to see commonly used layers, such as parcel data, municipal boundaries, and locations of known contaminated sites.

NJ-GeoWeb users include people who want to submit a permit or learn more about environmental protection and real estate professionals who want to see factors for potential real estate buyers or sellers to consider. Many people use the application, so NJDEP provides virtual training at least twice a year, Bagtas said. The application includes links to training resources such as a quick-start tutorial, a user guide, frequently asked questions, and YouTube videos that show how to complete common tasks such as interacting with the map and searching for addresses and parcels.

Going Public with Educational Outreach

In addition to supporting staff and stakeholders with training resources, the bureau participates in educational initiatives that inform state residents about environmental issues and NJDEP programs. The bureau also connects with traditionally underserved groups.

"Education and outreach is an aspect of NJDEP, so it's part of our mission to support these programs as well," Witcher said. "Environmental justice and overburdened communities are formally defined in New Jersey. Permit applications for things like smokestacks and waste discharge include consideration of impact on communities."

In summer 2022, NJDEP hosted young people from overburdened New Jersey communities in a program that introduced them to all aspects of the agency, including environmental protection careers. NJDEP leadership wanted program participants to be aware of GIS as a career path, so the bureau's work was included in this initiative.

In one session, participants went to a state park, where they opened an ArcGIS Survey123 form and then took pictures of features such as benches and recycling bins. "At the end of the day, we showed them a map with all the pop-ups and pictures they had put in. I met with them formally and explained what GIS is, connecting the dots between their field activity and the map," Bagtas said.

Witcher stressed the importance of teaching GIS in an accessible way, noting that in 2023, bureau staff supported a public outreach event in Camden, New Jersey. "We went to meet students in the field to do data collection," she said. "We did field mapping using a smartphone, because that's technology they know."

Continuing Success with Service

The GIS footprint at NJDEP is still growing, as it has since the 1980s.

"Looking at the evolution of the program," Witcher said, "we've gotten so big. Everyone's bought into GIS. We now have programs that have their own GIS leads, and they support their users locally in a more formal way."

Living up to its name, the Bureau of GIS will continue to lead the way in supporting NJDEP's GIS community, Witcher said.

"You have to have a strong customer service component in your GIS program if you want it to be successful," she said. "You do really exciting things when people are empowered throughout the agency. You have to have that customer service element."

Learn about the Esri Advantage Program at links.esri.com/adv-program and Esri Academy at esri.com/training.

continued from cover

Landsat Explorer: Traversing Time and Geography with Remote Sensing Insights

beyond the narrow band of light that humans can see, revealing aspects and details of the earth's surface that are not observable in true-color photographs. This can provide unique perspectives for different features such as vegetation, soil, and water.

"With multispectral data, we can see the glow of photosynthetic activity of vegetation in the Amazon rainforest, examine crop health in southeast Asia agricultural areas, explore wildfire scars in Africa, and measure the retreat of Arctic glaciers," said Kate Fickas, Esri's director of imagery and remote sensing solutions.

The Landsat satellites and their multispectral sensors have become key observers of our planet. Since its first satellite launched in 1972, Landsat has recorded the earth's surface, creating a legacy of data. More than five decades later and with the 2021 launch of the Landsat 9 Earth observation satellite, Landsat is more than just a satellite program—it's a storyteller, a record keeper, and a guide to understanding our rapidly changing world. Jointly managed by the US Geological Survey and the National Aeronautics and Space Administration, Landsat's longevity and consistency have made it the gold standard in optical imagery and remote sensing.

> "With multispectral data, we can see the glow of photosynthetic activity of vegetation in the Amazon rainforest, examine crop health in southeast Asia agricultural areas, explore wildfire scars in Africa, and measure the retreat of Arctic glaciers."
>
> **Kate Fickas**
> Esri Director of Imagery and Remote Sensing Solutions

Unlocking Global Imagery for Everyone

Historically, the Landsat program has presented a few challenges. The first is the sheer volume of data, collected for more than 50 years. The second is the complexity of the spectral data. Despite advances in imagery and remote sensing data accessibility in the past decade, these challenges remain, especially for those who are unfamiliar with this type of data or who want a quick and easy way to explore Landsat resources.

To increase Landsat data accessibility, Esri developed the Landsat Explorer app in ArcGIS Living Atlas of the World. It enables users, regardless of expertise, to easily explore Landsat data. From urban expansion to the shrinking of lakes, the app makes the complex world of Landsat data accessible and captivating.

ArcGIS Living Atlas is now an entry point for exploring Landsat data. More than just a collection of maps and data, it's a dynamic gateway to accessible and empowering geospatial insights. This digital atlas holds a diverse range of data layers, maps, and apps, enabling users to better understand the world through GIS. According to Fickas, "It's an evolving resource that simplifies the discovery and application of geographic information—something that's critical in a time when geographic insights are needed for informed decision-making."

Landsat Level-2 data from as early as 1982 is a dynamic time series of imagery available across the ArcGIS system and used to power Landsat Explorer. With an intuitive user experience, the app leverages ArcGIS capabilities to unlock and explore a wealth of Landsat information.

This integration of traditional GIS with Landsat imagery offers a rich and dynamic understanding of our planet and location intelligence. GIS provides precise spatial information while imagery adds contextual depth, providing a holistic view that is greater than the sum of its parts. For GIS beginners and experts alike, Landsat Explorer can spark curiosity and provide comprehensive answers to complex spatial questions.

Reveal Answers with Ease: Landsat Explorer Features and Capabilities

Curious about how our planet's landscapes have transformed over the years? The Landsat Explorer app's dynamic global mosaic lets users visually traverse the earth's surface through the best available scenes.

Wondering which combination of spectral bands can reveal the hidden health of forests or agricultural land? Use the app's on-the-fly renderer of prebuilt multispectral band combinations and spectral indexes, such as the normalized difference vegetation index (NDVI), for quick visual analysis.

Want to know how many Landsat scenes are available with minimal cloud cover for specific dates? The interactive Find a Scene feature allows users to filter images by location, sensor, time, and cloud cover. Use the Swipe and Animation modes to choose which images and dates to compare, and then dynamically observe changes over time.

Trying to find which year a forest fire occurred? Use the Analysis mode to view a chart of monthly, per-pixel trends in spectral indexes over the past four decades to examine and capture spectral changes.

These features can unlock a new world of possibilities, providing a valuable toolkit for informed planning and environmental stewardship.

To explore the app online, go to **links.esri.com/lsa**.

↑ The Landsat Explorer app in Explore mode shows the Richat Structure (also known as the Eye of the Sahara), an ancient geologic feature in the Sahara Desert.

ArcGIS Living Atlas of the World Features Updated US Census Survey Estimates

Big-box retail executives, nonprofit employees, and city planners in the United States have something in common—they all use data from the US Census Bureau's American Community Survey (ACS) to examine community characteristics. For example, stakeholders at major retailers determine new store locations and product promotion strategies by analyzing the survey's demographic data. Grant writers identify underserved communities and use that information to apply for funding. City planners decide where to develop infrastructure and resources such as roads and fire stations based on area populations, contributing to local job growth.

The newest ACS five-year estimates, for 2018–2022, are now available in ArcGIS Living Atlas of the World. Integrating this data allows GIS professionals to explore, map, analyze, and download data at state, county, and tract levels. With these free, readily accessible, and easily downloadable layers, users can save time that would otherwise be spent processing data.

Since 2018, the ArcGIS Living Atlas policy mapping team has provided the GIS community with a comprehensive set of layers. Now, any maps or applications utilizing these layers will automatically display this up-to-date data.

Accessing the Latest ACS Data

ArcGIS Living Atlas provides a wide range of ACS layers covering various topics, such as population, income, education, health insurance, language, and race/ethnicity. These layers provide data for states, counties, and census tracts. With more than 100 layers available, users can analyze, map, and chart this information.

Each layer displays subjects on a map, accompanied by informative pop-ups that reveal important patterns. Users can also create customized web maps and apps that tell stories about topics such as population or housing.

Sourced directly from the US Census Bureau API, the ACS layers provide many benefits to users, including the following:

- Rigorous quality assurance checks ensure accuracy by comparing every value in every layer to the source.
- Source table names are documented for easy reference.
- The original census field names are used throughout, maintaining consistency.
- Boundaries are trimmed along coastlines, lakes, and major rivers to create visually appealing maps of census data.
- Additional attributes, such as percentages and related margins of error, are already calculated for convenience.
- Each field is fully documented with a human-readable field alias and a detailed field description, eliminating the need to search for metadata documents.
- Layers always reflect the latest Topologically Integrated Geographic Encoding and Referencing (TIGER) boundaries that correspond to the most recent ACS figures provided by the US Census.

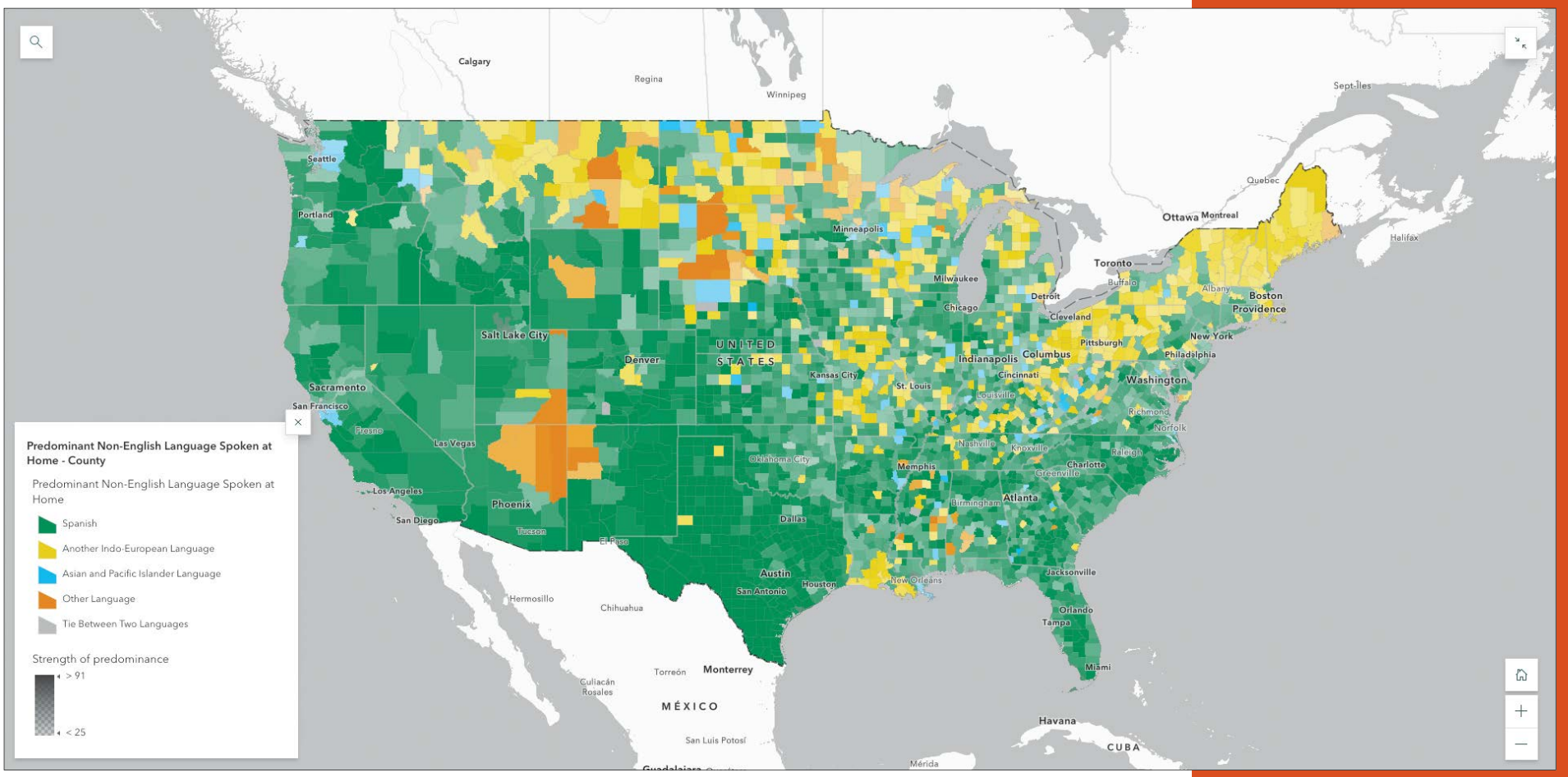
Layer Enhancements and Changes

There are two notable changes about census attributes in the updated data. First, the Specific Asian Groups layer has been expanded to include additional groups. This necessitates updating any maps using this layer to reflect the new fields. Second, Connecticut has made geographic changes to better align its counties with regional planning entities. Additional enhancements include updated cartography and new boundaries. Explore the interactive ACS data story in ArcGIS StoryMaps (links.esri.com/acsdata-sm).

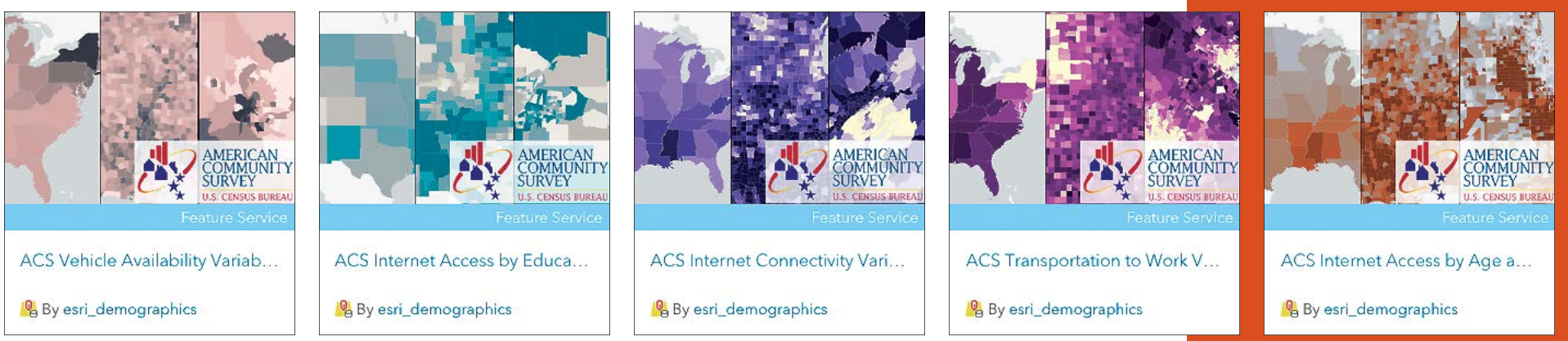
Keeping Census Maps Accurate

When working with maps that use census data, it's important to be aware of variables that may impact data. For example, if maps involve currency values such as earnings, income, median contract rent, or median home values, it's crucial to consider inflation. Likewise, to enhance the reliability of estimates, it's valuable to incorporate margins of error into maps.

Learn about aggregating tracts using neighborhood boundaries or other shapes with the Mapping with Margins of Error learning path (links.esri.com/wmwmoe).



↑ ACS data can be used in ArcGIS Living Atlas to show which non-English languages are predominantly spoken in homes across the United States.



↑ Infrastructure layers can be added to ArcGIS Living Atlas maps to show vehicle, public transit, and internet accessibility.

A 3D Living Digital Twin Guides Improvements for a Vietnam Port System

Organizations around the world are turning to 3D GIS workflows and models for asset monitoring, mission planning, and risk analysis. Supporting these efforts are advances such as reality capture and feature extraction from point clouds, which generate extensive and distributed 3D datasets.

Open data standards such as Indexed 3D Scene Layer and 3D Tiles help optimize the distribution of massive 3D datasets on mobile and web applications, enabling tile set integration with advanced 3D workflows. Users can access integrated mesh and 3D object elements of a 3D Tiles tile set from local directories or public services in ArcGIS Pro 3.2. Combined with data and analysis tools, these tile sets provide additional context to help make data-driven decisions with greater accuracy and speed.

The ArcGIS system enables multidimensional databases by integrating unstructured information, geospatial-features, BIM, imagery, point cloud, reality mapping, and real-time data. This facilitates the creation of digital twins. These practical, efficient, and sustainable 3D virtual representations of real-world operating environments can improve collaboration, awareness, and understanding.

A Vietnam Port's Digital Twin

Located at the mouth of the Thi Vai and Cai Mep rivers in Vietnam, the Cai Mep–Thi Vai port system is near several major shipping routes, including for the Americas and Europe. With a naturally deep ship channel depth, the port has the potential to become an even more important maritime gateway to Southeast Asia. But development of the port, which has been operational since only 2009, has been stalled by factors such as dredging needs and the lack of a logistics center. To solve these problems, the government of Vietnam requested a comprehensive study for the port's navigational channel and primary plan.

To conduct this study, Vietnam-based port and coastal consultancy Portcoast Consultant Corporation developed a digital twin of the port system. Khoi Tran, Portcoast Digital Transformation Centre vice director, said this has helped boost port capacity, reduce environmental impact, and reduce the number of collisions and other accidents. In addition to ArcGIS Pro and ArcGIS Online, Portcoast used ArcGIS Earth, Scene Viewer, and ArcGIS Maps SDKs for Unity for the project.

Tran said Portcoast is also using data from GPS, terrestrial laser scanners, unmanned aerial systems with lidar and photogrammetric sensors, mobile mapping systems, unmanned surface vehicles with wideband multibeam and side-scan sonar, and subbottom profilers with drilling geotechnical boreholes for data collection.

↑ Vietnam prime minister Pham Minh Chính and Portcoast board chairman Tran Tan Phuc discuss the Cai Mep–Thi Vai port system digital twin with stakeholders.

This data is processed and integrated using GIS and BIM to construct 3D assets such as reality mesh, 3D point clouds, 3D objects, and BIM models. The survey, BIM, and GIS data is used to create an accurate representation of the port's physical environment.

With immersive 3D content across desktop and mobile devices, the web, and game engines, this enables stakeholders to explore and interact with a virtual representation of the port system, providing details about underground technical infrastructure—subsurface structures, riverbeds, and geological layers—and other information needed for effective management, maintenance, and operation.

Tran said it also enables analysis and simulations of various scenarios to evaluate the impact of proposed changes or expansions and optimizes the design and operation of the port. This fosters better decision-making processes, heightens efficiency, and mitigates risks and costs associated with infrastructure development and management. Overall, Tran said, it shows how a digital model of infrastructure and urban areas can meet modernization requirements and address global trends.

← ArcGIS enables digital twins by managing data, linking transactions, creating realistic visualizations, and performing analytics via an integrated 3D system of record.

↑ A digital twin of Vietnam's Cai Mep–Thi Vai Seaport may help make the port an even more important maritime gateway.

University of Minnesota Proves Sustainable Development Goals Are Local

The 17 Sustainable Development Goals (SDGs) adopted by all United Nations (UN) member countries in 2015 are as ambitious as they are sensible. Set out to help countries end poverty, protect the planet, and ensure prosperity for all by 2030, these interwoven goals include ending hunger; guaranteeing gender equality; and creating inclusive, sustainable cities while protecting land and conserving water. To eliminate poverty, for example, there must be access to gainful employment, clean water, quality education, and ample food sources.

Above all else, the interrelated goals are applicable to every region and every population in the world—including Minnesotans.

SDGs are a tool to help with the problems that we all face, said Katey Pelican, coleader of the University of Minnesota's Sustainable Development Goals Initiative and director of the Strategic Partnership and Research Collaborative office in the university's Research and Innovation Office.

Building a Statewide SDG Hub Site

The University of Minnesota—a public land-grant research university with five campuses, more than 68,000 students, and an international presence—has used the SDGs since 2019 as a framework for creating a more coherent approach to its work inside and outside the university. The university is the sole academic member in the SDG Data Alliance, a partnership of foundations, UN organizations, governments, and private industry—including Esri—bringing GIS technology to developing countries to speed SDG achievements.

"It fits us well," said Pelican. "We're a huge, decentralized do-gooder," she said of the university system based in Minnesota, which itself has a culture of offering a helping hand.

The university created its own prototype, the SDGs in Minnesota hub site, at sdg-umn.hub.arcgis.com. Built by a team of several students and faculty members using Esri's Sustainable Development Goals Solution released in 2022, the site shares relevant county-level data for help in decision-making, including showing where each county performed on the 17 SDGs. The hub site's creators hope it will be replicated by universities worldwide, making it a catalyst for local action.

Bridging the Gap Between Goals and Local Action

Last year, as the SDG initiative was nearly at the halfway mark of its 2030 target, UN Secretary-General António Guterres warned, "Unless we act now, the 2030 agenda will become an epitaph for a world that might have been."

Part of the problem, Pelican said, has been a wide gap between national goals for addressing the SDGs and local action. That's where she hopes the university's solution—its hub site—can bridge the gap as a tool that can support local efforts toward achieving the goals. "That's ultimately our vision," she said.

The SDGs have been woven into the university's strategic planning since 2019. The hub site is part of that, boosting impact by using GIS tools to make information more accessible to more people. For example, the university has mapped the campus locations of its academic experts and indicated their research related to SDG goals. It has also mapped the university's SDG work with the public, such as financial counseling for young mothers and outreach on residential clean-water programs.

Spatial thinking is another way to frame all this, said Len Kne, director of U-Spatial, the university's research center for GIS, remote sensing, and spatial computing. "You're talking about a place and people in that place and bringing all that together and using geography as the lens, as the filter, as the way of intersecting all of these different approaches and indicators," he said.

Eventually, the hub site is expected to be used by local and state policymakers, organizations, and the public to measure and visualize progress. It will be a virtual place to facilitate collaboration on efforts, Kne said. It also recognizes that Minnesota, like other states, is made up of unique localities in rural or metropolitan areas, and that to address issues such as poverty, policy has to be addressed locally.

Pelican and Kne believe that their hub site can eventually be replicated by academic institutions around the world to foster local SDG implementation.

"We're a land-grant university, so we've been focused on Minnesota as the prototype to show what's possible," Kne said, adding, "I think we'll continue to focus on Minnesota, but it would be nice to expand more broadly."

Hub Site Development Lessons

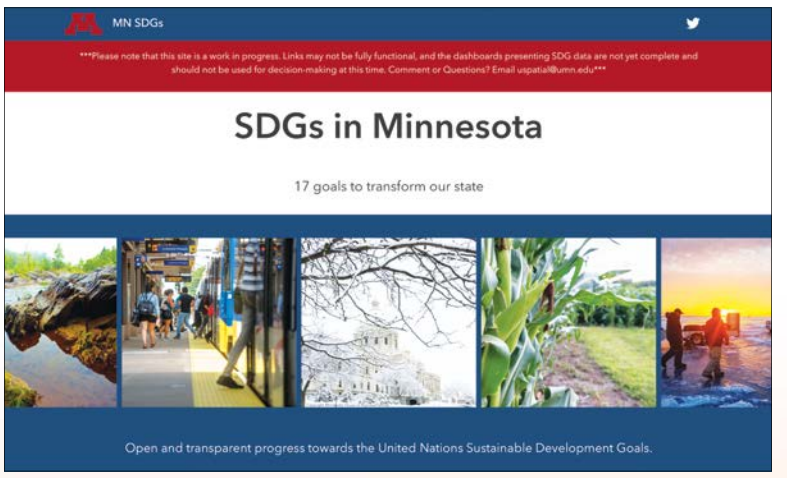
One of the university's biggest challenges has been creating a uniform approach to data standards, indicators, and the metrics used to measure SDG efforts so that everyone is on the same page and communicating in the same language with consistent measures.

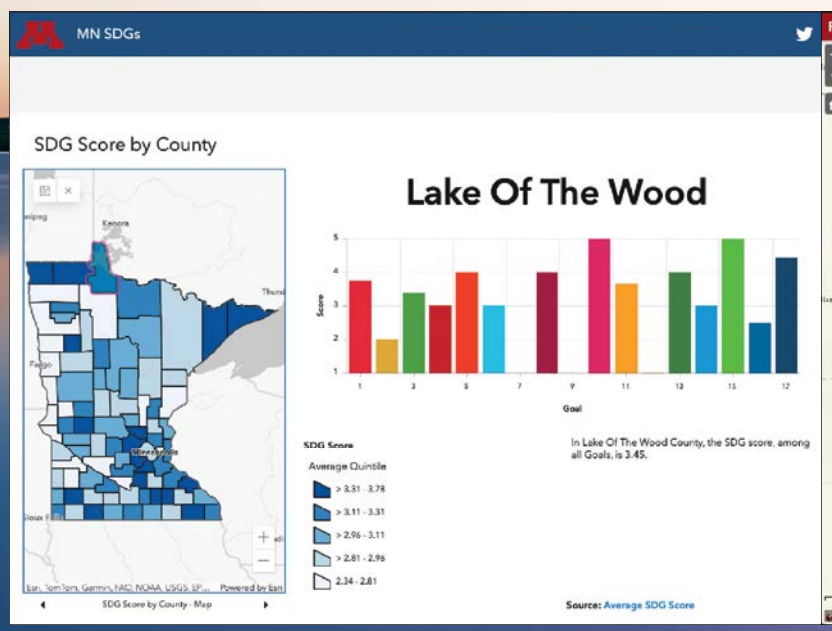
Universities can be neutral parties to help determine those standards and indicators. A state may be reluctant to make comparisons between its counties based on SDG performance. However, a university can evaluate SDG performance in a nonpolitical context. "We're neutral, but we can also make observations and statements that the state cannot," Kne said. "We can make comparisons between counties."

The county-level data that Kne and his team have collected so far has come from ArcGIS Living Atlas of the World, US census data, the Federal Emergency Management Agency, state agencies, and university colleagues. The team also collaborated with the West Central Initiative (WCI) in Minnesota about what indicators it relies on. Working closely with WCI, a regional nonprofit foundation helping nine rural counties and a portion of the White Earth Nation in west central Minnesota to thrive, the university was able to deliver SDG indicators for its region. WCI has since embedded the hub on its own site.

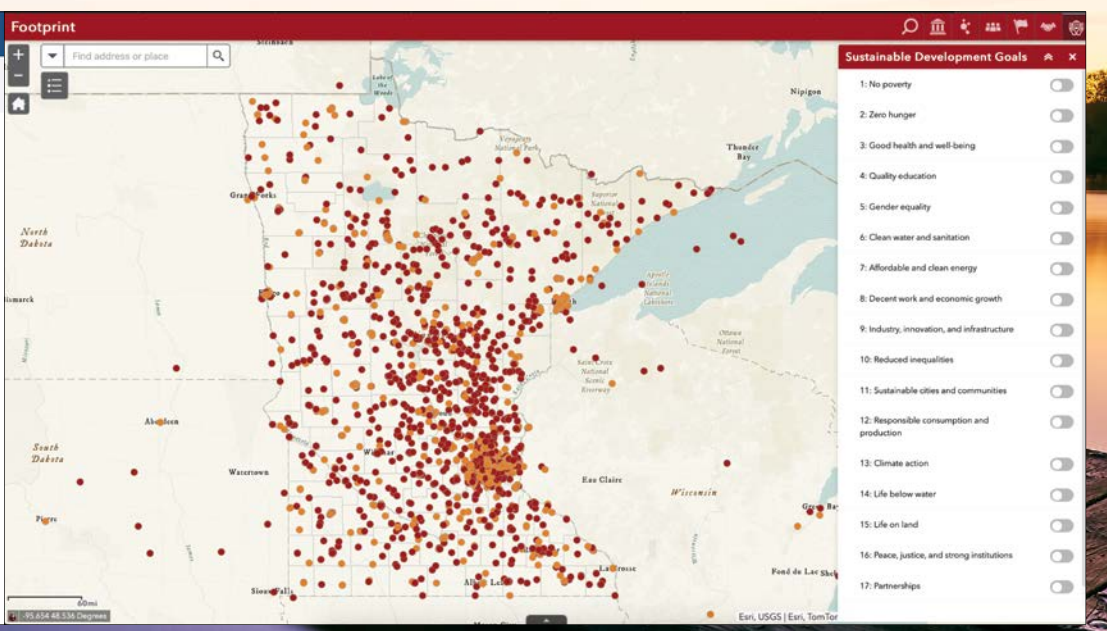
Kne expects the hub site to always be a work in progress, since new and different datasets are coming online all the time.

He also hopes to automate the process eventually and incorporate subcounty data for cities and towns, "knowing that a lot of the change that happens in moving that bar with SDGs is going to happen at that local level," Kne said.





↑ A hub site map shows how Lake of the Woods County is achieving Sustainable Development Goals (SDGs).



↑ A smart map shows the locations of SDG work and research happening across Minnesota.

Collaborative Cartography: The Art and Science of Beautiful Maps

Florida's Jacksonville University merges geography and art in an inventive new class.

Cartographers and artists are visual storytellers, striving to convey messages that audiences can easily interpret. Despite the disparate mediums that they use, students of geography and illustration can benefit when principles from both fields are incorporated into their work.

At Jacksonville University in Jacksonville, Florida, the Sustainability, Geography, and Environmental Planning Department and the visual arts programs co-developed Beautiful Maps, an interdisciplinary course uniting students in geography and illustration. During the spring 2023 semester, students explored technical and stylistic elements of cartography, experimenting with GIS and hand-painting maps. The course fostered exploration, collaboration, and innovation as students learned to create accurate and visually captivating thematic maps.

Three Jacksonville University professors created and taught Beautiful Maps. Each led a four-week block of the curriculum in their area of expertise. One of the instructors, geography professor Dr. Ray Oldakowski, said he has embraced digital transformation. Since the 1990s, he has moved from hand-drawing maps on acetate sheets to deploying ArcGIS Pro. He noted that while today's GIS-powered maps serve as powerful, dynamic analytical tools, many illustration students were unfamiliar with these advances.

"They had no idea that maps were used for anything besides showing location," Oldakowski said. "We showed them the concept of a thematic map, and they learned how we can use maps to portray information."

Similarly, the geography students had little insight into how art students applied their degrees and skill sets professionally. The geography students learned that illustrators work in fields such as advertising, marketing, filmmaking, and creating artwork for children's books and comics. Artists in these fields create specialized visuals that engage and motivate intended audiences.

Thinking Outside the Map

The inspiration for the course came from an interaction between Dr. Ashley Johnson (one of Oldakowski's colleagues), and one of her students. An associate professor of geography, Johnson had been approached by a student with color vision deficiency. The student explained that they often had trouble distinguishing data points and other features on maps.

Johnson "started thinking about how we're often so obsessed with the technical issues on a map that we don't really look at the art components of it," recalled Oldakowski. "So, she got in touch with a colleague of ours in the illustration department, Nicholas McNally." As an associate professor of art in illustration, McNally had the expertise to make the new course a reality. The trio soon began to collect ideas and resources from their own courses to build the Beautiful Maps curriculum.

The final course focused on interactive learning and promoted collective feedback and constructive criticism. During the fine art portion, McNally introduced basic principles of color, which were illuminating to Oldakowski.

"I'd never heard of the color wheel," he said. "We learned about the primary colors, and then how to strategically choose colors instead of just saying 'Oh, that looks nice.'"

As students made their first maps in the art lab, illustration majors often strayed from the standard conventions of mapmaking. Many painted maps that gave shape to imaginary or historic places. Oldakowski was impressed by their creativity.

"They didn't feel restricted to it being the creation or portrayal of real-world information, whereas sometimes as geographers, we're just thinking of maps as being there to portray data," he said.

Early in the semester, the class traveled to the University of Florida Map and Imagery Library. One of the largest academic map libraries in the United States, it houses about 500,000 maps and 300,000 aerial images.

"We brought the students there so that they could see how cartography has changed over the decades," Oldakowski said. Students were asked to document their trip using ArcGIS StoryMaps. It was the first time the illustration students had used the application.

Using GIS to Build New Perspectives

During the four-week instructional blocks led by Oldakowski and Johnson, coursework focused on principles of geography and geospatial technology. While geography majors had been introduced to GIS technology in previous courses, the art majors were unfamiliar with it. As the students explored thematic maps and watched ArcGIS demonstrations, new connections began to form—and new perspectives.

Oldakowski "gave me the inspiration to look at the world in a different way," said Erik Henderson, a Jacksonville University graduate who credits Oldakowski with inciting his own passion for GIS.

Henderson has spent 20 years in the geospatial technology field, forging a career that led him to his current role as director of rail and transit markets at Esri. He believes that Oldakowski's ability to apply geography to any industry allows the professor to connect with students, no matter what career they choose to pursue. "He's really good at making those connections for people to understand the power of geography," Henderson said.

Another perspective was described by Johnson. Halfway through the course, Johnson organized a special remote session featuring her friend, Jason Treat. Treat has been a senior graphics editor for *National Geographic* since 2012. Johnson felt that Treat's exceptional career and award-winning graphics capture the essence of beautiful mapping.

Treat explained that when someone has large amounts of data they'd like to present, each artistic choice is critical. Cartographers must find ways to convey information without overwhelming or confusing the audience. For example, his five-panel perforated poster and interactive graphic for the September 2013 *National Geographic* magazine illustrated how Earth would appear if its icecaps melted, telling a story that is striking and alarming. This map inspired two of the students to create their own map, titled *Where'd Florida Go?*, which depicts the projected effects of sea level rise on the Florida peninsula.

National Geographic uses symbology in its maps that even children can understand. To reinforce this concept, students in Beautiful Maps created their own wildfire symbols. The art majors delivered unique representations and inspired their science-focused peers to test their own creativity.

↑ Beautiful Maps art was displayed at an exhibit at the end of the semester.

← The Beautiful Maps class took a field trip to the University of Florida Map and Imagery Library.

In the same vein of experimentation, students tried an application that blends photographs and ArcGIS basemaps. Results varied, but the inventiveness of students from both disciplines impressed Oldakowski. Students also used drones to capture imagery, then added their images into ArcGIS Pro to build maps.

Showcasing Talents, Embracing Room to Grow

At the end of the semester, students and faculty put together an art exhibit. It was a novel idea for Oldakowski.

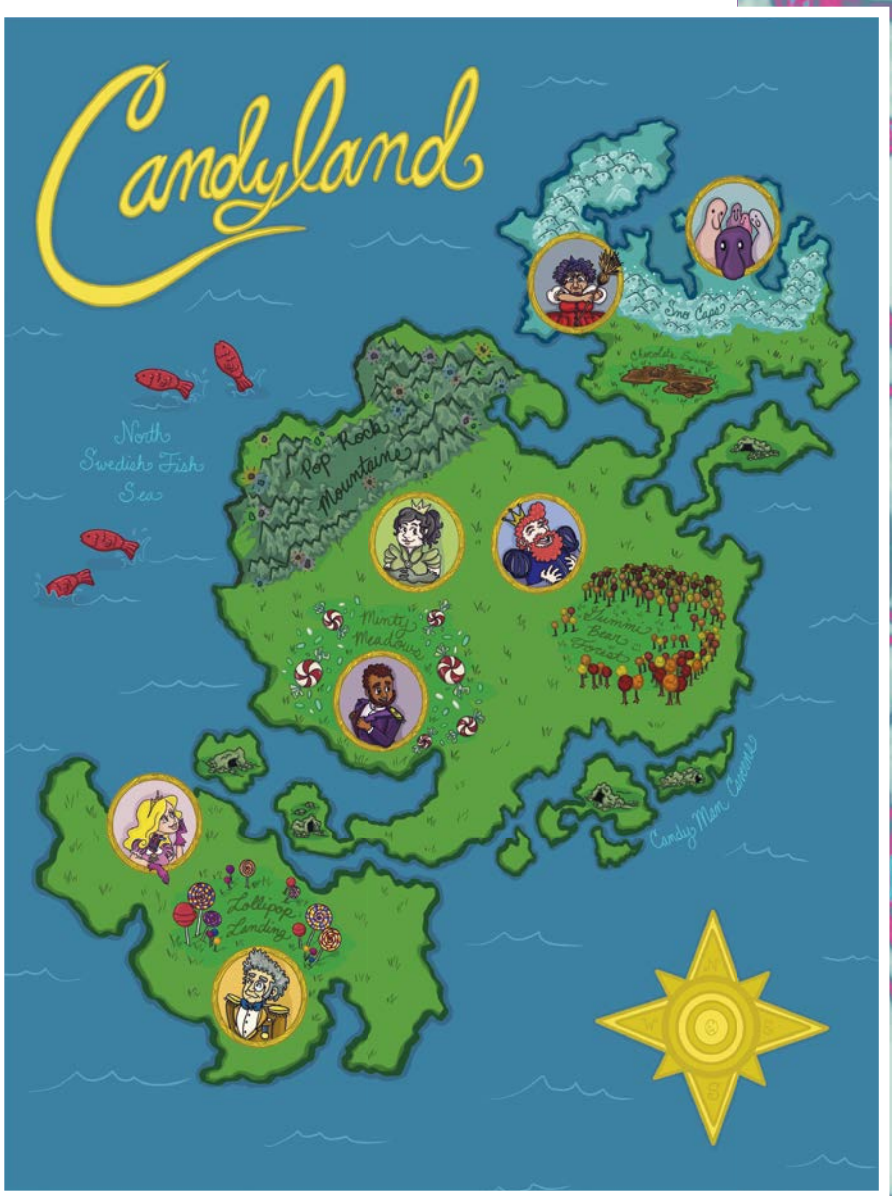
"We hadn't thought of doing an exhibit with maps," Oldakowski said. "Students showed their painted maps…their drone imagery…their ArcGIS Pro maps. All the displays were framed…and students stood by their work and talked about it."

Students gave positive feedback about the course. Some art students decided to pursue additional classes in geography, and vice versa. Oldakowski said Jacksonville University will probably offer the course again starting in 2025, alternating between Beautiful Maps and a GIS conference hosted by his department. As Oldakowski demonstrated when he presented on the course at the 2023 Education Summit @ Esri UC, future students will hopefully learn that compelling maps can be both beautiful and true.

→ Jacksonville University students Gabe Barro and Sasha Heylock created a map to depict the projected effects of sea level rise in Florida.

Learn more about innovative approaches to GIS education at links.esri.com/carto-edu.

To elevate your mapmaking skills, register for the Esri Academy Cartography massive open online course (MOOC) at links.esri.com/carto-mooc.



↑ Jacksonville University illustration student Olivia Ellis created a Candyland-themed map during the Beautiful Maps course.

→ Olivia Ellis created a photo blend combining a personal image and an ArcGIS basemap.

New and Improved: Big Steps in Esri's Digital Journey

Shoppers using the online Esri Store since it launched several years ago have recognized that it's not only a convenience but often a necessity. The Esri Store lets users buy additional licenses immediately—even after normal working hours—and easily place repeat orders, add users, or purchase ArcGIS Online credits. This digital buying experience allows users to buy what they need, when they need it, so that projects are not delayed.

While online shopping can create distance between a company and its customers, Esri has maintained its relationship-driven focus by balancing speed, convenience, and efficiency with personal support in its online store.

In its early days, the store was targeted to customers who wanted to buy personal-use and student-use licenses. Since then, a cross-divisional internal team has listened to user feedback to help make the Esri Store more robust. Nearly 100 products are available to users from organizations of all sizes and a myriad of industries. Esri stores are available in more than 27 countries and in more than 20 languages, with many more distributors scheduled to go online with stores in the next year.

In addition to must-have online store features such as product variety, clear pricing, and detailed product descriptions, there have been new customer-friendly innovations. The Build & Share Cart, launched in April 2023, is an assisted digital shopping experience, where a user can call the Esri sales team and learn about product functionality and licensing. At the end of the conversation, an Esri sales representative emails the Esri user a personalized digital shopping cart. Compared to a quote-request process, this approach saves time while helping even the most self-navigated users know that they've chosen the right GIS products.

For users who require a quote before making a purchase, Esri's online store now has an option called Quote to Order. Currently available only in the United States, it is most appropriate for end users who are purchasing software valued at less than $100,000 and allows users to begin the quote-request process digitally. Benefits include immediate access to a subset of Esri products at any time via online ordering, privacy (with no need to give payment information over the phone), and reduction of time for orders to be submitted to Esri.

Visit the US Esri Store at
esri.com/en-us/store/overview.

Learn more about Quote to Order at
esri.com/en-us/quote-order/sales.

FDA Uses ArcGIS Business Analyst for Retail Food Risk Factor Study

One responsibility of the US Food and Drug Administration (FDA) is protecting and ensuring the safety of the country's food supply. For a study that began in 2023 and is scheduled to end in 2027, the FDA national retail food team is collecting data on foodborne illness risk factors in US retail food service facilities. The study assesses food safety practices and procedures in areas such as employee handwashing, prevention of bare-hand contact with ready-to-eat food, and prevention of cross-contamination. It builds on data from a 1998–2008 study that established a baseline for these factors.

According to Dr. Guilan Huang, regulatory information specialist for the FDA Center for Food Safety and Applied Nutrition, such studies measure practices and behaviors identified by the US Centers for Disease Control and Prevention as contributing to foodborne illness outbreaks. The studies also measure progress in reducing foodborne illness risk factors, examine the relationship between known risk factors and food-handling practices, and evaluate the effectiveness of food safety management systems and certified food protection managers.

According to US Centers for Disease Control and Prevention estimates, 48 million people in the United States become sick due to foodborne illness each year. In this group, 128,000 must be hospitalized, and 3,000 die.

Additional information on the FDA retail food risk factor study can be found at links.esri.com/rfrfs.

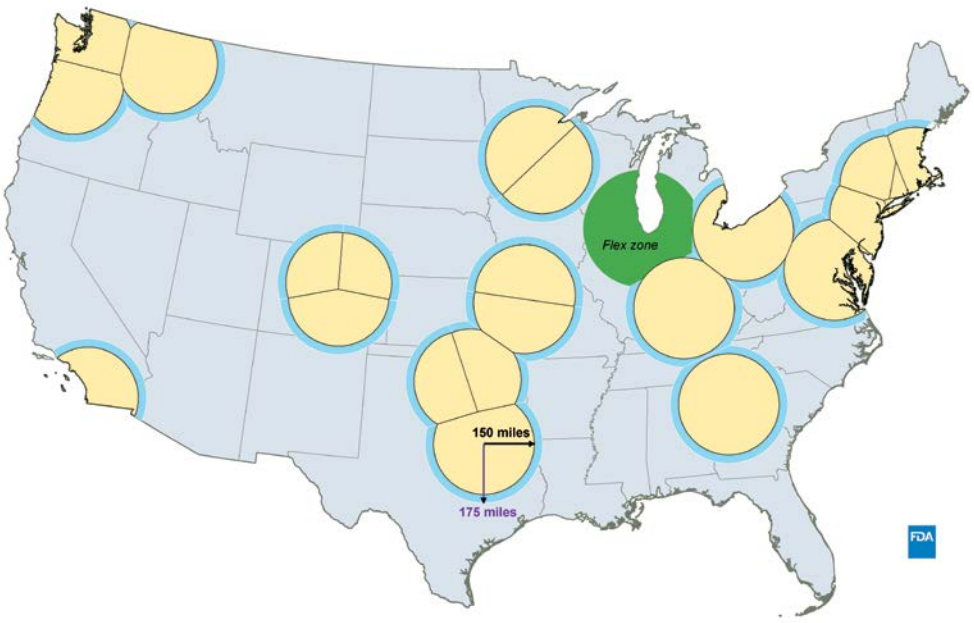
Using GIS to Overcome Resource Limitations

The National Restaurant Association estimates that there were 749,000 restaurants in the United States in 2023. However, the FDA has only 20–24 retail food specialists available at any one time for data collection. Because of the limited number of specialists and the travel needed for data collection, the FDA needed a random sampling procedure that provided a high level of accuracy and that minimized travel time. And because of the length of the multiyear study, a flexible method was needed that could be easily adapted for changes in collection areas, personnel, or procedures.

After investigating different methodologies, the FDA selected spatially random sampling, which involves random selection of sample facilities in which each facility has an equal chance to be selected. Huang implemented it by creating buffered areas centered on the specialists' ZIP codes.

Using ArcGIS Business Analyst for the desktop and the product's accompanying datasets, Standard Industrial Classification and North American Industry Classification System codes from the US government were applied, Huang said. She added that multilayer filters were created using the codes, key words extracted from the FDA's *Retail Food Risk Factor Study*, and data from the previous 10-year study and the current study.

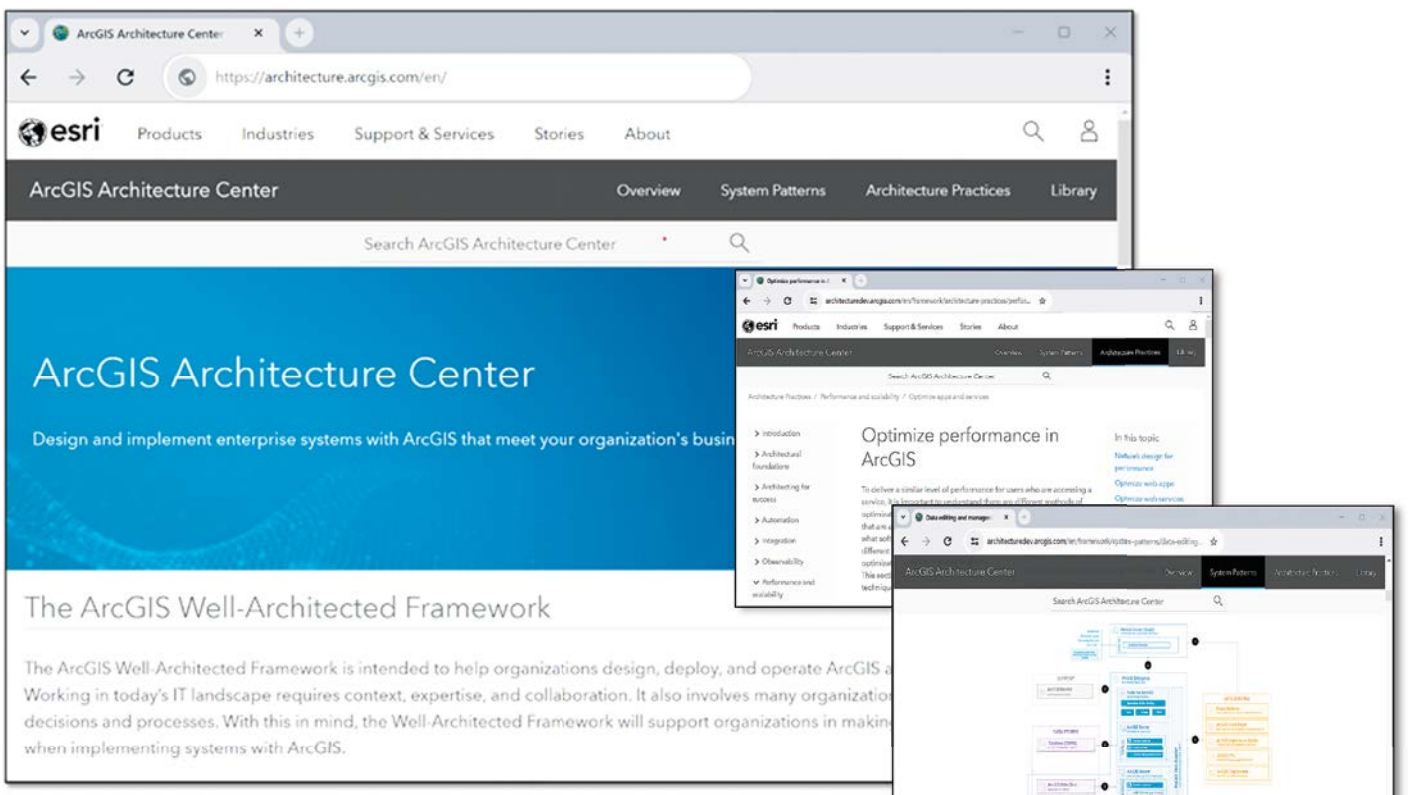
"Spatial analysis was fundamental in conducting this study because it allowed us to customize cost-effective spatially random sampling and perform rigorous quantitative analyses," Huang said. She added that she hopes that the research will lead state, local, tribal, and territorial agencies as well as industry to develop and implement retail food safety policies and initiatives that target specific interventions that reduce foodborne illness risk factors.



↑ To determine the areas for researching sample facilities, the US Food and Drug Administration (FDA) used spatially random sampling and mapped buffered areas centered on food specialists' locations.

Empowering IT Professionals with Architecture Patterns, Practices for ArcGIS

Designing, implementing, and operating effective enterprise systems in today's IT landscape often requires extensive knowledge and expertise in technology and the business objectives that the systems are intended to support. The ArcGIS Architecture Center (architecture.arcgis.com) is a resource that empowers IT professionals, system architects, GIS professionals, and support team members by providing foundational information about ArcGIS products such as ArcGIS Enterprise, ArcGIS Online, and ArcGIS Pro. It also guides organizations in making knowledgeable decisions when ArcGIS systems are implemented.



↑ The ArcGIS Architecture Center offers resources for IT professionals on how to set up an enterprise GIS.

While GIS professionals have long been adept at navigating and utilizing geodatabases, mapping interfaces, and designing user workflows, this new resource extends their expertise to support working with IT professionals in building out ArcGIS systems.

Essentially, the ArcGIS Architecture Center is a bridge, providing system patterns, best practices, and a full architecture library to ensure that IT professionals have the necessary resources for their organization's ArcGIS infrastructure. It brings together years of collective experiences, recommendations, and best practices for building enterprise systems from across Esri and its community of distributors, partners, and users.

The website has four main sections:

1. The Overview section (links.esri.com/arcgis-intro) provides information on ArcGIS written for IT professionals—how it's designed, its functional capabilities, how its products support different deployment and operational models, and how it integrates with different IT landscapes.
2. The System Patterns section (links.esri.com/sp-i) presents eight system patterns—common and composable examples of how users can build systems with ArcGIS. The key capabilities of each pattern are described in detail, along with different deployment options, deployment considerations, and potential integrations with other system patterns. These ArcGIS system patterns are abstractions of actual systems, describing the most common types of geospatial systems that organizations implement with ArcGIS software and services.

   These are the eight system patterns:
   - Location services
   - Self-service mapping, analysis, and sharing
   - Enterprise application hosting and management
   - Data editing and management
   - Imagery data management
   - Mobile operations and offline management
   - Big data analytics
   - Real-time data streaming and analytics
3. The Architecture Practices section (links.esri.com/wap-api) introduces concepts and best practices centered on six key architectural pillars—automation, integration, observability, performance and scalability, reliability, and security—that are relevant for any ArcGIS system. Designing and building with ArcGIS doesn't have a one-size-fits-all framework, but this section provides guidance and considerations and supports a more advanced and effective architecture process for various systems and projects.
4. The Architecture Library (links.esri.com/arcgis-lib) has documents, presentations, videos, samples, and other assets to assist users in designing and implementing well-architected systems with ArcGIS. These items can build on existing ArcGIS system patterns and architecture practices or may be related to specific industries, deployment environments, or integration technologies. This section provides the most up-to-date resources.

The content on this site allows users to explore specific topics of interest or simply peruse a design pattern or technical pillar. As users become more familiar with the content, they can keep reading for more information or obtain hands-on experience by designing or testing systems based on the provided ArcGIS system patterns. The site also includes information on key ArcGIS additions, updates, and changes.

ArcGIS Supports Species Conservation in Eastern South Africa's Nature Reserves

In the Nguni languages of southern Africa, the word "mpumalanga" means "the place where the sun rises." It's a fitting name for the South Africa province of Mpumalanga—both in terms of its location near Africa's eastern coast and as a region of optimism in the wake of apartheid.

A place of ancient human archaeological history and rich agricultural, mining, and tourism resources, Mpumalanga is known for its magnificent scenery, tribal legends, and colorful gold rush stories from the late 1800s. But Mpumalanga also has rich biodiversity and incredible value as a home to many species that can only be found there.

Many of these species are protected in Mpumalanga's extensive nature reserves. These species include Barberton sugarbush (a flowering plant threatened by mining activity), Sim's spotted aloe (another plant, threatened by road construction), and Treur River barb (a river fish that has overcome displacement by exotic fish species and gold mining).

Mpumalanga is also home to more than 300 species of flora and fauna that are officially classified as vulnerable, endangered, or critically endangered. More than 300 others are classified as species of conservation concern. This makes identifying and locating their ranges vital so that they can receive the conservation attention needed to ensure their protection.

GIS-Fueled Conservation in Mpumalanga Province

As a biodiversity planner and GIS manager for the Mpumalanga Tourism & Parks Agency, Mervyn Lötter supports a commitment to conserve and protect all animal and plant species in the province. In this effort, Lötter faces an uphill challenge, albeit with some powerful GIS tools.

Surveying the local environment and building awareness of it is central to Lötter's work as he manages his organization's spatial databases and GIS. He also coordinates the collection of species data being gathered by scientists in the field using ArcGIS Survey123 and ArcGIS Field Maps.

With this information, Lötter runs a systematic conservation plan for Mpumalanga and brings together all spatial data on species, ecosystems, threats, and areas currently under protection. This field data is included in the agency's conservation plan, where conservation targets are set and progress is assessed. When targets fall short, additional areas are prioritized for conservation.

Partnerships, Scholarships, and Collaboration

Having reliable and detailed GIS information is essential for attracting partnerships, building public support, and securing financial support in a part of the world where conservation funding is often scarce, Lötter said. He noted that the way data is presented can matter as much as the data itself, and that maps and web apps are effective tools to convey important messages.

"If you want your products used and you want *[them]* to be considered by municipalities and the like, then you need to make the data available in a format that they can use and access and understand," Lötter said.

Education and industry collaboration have also been key to Lötter's GIS efforts. After starting his career at the Mpumalanga Tourism & Parks Agency as a botanist in the mid-1990s, Lötter learned about GIS as a way to predict the distribution of plant species. In 2011, he joined 16 other recipients in a scholarship program offered by the Esri-supported Society for Conservation GIS (SCGIS), a nonprofit organization that helps scholars from developing countries access GIS training.

"No other training event has had such a positive impact on my life, ever," Lötter said.

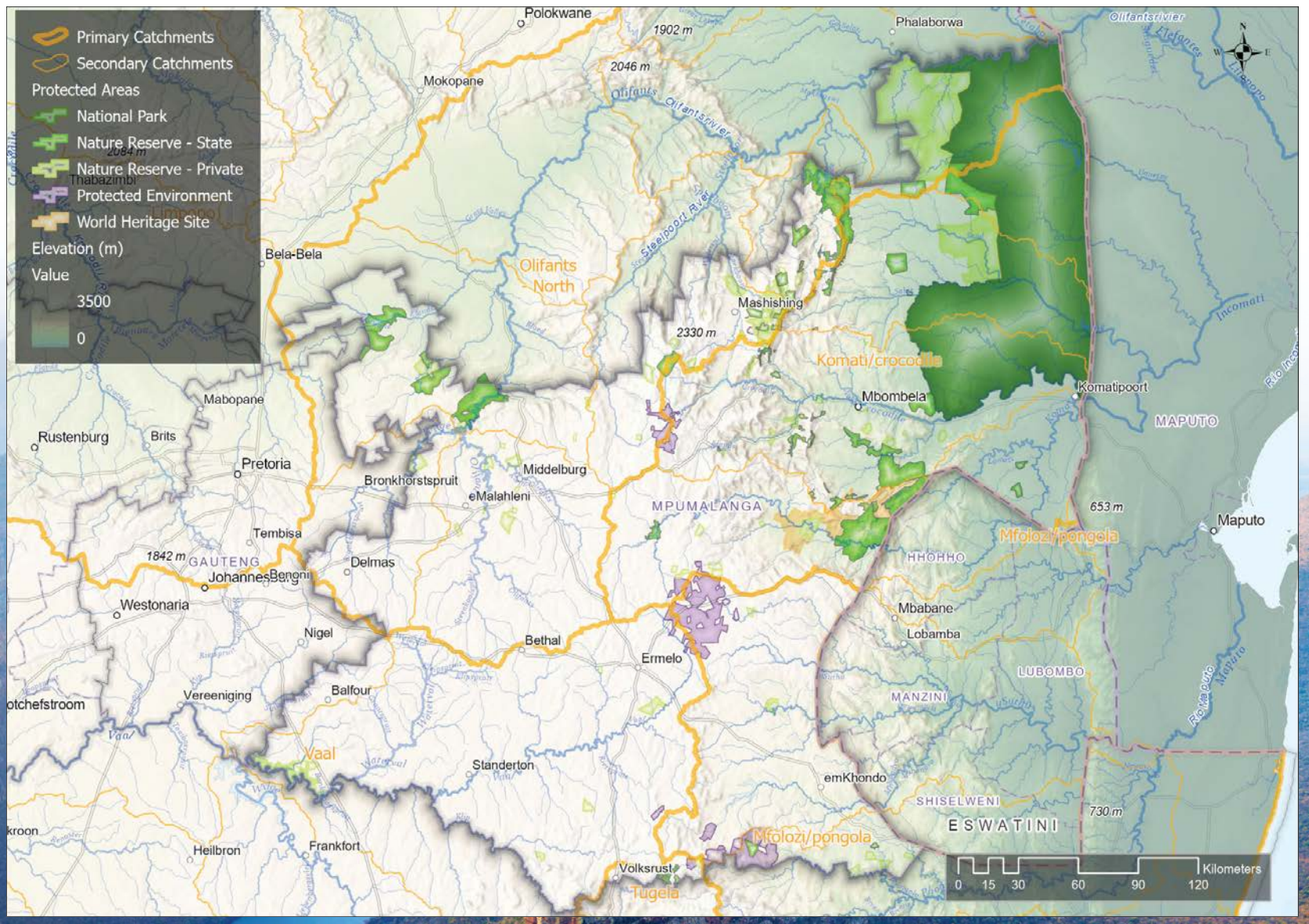
There was still plenty to learn, though, and Lötter's ongoing need for education found a ready resource in Esri Community (community.esri.com), a global online community of Esri users where members can find solutions, share ideas, and collaborate to solve problems with GIS.

"I would never have been able to learn to use GIS to its full potential on my own," Lötter said. "Through the Esri Community, you're much more able to reach out to a broader network to get their advice, their support, and learn from where others are stumbling."

Lötter described Esri Community's role in supporting GIS professionals by quoting an African proverb: "If you want to run fast, run alone. But if you want to run far, run together."

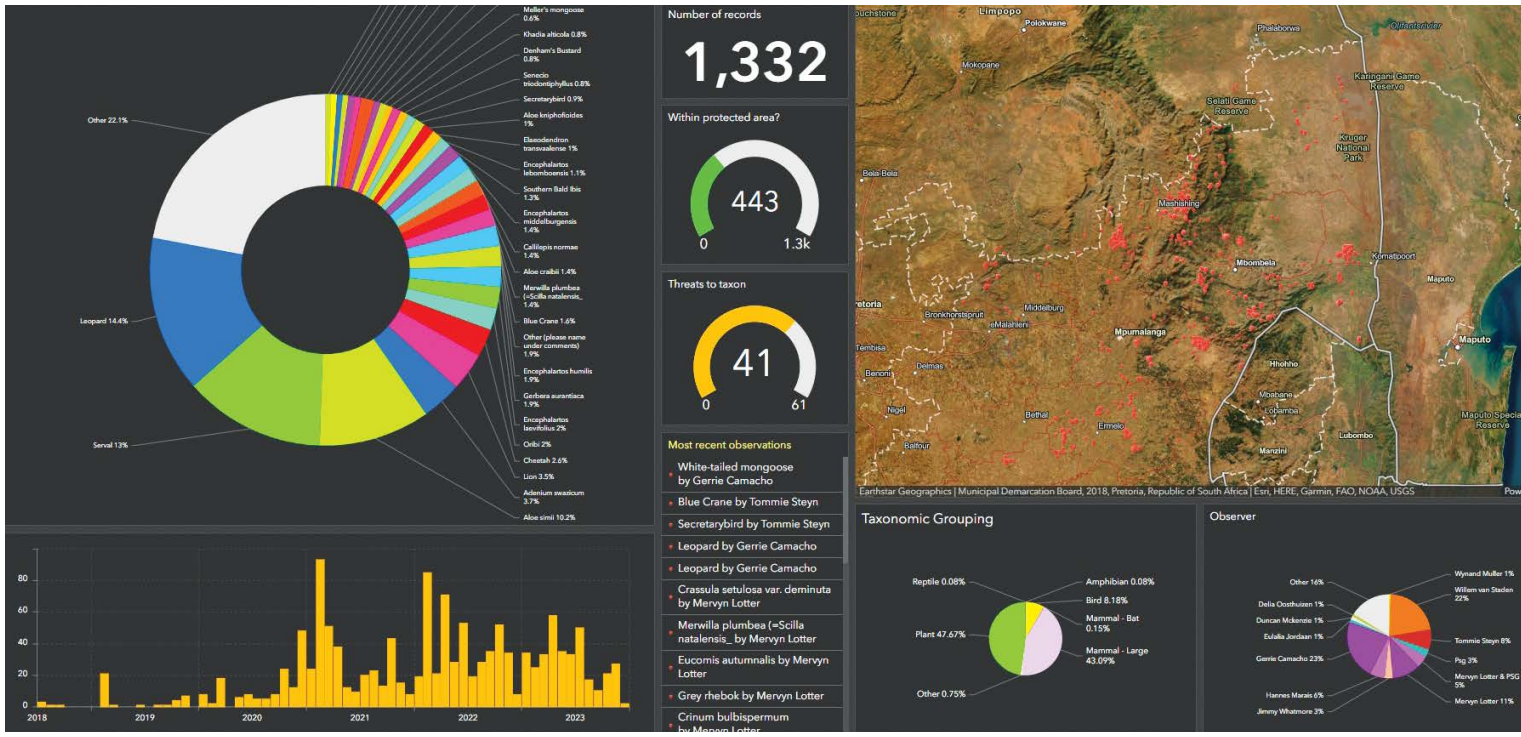
Giving and the Spirit of Ubuntu

Now nearly three decades into his conservation work, Lötter's community-mindedness is reflected in hundreds of Esri Community messages and responses. An SCGIS board member for the



↓ The Mpumalanga Tourism & Parks Agency uses GIS to create biodiversity maps and identify priority areas for conservation.

→ A dashboard, created using ArcGIS Dashboards, shows species of conservation concern in Mpumalanga, recorded using ArcGIS Survey123 and ArcGIS Field Maps.



last decade, he is now a GIS trainer for the SCGIS Global Scholarship program and the SCGIS Train-the-Trainer program for scholars who are selected for additional training to become certified instructors.

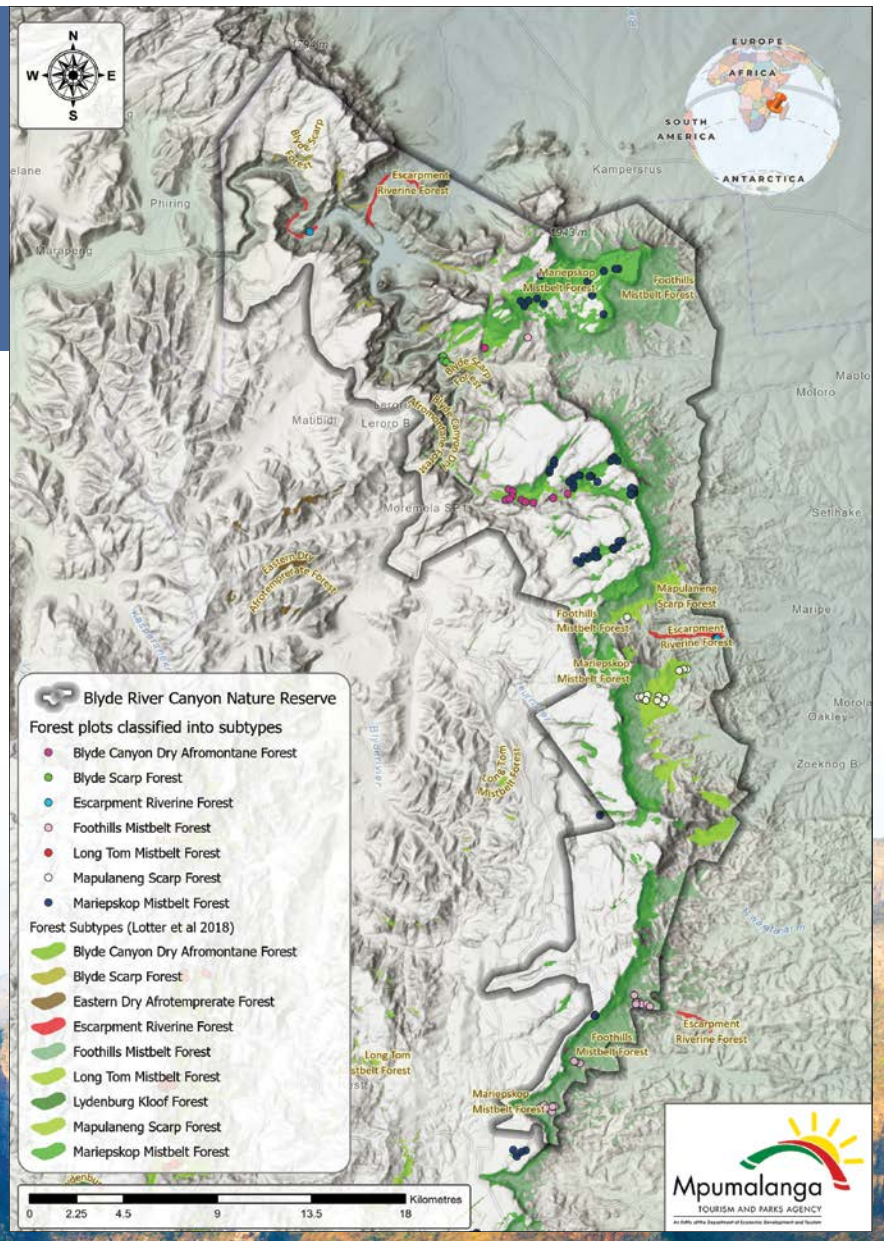
Lötter captured his philosophy about giving back to the GIS community by sharing another African term—"Ubuntu," which he translated as "taking care and having care and concern for your neighbors or your community."

"You can't do everything on your own," Lötter said of the GIS community. "We need to help and support others."

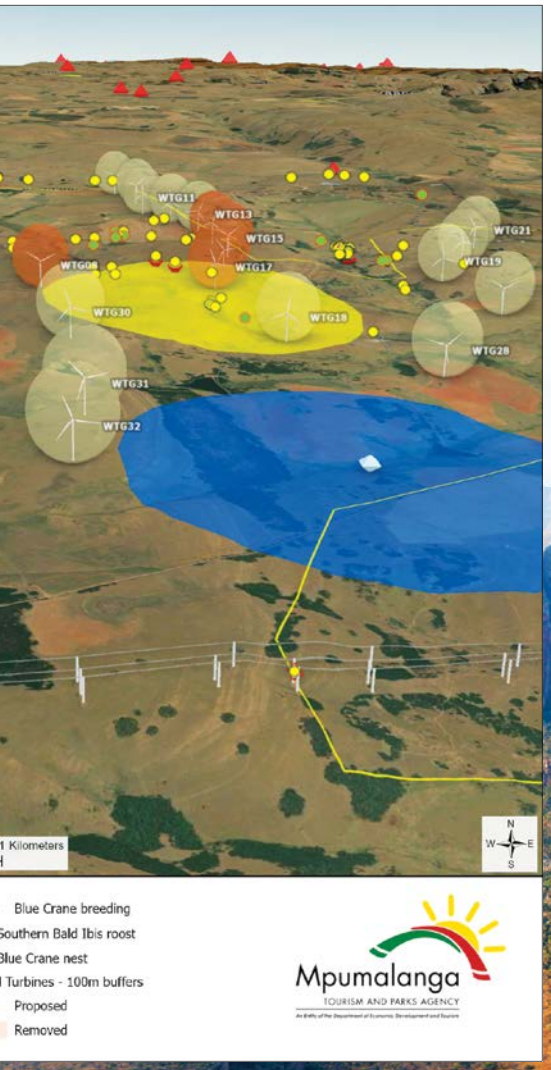
Learn more about Esri Community at community.esri.com.

Find out more about the Society for Conservation GIS Global Scholarship Program at scgis.org/training and the Train-the-Trainer program at links.esri.com/scgis-ttt.

← A regional forest classification map helps Mpumalanga identify priority areas for conservation.



↓ The Mpumalanga Tourism & Parks Agency uses GIS to assess the possible impact of wind farms on species of conservation concern.



"Through the Esri Community, you're much more able to reach out to a broader network to get their advice, their support, and learn from where others are stumbling."

Mervyn Lötter
Mpumalanga Tourism & Parks Agency
Biodiversity Planner and GIS Manager

↓ Mpumalanga's Blyde River Canyon is part of the Blyde River Canyon Nature Reserve, where ArcGIS Survey123 and ArcGIS Field Maps are used to help in conservation.

In the Czech Republic, Brno Unlocks the Power of Open Data with ArcGIS Hub

Data is everywhere—it's generated by smartphone activity; credit card transactions; and sensors in cars, homes, and cities. It reveals insights into behavior, preferences, and needs. Smart cities use this information to provide better services to their residents. Brno, a city in the Czech Republic, analyzes open data and uses it to create valuable apps that inform residents and spur data-driven decision-making.

GIS technology and spatial data form the backbone of Brno's decision-making and policy planning processes. Every day, the system collects and manages data about a wide range of topics, including green space, traffic patterns, and population statistics. In 2018, the city's Data, Analysis, and Evaluation Department launched a citywide data platform—data.Brno—that uses open data, making information free and available to the public.

Prioritizing Accessibility

Created with ArcGIS Hub, data.Brno is a primary source for city information. It allows anyone to download dynamic data and incorporate it in their projects or systems. The hub site offers about 150 datasets that are regularly updated and accompanied by comprehensive metadata. A valuable internal tool, it's a shared resource for the city's primary strategic document, Strategy Brno 2050, and it boosts collaboration across city departments.

Staff members in the Brno Chief Architect's Office created an extensive zoning plan database using several datasets from data.Brno as well as some of their own. Many conceptual documents, measures, and activities that are needed for the city's successful growth are created based on data shared on the platform.

The platform's data is published using open data standards that promote transparency and openness. Residents have immediate access to information regarding local climate, transit, election results, and other aspects of Brno. Data is published in a machine-readable format that is free of license restrictions, easily accessible, and included in a national open data catalog that combines available and open datasets from across the country. The catalog feeds into the official European Union open data portal, contributing to more than 1.5 million datasets from the region.

↑ A variety of accessible GIS dashboards help data.Brno users visualize and understand large swaths of data.

A Tool That Fosters Innovation

In addition to being compatible with Brno's citywide GIS, city staff chose ArcGIS Hub because it allows users to easily work with spatial datasets and download data in open formats. Users can directly access data with dynamic, ready-to-use layers; application programming interfaces; or a REST service.

Because of this, anyone can reuse the platform's open data. A developer who wants to use data about cultural events held in Brno can easily integrate ready-to-use data from the Tourist Information Center into an app or GIS client. Hackathon participants use this data as a foundation for their exercises. High school and university students cite the platform's data in academic papers, and novice analysts use it to train for their careers. With data from this authoritative source, anyone can create an app or website that includes information about the city.

Storing authoritative data in one place makes it easier for city employees to collaborate and create innovative apps that are integrated into the data portal. The primary aim of these apps is to enable easy access to information to make data-driven decisions. Users can find waste-disposal sites and bike-share locations and get transit information.

Based on information from data.Brno, Brno in Numbers uses a dashboard to visualize basic annual statistics, trends, and interesting facts about the city and its residents in one place. With BRNO BRZO, an app with data.Brno data about recently completed and planned developments, users can access historical information, project plans, and status updates. It's an essential tool that attracts investors and developers to the city.

Another valuable tool built with the help of the data is a map of solar potential, which visualizes the amount of sunlight falling across the city. This detailed map empowers residents to identify the potential for installing solar panels on their rooftops. By leveraging this information, Brno's environmental department can strategically plan the installation of solar panels on city-owned buildings, contributing to the city's efforts to combat climate change.

These apps are valuable for internal and external use. Brno collects real-time data on various transportation modes, including cars, bikes, and public transit. This information enables city staff to anticipate traffic patterns, prevent congestion, and optimize traffic flow. Brno also collaborates with the Waze for Cities program, which provides near real-time international data feeds on road events and traffic speeds. This data informs the planning and maintenance of transportation infrastructure. A public version of the app uses the same data, showing bike and car traffic, available parking, and more.

Planning for the Future

These are just a few examples that show how data is leveraged to enhance Brno's livability and sustainability. By adhering to high-quality open data standards, the city maximizes the impact of its data and fosters development of innovative tools and applications that benefit residents. The Data, Analysis, and Evaluation Department considers feedback from users, ensuring the portal continues to improve and meet their needs.

Brno relies on worldwide standards and software solutions, so these practices can be replicated in other cities. The hub site provides data-driven approaches to create a healthier and happier city by increasing transparency, optimizing urban management and services, and fueling innovation.

A version of this article was originally published on the data.Brno website.

Rising from the Ashes: Using GIS to Guide Post-Wildfire Storm Runoff Planning

In 2018, the town of Paradise, California, was a quiet community of about 26,000 people. Situated between two canyons, its neighborhoods were interspersed with ponderosa pine and oak forests that edged up to the rugged canyons and winding creeks. But in November of that year, disaster struck. Sparks from a faulty electric transmission line, combined with unusually dry and windy conditions, caused a fire to sweep through the town, located about 85 miles north of California's state capital of Sacramento.

Today known as the Camp Fire of 2018, it was among the deadliest and most destructive wildfires in California's history. According to reinsurance firm Munich Re, it was also the most expensive natural disaster in the world that year in terms of insured losses, with an estimated damage cost of more than $16 billion. The California Department of Forestry and Fire Protection reported the destruction of more than 18,000 structures, while 85 civilians lost their lives. Thousands of Paradise residents were forced to evacuate, and many are still making their way back to Paradise, bringing the population to about 10,000 as of late 2023.

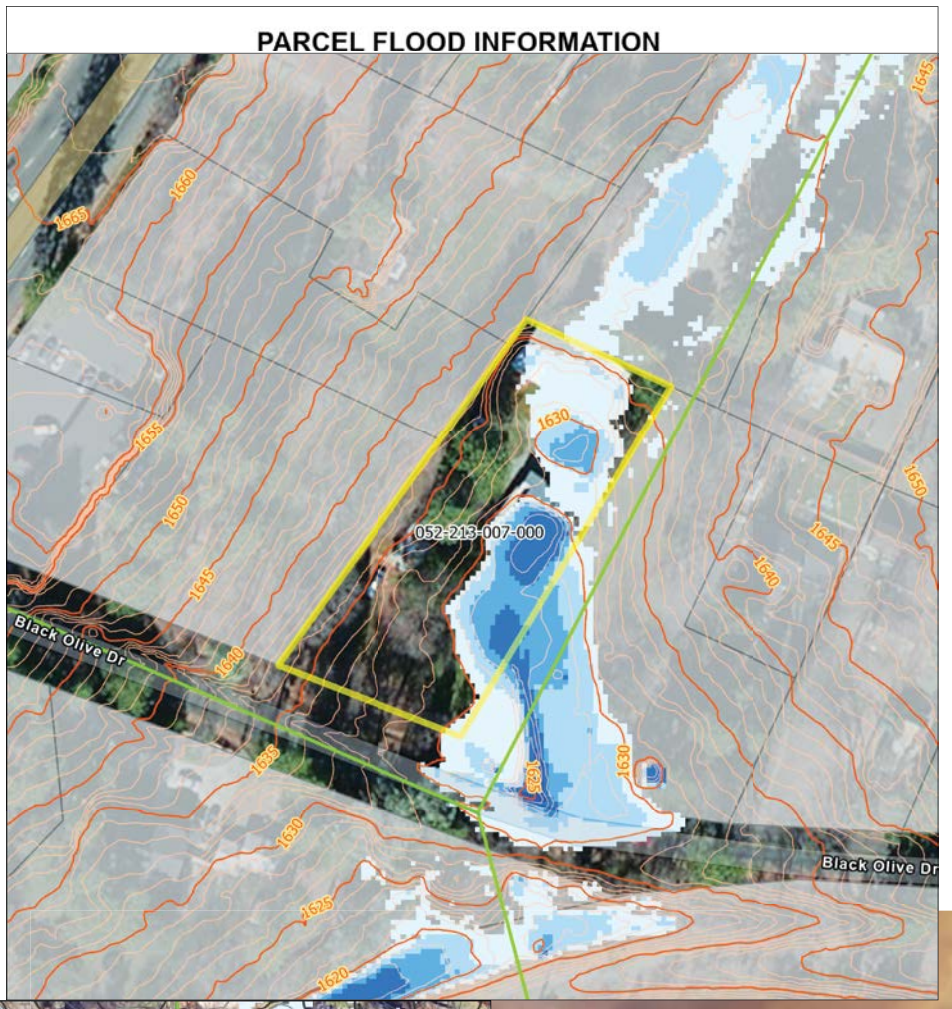
Now, rebuilding is the order of the day. More than 2,000 single-family homes and 400 multifamily units have been built since the fire, schools are being rebuilt, and the community is thriving, according to Marc Mattox, Paradise public works director and town engineer.

Storm Drains: A New Plan

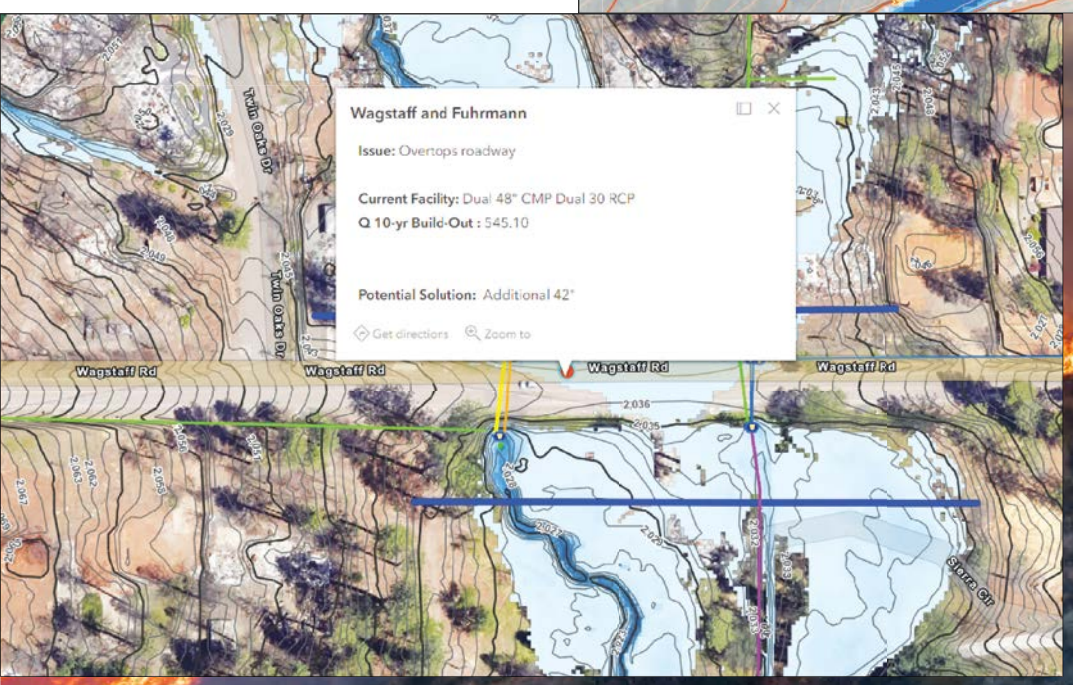
With an intense wildfire such as the Camp Fire, the soil can lose its ability to absorb water. This can increase stormwater runoff, which is rain flow that travels on the ground's surface. Excess stormwater runoff can cause a slew of problems, including flooding, erosion, and pollution.

To help guide reconstruction and make Paradise more resilient to future storm runoff, Paradise's engineering team developed a new storm drain plan with help from a federally funded Hazard Mitigation Grant Program allocation. The plan prioritizes project improvements and sets ways to evaluate recovery efforts related to stormwater drainage. Improved roadways and drainage systems are expected to make Paradise less susceptible to flood damage and better able to respond to excess stormwater runoff.

Leveraging ArcGIS Online, ArcGIS Enterprise, ArcGIS Survey123, and ArcPy, Esri partner Wood Rodgers (woodrodgers.com) extracted data from hundreds of drawings and put it into an ArcGIS Enterprise geodatabase. Wood Rodgers also created a digital drainage system basemap for the town's existing infrastructure, while an architecture, engineering, and construction project content delivery system helped share information with the town, stakeholders, and project subconsultants. Wood Rodgers used an ArcGIS Survey123 condition assessments form to organize and evaluate field data collection. ArcGIS web maps were used to share georeferenced drawings and storm drain infrastructure with the town to help document progress.



→ ArcGIS Pro and ArcPy were used to map potential 100-year flood depths, topographic contours, and existing drainage features for every parcel in Paradise.



↓ An ArcGIS Experience site was configured to allow engineers in different locations to recommend solutions to known problem areas by sketching in various design elements for the proposed changes.

Creative Use of GIS

According to Wood Rodgers project manager Harvey Oslick, GIS was instrumental in delivering a high-quality plan while meeting budget and schedule constraints. "One major challenge," he said, "was that we needed to model 450 culverts without precise survey data." Though lidar data was available, Oslick explained, it generally did not capture culvert terrain elevations. GIS-estimated elevations guided terrain modifications to get the model to provide reasonable simulations of expected system performance. "This creative use of GIS probably saved three weeks of tedious effort," Oslick said.

Using a web mapping application configured in ArcGIS Enterprise, the plan also provided design recommendations for areas with known drainage issues, providing a basis for construction cost estimates. Wood Rodgers also developed a flood parcel information tool in ArcGIS Pro to identify potential 100-year flood depths, topographic contours, and existing drainage features on a parcel-by-parcel basis by simply entering an address.

According to Mattox, this has helped support town reviews of reconstruction, new development, and town capital improvement projects. "Our engineering division has been able to run the tool, output the flood information for all 11,000-plus parcels, and pass it along to the homeowner or developer for their use in the rebuild process, saving time and valuable resources," Mattox said.

Since completion, the plan has received awards from the American Council of Engineering Companies of California and the American Society of Civil Engineers—Sacramento Section.

Today, many streets in Paradise remain lined with empty lots. But new homes are being built, and the opening of a new or returned business is often met with public celebration. Helped by determination, optimism, and a few strategically used ArcGIS applications, Paradise is poised to come back stronger than ever.

Scientific Currents

By Dr. Dawn Wright
Chief Scientist, Esri

CLIMATE ACTION STILL ON THE FRONT BURNER

Many people now contend that climate change has emerged as a pivotal global issue and that humanity has officially entered a new climate era. United Nations (UN) secretary general António Guterres has gone so far as to declare that we are in an era not of global warming, but of "global boiling."

The global geospatial tech community continues to work steadfastly to address this singular challenge of our time. This was evidenced by the popularity of Esri's first massive open online course (MOOC) on the subject, offered last year (links.esri.com/sc-fall23). The class, called GIS for Climate Action, was held from October to December 2023 and attracted remarkable interest, with about 16,600 participants globally.

The MOOC is available again this spring, from May 1 to June 12. Register now at links.esri.com/mooc24 to explore how to create clarity from a myriad of climate data sources and illuminate climate-related risks, opportunities, and sustainable solutions. Course videos, exercises, and discussion boards will show how the latest ArcGIS capabilities can be deployed to monitor climate change indicators, predict associated natural hazards, understand coastal flooding impacts, model sea level rise, identify solar energy potential, predict natural hazards, and create insight and—most importantly—drive positive action toward a more climate-resilient future.

↑ The Esri team attended various events at COP28 in Dubai.

In addition to the MOOCs, Esri remains actively involved in a multitude of climate-related activities. This column highlights a few of them.

It's my opinion that the world is paying more attention to the annual UN Climate Change Conference and the UN's Conference of the Parties (COP). This event—also referred to as the Climate COP—brings together government policymakers, activists, scientists, industry leaders, and journalists from across the globe to assess the latest science about the climate crisis and develop global goals aimed at slowing climate change and mitigating the worst of its impacts. Esri and its distributors local to the host nations have participated in the last few COP events (COP26 in Glasgow; COP27 in Sharm El-Sheikh, Egypt; and COP28 in Dubai) and are expected to participate in COP29 in Baku, Azerbaijan, in late 2024.

Esri has also had strong representation at the "other" COP—the UN Biodiversity Conference, also known as the Biodiversity COP, the most recent of which was COP15. This global meeting occurs every two years at locations separate from the Climate COP, and focuses on the international Convention on Biological Diversity (cbd.int). One of its most significant outcomes has been the landmark agreement to protect 30 percent of the planet's lands, inland waters, coasts, and ocean (links.esri.com/sc-spring23) by 2030. This is often referred to in the media as 30x30 or 30 by 30.

Although the climate and biodiversity COPs have acted independently of each other, there's growing consensus among scientists, natural resource managers, and conservation activists that the two should be inextricably linked, and that we need solutions that tackle climate and biodiversity simultaneously. Indeed, climate solutions can promote biodiversity.

More specifically, the International Union for Conservation of Nature (IUCN; iucn.org) recently announced Esri as its geospatial partner on the IUCN Act30 initiative, which aims to advance 30x30 in 18 countries. Via this initiative, national conservation planning maps will be developed for each country, highlighting Indigenous Peoples areas, key biodiversity areas, and protected and conserved areas. Other partners are the High Ambition Coalition (hacfornatureandpeople.org, a new 30x30 organization funded by the World Bank Global Environment Fund), and the International Indigenous Forum on Biodiversity (iifb-indigenous.org).

Esri has also been collaborating with the Group on Earth Observations (links.esri.com/sc-spring21) to conduct a global, crowdsourced assessment (using ArcGIS Survey123 and ArcGIS StoryMaps) of how citizens, policymakers, and local governments are experiencing heat impacts in their communities. Responses will be combined with existing data and new satellite feeds to develop the Global Heat Resilience Service (GHRS).

The GHRS will leverage the power of high-resolution data in the cloud, augmented by AI, to help city planners understand when and where extreme heat events will occur, as well as varying vulnerability levels and what actions will best manage risks. This service, currently in the design phase, is intended to be a trusted, free, and openly accessed decision-support tool for major cities. Progress can be tracked at links.esri.com/ghrs.

In the United States, many people now recognize the National Climate Assessment (NCA; nca2023.globalchange.gov) reports, mandated by the US Congress, as the preeminent source of authoritative information on the risks, impacts, recommended responses, and best solutions to combat climate change for the country.

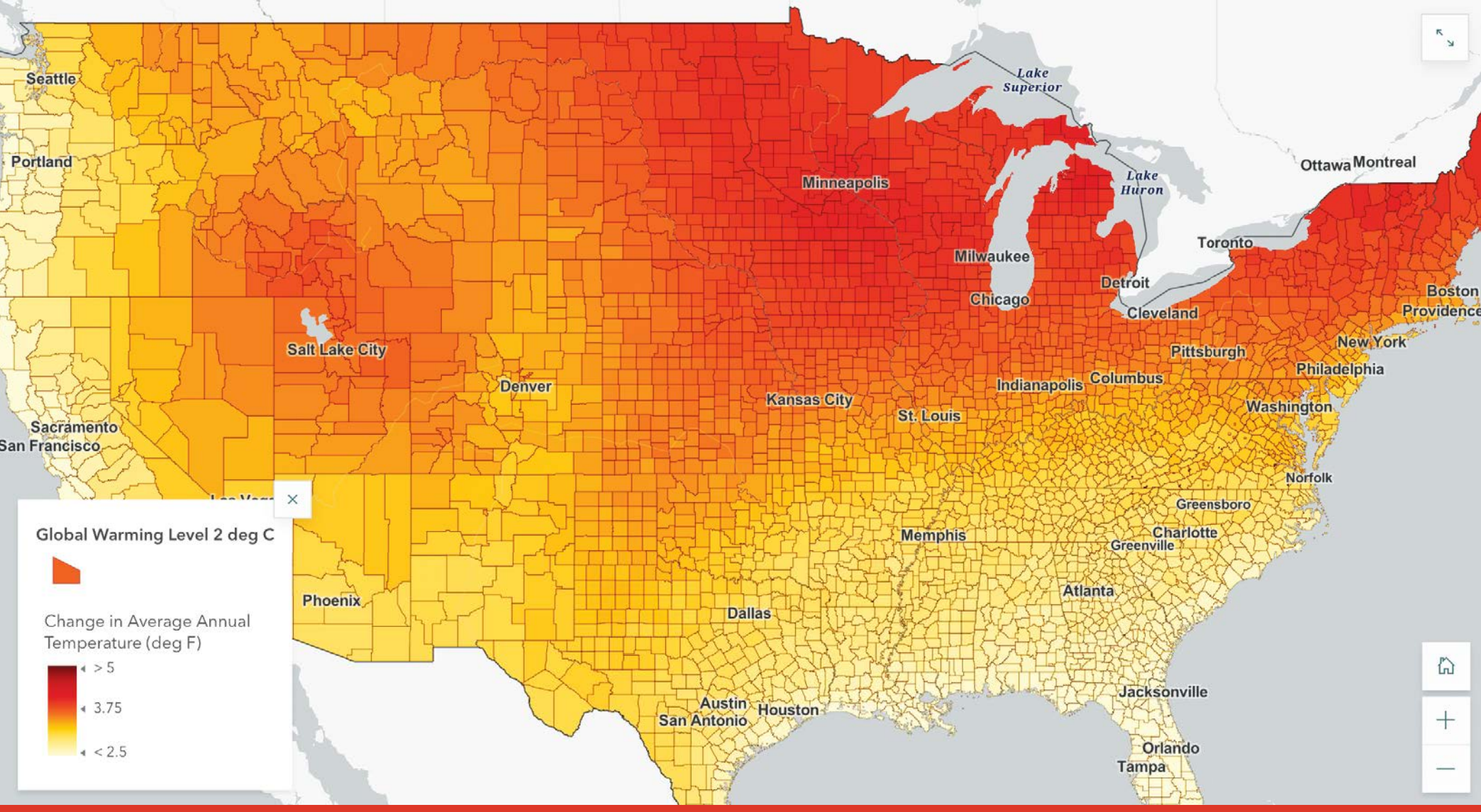
For the fifth annual iteration of this report (NCA5), more than 500 climate science experts from across the nation and thousands of additional stakeholders from state, local, and federal government organizations; nongovernmental organizations; and industry were engaged in the process. Unlike previous NCA reports, NCA5 is accompanied by the new NCA Interactive Atlas (atlas.globalchange.gov), powered by Esri technology. The atlas provides interactive, online access to the climate projections used in the report and helps users better understand the guidance and tools in NCA5. It uses hundreds of interesting and insightful maps that drive home climate change impacts with all the detailed information that is in NCA5. This is essentially the decision support needed for climate resilience planning across the country, even down to the scale of individual communities.

More good news is that the Bezos Earth Fund (bezosearthfund.org) has recently established the largest philanthropic commitment ever to fight climate change, by way of protecting nature. Esri has a new partnership with the fund that involves collaboration with Columbia University and the University of Albany to better understand how people are using AI to combat the climate crisis. This will result in a landscape assessment report to help inform and guide the fund as it provides philanthropic support to further innovation in the AI and climate space (links.esri.com/ai-fund-storymap).

These are just a few of the many climate projects and solutions that Esri is involved in with our users and partners. This is a time of "purposeful frenzy" at Esri, as climate change continues to be one of the critical challenges of our time, requiring immediate and effective action. I hope these developments will encourage and inspire you to participate in or spread the word about them whenever and wherever possible.

About the Author

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



↑ A map from the National Assessment Interactive Climate Atlas shows how average annual temperatures are projected to change compared to recent conditions, indicating that, overall, the United States is warming faster than the global average. Explore further at links.esri.com/climate-storymap.

ArcGIS Helps Implement European Union's Open Data Directive

The goal of the European Union (EU) Open Data Directive has been to put more public data—location based or otherwise—into the reach of those who can use it, especially datasets considered to be particularly beneficial to society. These include geospatial, meteorological, earth-observation, and environment datasets.

According to the European Commission's EUR-Lex website, the directive is based on the principle that public and publicly funded data should be reusable for commercial and noncommercial purposes. Potential socioeconomic benefits include more affordable public services, more sustainable public transportation, improved carbon-reduction efforts, and better ways of reacting to climate emergencies.

The directive is a legal framework for public data reuse and is part of the European Commission's larger data strategy. The regulation implementing this data strategy includes a list of high-value datasets to be shared under the directive by June 2024. In addition to being made available for free to anyone who wants them, high-value datasets must be presented in a machine-readable format via APIs and bulk downloads. ArcGIS products such as ArcGIS Hub, ArcGIS Online, and ArcGIS Enterprise help deliver this beneficial data for friendly reuse.

A Geographic Approach to Open Data

Ultimately, making open data available to leaders, decision-makers, knowledge workers, students, researchers, innovators, and the public means that more of Europe's brightest minds will be able to apply a geographic approach to problem-solving and developing innovations, including those related to AI. This includes location data, which helps reveal patterns and trends; model scenarios and solutions; and ultimately helps people make sound, strategic decisions as they address often complex issues.

> "Our portal is a kind of telephone book you can browse through, looking for the dataset you need."
>
> **Jelle Verburg**
> Former Product Owner of Dutch Government Data Register data.overheid.nl

"We want to make as much government data as possible findable and accessible, including clear information about the quality," Jelle Verburg, former product owner of data.overheid.nl, told Esri Netherlands in 2019. ArcGIS helped optimize the ability to find geospatial open data on the site, which is the data register of the Dutch government. "Our portal is a kind of telephone book you can browse through, looking for the dataset you need," Verburg said.

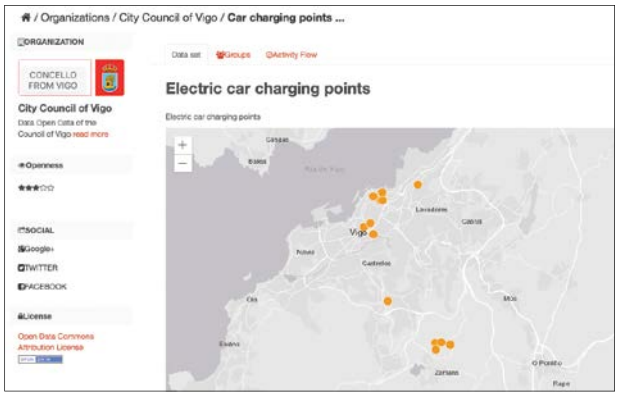
Many local and national EU governments already use ArcGIS to deliver open data, including the following:

- The Assen GeoHub, at opendata-assen.hub.arcgis.com in the Netherlands, supports the City of Assen's goals for transparent, reliable, and easily auditable government.
- In the Czech Republic, the City of Brno (see article on page 22) shares standards-based open data at datahub.brno.cz. In the city of Prague, leaders are using open data such as satellite earth observations to better understand relationships between human health and the built environment and help guide efforts to cool the city with green space.
- In Spain, the Vigo city council shares 2D and 3D open data in its Portal de Mapas at mapas.vigo.org for sustainability analyses such as the potential energy produced by solar panel arrays at specific locations.
- In Ireland, the national geospatial open data hub GeoHive at geohive.ie provides free, web-based access to up-to-date Irish spatial data to meet the needs of citizens, businesses, and government.

ArcGIS Supports Open Data

ArcGIS Hub, ArcGIS Online, and ArcGIS Enterprise are helping implement the Directive by helping users meet requirements such as open formats, enabling data reuse by electronic means, supporting online search and discovery, and making dynamic data available via an API and bulk download. International open standards and specifications, including GeoServices REST, Open Geospatial Consortium (OGC) API features, SpatioTemporal Asset Catalogs, and OGC GeoPackage, are supported.

Ensuring that demand for reusable open data can be met, ArcGIS Online supports scalable web services. End users can quickly put data layers to use or use them in applications created using low-code application builders.



↑ The data portal belonging to the City of Vigo in Spain shows EV charger locations and is among the open data made available to anyone under the Open Data Commons Attribution License. (Data source: City Council of Vigo.)

Metadata in ArcGIS follows international standards, including ISO standards and Infrastructure for Spatial Information in Europe (INSPIRE) Directive formats. The ArcGIS system helps ensure that spatial datasets are available according to findable, accessible, interoperable, and reusable (FAIR) data principles.

ArcGIS Online also includes the free ArcGIS Hub extension's open data capabilities. This allows ArcGIS Online users to provide open geospatial data; maps; apps; and nonspatial data such as documents, images, spreadsheets, tables, and PDFs to residents, students, journalists, business innovators, civic developers, and others. ArcGIS Hub also makes it easier for site visitors to find the data they're looking for by searching an online open data catalog. Hub automates many search engine optimization techniques and web content accessibility guidelines.

Automated catalog feeds use international open standards such as GeoRSS, OGC API - Records, and DCAT Application Profile for Data Portals in Europe (DCAT-AP) to allow sharing with open data portals such as data.europa.eu. Hub also supports multilingual capabilities with automatic translations and license generation for Creative Commons public domain dedication or other less restrictive standard public licenses.

Ensuring the Reuse of Open Data

By supporting the EU Open Data Directive, ArcGIS helps organizations make their data available for friendly reuse so that it can then be used to gain insights for decision-making or to develop innovations. As Esri co-founder and president Jack Dangermond said in a 2021 company statement commending the EU's efforts, the directive "empowers European users to find solutions and enact data-driven policy to address challenges, from local to global."

← The data portal belonging to the city of Vigo in Spain shows a 3D view of Vigo that illustrates the solar energy potential of various locations. (Data source: City Council of Vigo.)

EXECUTIVE MASTER OF GEOGRAPHIC INFORMATION SYSTEMS (EMGIS) AT REDLANDS

GIS AS A COMPETITIVE LEADERSHIP STRATEGY

This new STEM-designated program provides a blend of contemporary GIS knowledge and geospatial analytical skills that can empower professionals to take on leadership positions within IT/GIS/Analytics/Strategy functions within their organizations or find similar leadership opportunities in other organizations, sectors, or industries.

LEARNING OUTCOMES

Upon completion of the program, EMGIS graduates will be able to:

- Effectively address geospatial opportunities and challenges within and outside the organization by synthesizing GIS and geospatial analytics domain knowledge.
- Efficiently manage GIS projects in the organization by applying knowledge of the conceptual and technical components of contemporary GIS and its workflows along with management competencies.
- Develop an effective geospatial strategy by engaging relevant stakeholders to maximize the value of GIS across the organization.
- Make competent and ethical executive decisions using geospatial data and GIS technology to create sustainable value for the organization, society, and environment.
- Feedback on the effectiveness of these PLOs from the EAC were received and incorporated.

AT-A-GLANCE

9-12 months | STEM-designated | Online synchronous with two in-person course residencies

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DEPARTMENT OF GEOGRAPHIC INFORMATION SCIENCE

MASTER OF SCIENCE IN GIS (MS GIS)

Enabling professionals with enhanced skills of geo-analytics, problem solving, project management, and effective communication for solving real-world problems with GIS.
On campus | 10 or 21 months

MASTER OF GIS (MGIS)

Designed for professionals seeking to enhance their theoretical knowledge of GIS and skills of geo-analytics, project management, and effective communication using GIS.
On campus 8 months | Online 20 months

UNIVERSITY OF Redlands

redlands.edu/emgis

#3 MOST INNOVATIVE UNIVERSITY IN THE WEST

U.S. News and World Report 2024

Located in Redlands, California—close neighbors and partners with geospatial leader, Esri—we offer academic programs that enable access to Esri technology, training, people, events, and internships, including classes taught by Esri employees.

RELENTLESSLY REDLANDS

"The target audience for the Executive Master of Geographic Information Systems (EMGIS) includes but is not limited to mid- to senior-level managers and executives who aspire to lead organizations and units that use GIS in government, the private sector, and not-for-profit sector. Managers and executives will have a solid grasp of the technical, methodological, as well as strategic, management, and leadership aspects of GIS."

—Thomas Horan
Dean, School of Business & Society

Infotech's Appia Combines Construction Contract Data with ArcGIS

Thousands of projects across the United States have been funded through the Infrastructure Investment and Jobs Act (IIJA) since it was signed into law in 2021. These projects include replacing the Baltimore & Potomac Tunnel in Maryland, retrofitting the Golden Gate Bridge in California, and constructing a multimodal transportation center in Lincoln, Nebraska.

As part of the bidding process for IIJA projects, state and local government agencies are tasked with incorporating construction contract activities into their maps and dashboards, such as bid item data and funding.

However, construction contract data cannot be directly processed with ArcGIS products. Esri partner Infotech (infotechinc.com) offers an integrated solution with its Appia software, which integrates ArcGIS Online and ArcGIS Enterprise functionality for construction contract and compliance management. The company works with state, local, and private entities to streamline construction project processes including funding management, secure online bidding, and inspection solutions.

"The IIJA is a once-in-a-generation funding for infrastructure with a specific call for advanced digital construction management systems," said Infotech chief revenue officer Chad Schafer. "This will allow the industry to progress towards a complete digital project delivery methodology to further automate manual processes. In addition, it will facilitate both collaboration and data workflows across an agency's different business sectors."

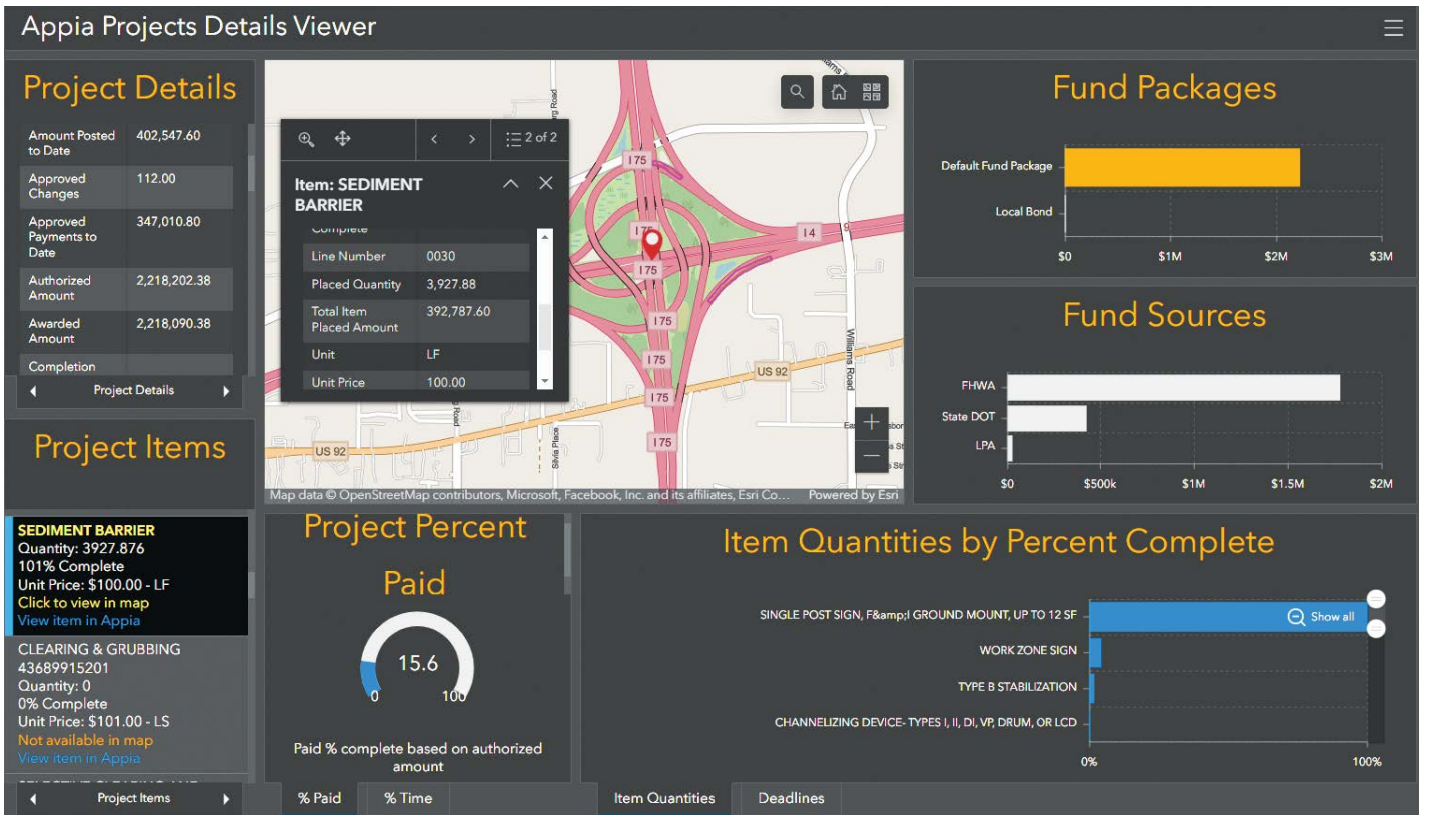
After a connection has been established between Appia and a user's ArcGIS account, a feature service is created with the Appia project data that can then be visualized with Esri tools and shared internally or externally with the public.

"We wanted to seamlessly incorporate construction contract data into a GIS to add georeferencing and visualization capabilities, such as maps and dashboards, into the workflow for the Appia service," said Schafer. He added, "It's important to allow easy access to that enhanced data throughout the entire organization. The exchange of data across the different business areas is essential to support digital project delivery and provide the level of transparency and accountability required for IIJA contracts."

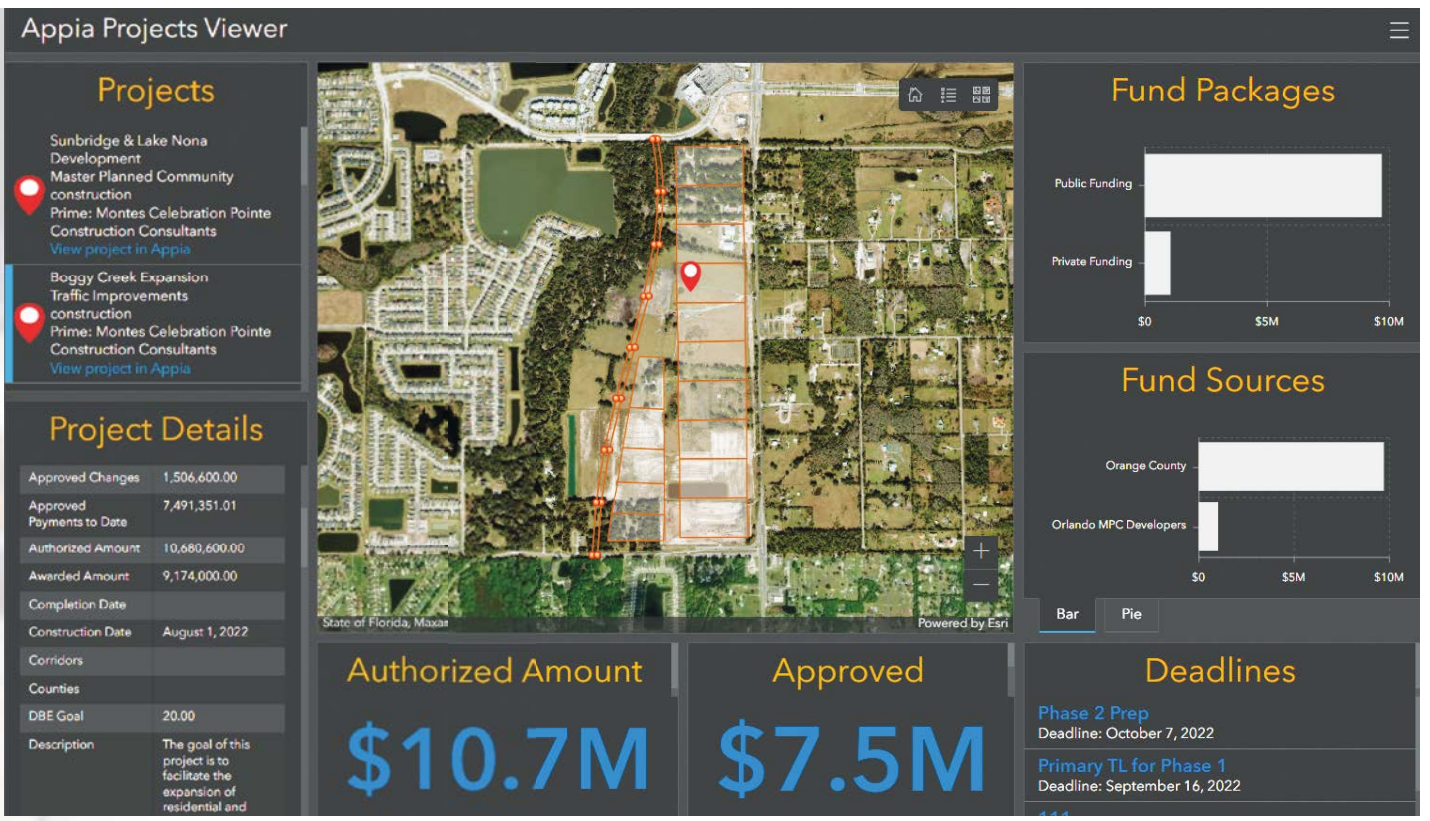
The integration allows the Appia service to use ArcGIS functionality such as analytics, dashboard displays, and mapping services. The enhanced workflow provides construction progress data that can be georeferenced. Capabilities include visualizing where funding is allocated and the amount of remaining funds, in an easy-to-understand and shareable manner that addresses various IIJA requirements. The Appia data integration with ArcGIS presents Appia's near real-time construction data in a dashboard created with ArcGIS Dashboards, showing project details in a state or specified municipality.

Infotech also launched an integrated workflow with ArcGIS Field Maps in 2023 by connecting Appia to Field Maps using Seiler Geospatial's GeoBridge solution. This integration enhances field inspection processes and ties the item/asset data to geolocation for better digital project delivery.

"Combining Infotech developed systems' data with the analytical and visualization capabilities of ArcGIS provides our clients with new levels of near real-time data analytics," Schafer said. "It also allows unique insights into the way infrastructure funds are being distributed and managed across the many projects that are underway throughout the United States."



↑ The Appia and ArcGIS integration synchronizes project data and location information to ArcGIS Dashboards for visibility into project status and health.



↑ When integrated with ArcGIS, Appia daily work reports show GIS-enabled details and locations on public or private dashboards.

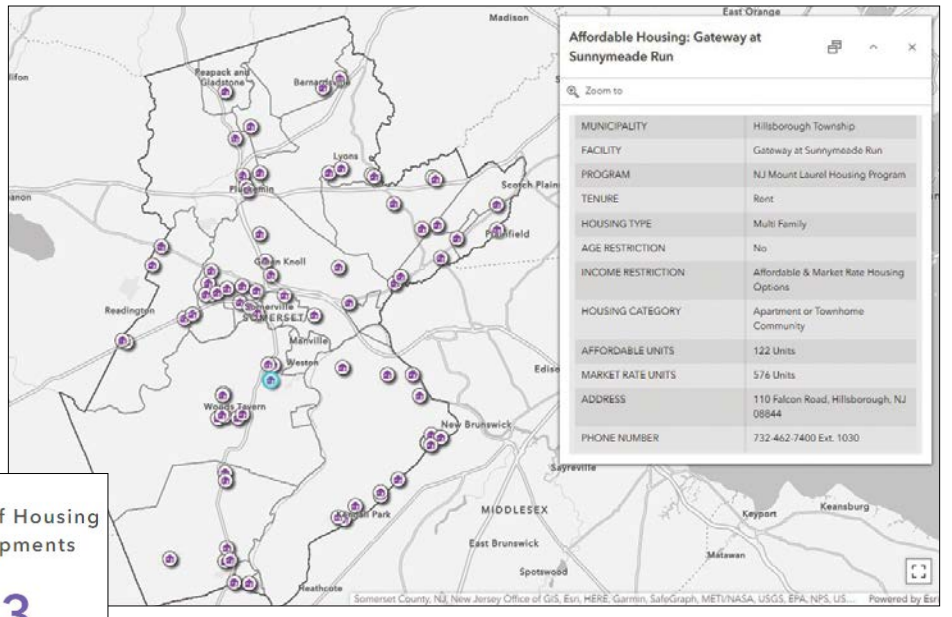
ArcGIS Experience Builder Helps New Jersey County Explore Affordable Housing

Affordable housing is a pressing issue across the United States. According to the US House of Representatives' Committee on Financial Services, there's a nationwide shortage of nearly 14 million rental housing units for rent and purchase. Housing costs in New Jersey are among the country's highest, which particularly affects low-income households. However, various federal laws require local governments to provide opportunities for affordable housing.

Located between New York City and Philadelphia, New Jersey's Somerset County has around 350,000 residents, according to the 2020 US census. Somerset County was New Jersey's second-most affluent county in 2022, based on median household income reported by the census, with high housing costs to match. The January 2024 median home value was nearly $570,000, according to Realtor.com, with home values and rental costs that had jumped during the COVID-19 pandemic.

The county's Office of Planning, Policy, and Economic Development provides guidance to officials related to housing and demographics, including affordable housing. The office collaborates closely with the county's 21 municipalities to ensure that affordable housing options are available for residents, including seniors, and it has a comprehensive list of affordable and senior housing developments. However, until recently this data was not available in an easy-to-use, user-friendly format, and it was largely underutilized.

To raise awareness about the county's housing options, the Somerset County Office of GIS Services developed and deployed the Somerset County Housing Navigator website (links.esri.com/schn) using ArcGIS Experience Builder, a configurable solution for building web applications that is included in ArcGIS Online and ArcGIS Enterprise. This interactive and mobile-friendly site offers details on available housing options and allows users to perform searches and filter them based on preferences and needs. The website has gained popularity among residents and enhanced the county's capacity to provide essential data to people who are seeking a home.



↑ An interactive affordable housing map provides filtering options and property details.

Number of Housing Developments

83

Improving Data Availability

Previously, the county's housing data for affordable and senior housing was presented to the public in static PDF maps and extensive spreadsheets. These formats had three limitations. First, they were not interactive. Users could not actively engage with the data, such as clicking on a property for more information. Second, the PDFs' static nature and the spreadsheets' length made it hard for users to navigate and access the information efficiently. Third, the data was not optimized for mobile devices, limiting its accessibility.

"Our main priority is to ensure that our residents can easily access and benefit from this valuable information," said Somerset County Office of GIS Services manager Aarthy Sabesan. "Our residents are notably tech savvy, and we wanted to create a product that meets their evolving needs."

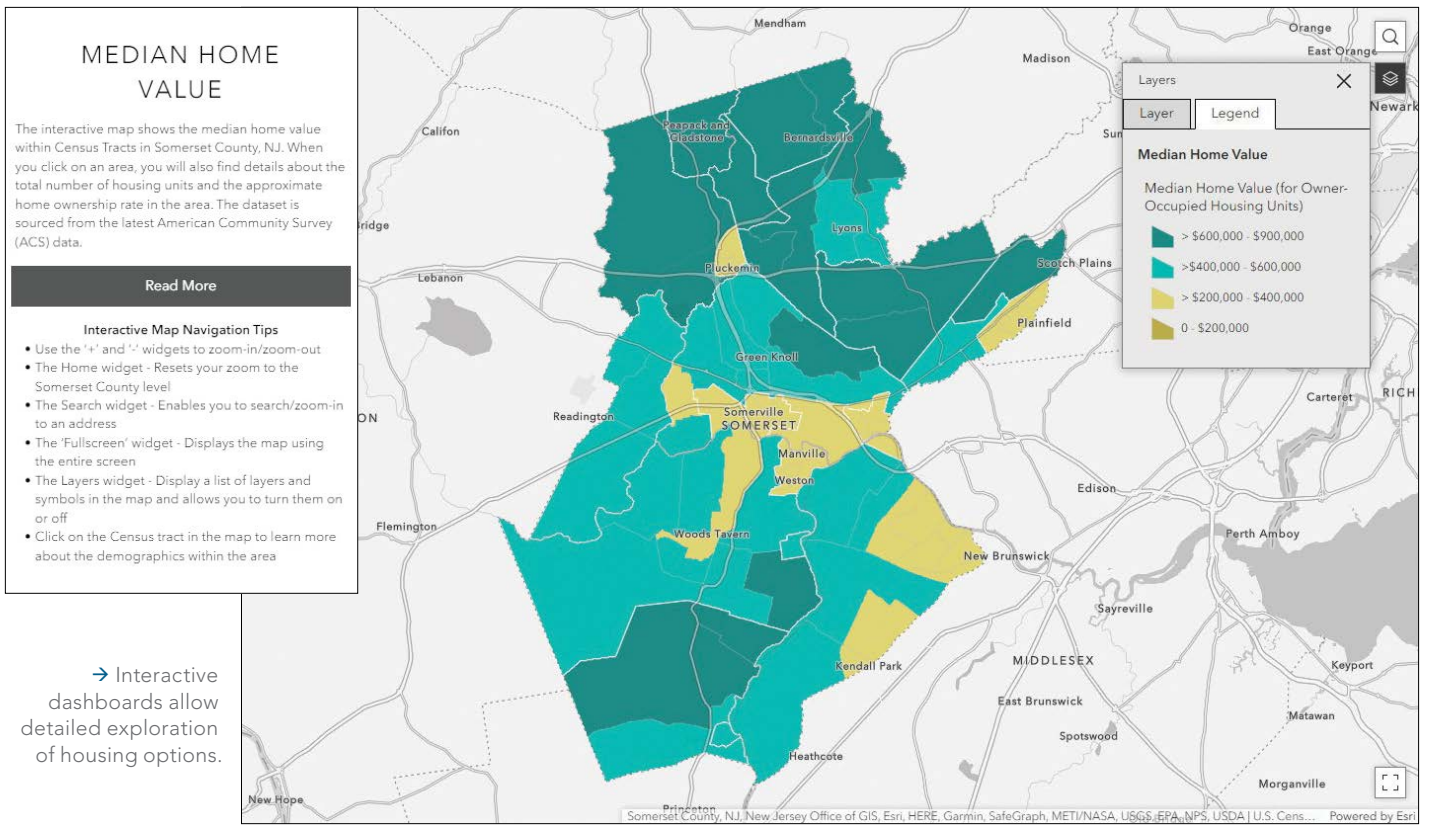
Sabesan and her team focused on crafting an engaging user experience (UX), including a mobile-friendly design. The goal was a design that would let users find information or complete a task in about three clicks. Using housing datasets that were updated in advance, developing the website took just five weeks.

"I was able to conceptualize and launch the application in about half the time I initially expected," said Sabesan. "The design flexibility played a significant role in that."

The new site features a comprehensive community profile with key demographic information such as age, education, employment, income, and housing. It also offers color-coded interactive maps showing median home values and a map with average rental prices. This information empowers users to make housing choices that align with their preferences and financial considerations.

The site's housing data section has three categories: affordable housing, senior housing, and market-rate rentals. The web pages for affordable and senior housing are integrated with interactive dashboards, enabling detailed exploration of housing options. The interactive housing maps provide an overview of available housing options, including property details and contact information. Users can filter the data according to their preferences, and the results can also be exported and printed. The sections also feature a consolidated list of housing assistance agencies and their contact information.

If users are unable to find the information they need, they can complete a form that is sent to the GIS team for routing to the appropriate housing agency. The form was built using ArcGIS Survey123, which is included in ArcGIS Online and ArcGIS Enterprise.



→ Interactive dashboards allow detailed exploration of housing options.

A Successful Launch

After going live in March 2023, the Somerset County Housing Navigator website now averages about 200 views per week. The GIS team plans to update the data every six months to ensure accuracy. This was the first site launch from the GIS team, and Sabesan said they met their goal of creating a site that's usercentric, interactive, and meaningful. "This eases the stress of finding a suitable, safe place to live," said Sabesan.

Sabesan said Experience Builder is a user-friendly and straightforward solution that allowed her team to create a simple and intuitive interface. "It gives us the freedom to make decisions as to how we want the information and the data to flow. That ability is crucial," said Sabesan. "You don't have to be an experienced UX designer or software engineer to create informative and visually stunning products." She added, "It doesn't just look like a GIS application. It looks like a website with GIS capabilities."

Feedback from management and others at Somerset County has been positive, Sabesan said. GIS team members are using Experience Builder to build other applications, and there have even been requests for nonspatial apps from other county departments.

According to Sabesan, "Experience Builder proved to be a versatile and highly adaptable product. With it, we crafted an intuitive and visually appealing website, ultimately delivering an outstanding digital experience for our residents."

Esri Partners Innovate for Utilities, City Development, and More

Revolutionizing Utility Management in Texas with ArcGIS Utility Network

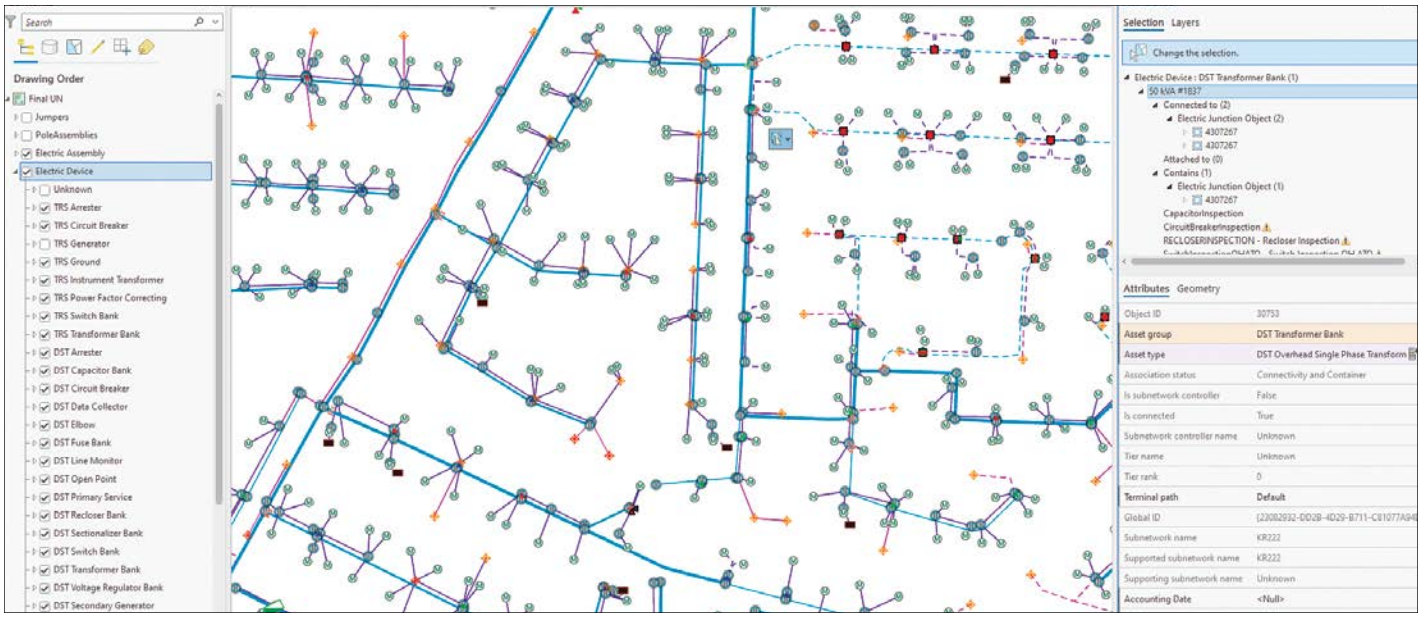
Denton Municipal Electric (DME), a community-owned utility based in the northern Texas city of Denton, needed to upgrade its electric system management. The existing software, pivotal to DME's operations, was approaching the end of its support life cycle, adding risk to operational stability. The challenge was not only in complexity but also in the critical nature of the systems involved. Recognizing the need for a more advanced and efficient system, DME turned to Esri partner **POWER Engineers** (powereng.com) for its expertise in utility network migrations and client-centric solutions.

DME and POWER Engineers began a transformative journey, leveraging ArcGIS Pro and ArcGIS Enterprise. They also shifted from an ArcMap geometric network to ArcGIS Utility Network, integrating the ArcGIS Utility Network Management extension and ArcFM Solution.

It was not just a technological shift but a pivot toward improved operational efficiency. DME's distribution data and system infrastructure were transformed, showing substation and transmission systems in Utility Network capability-based GIS for a comprehensive network model.

The result was a more intricate, interconnected, and intelligent utility network, enabling DME to model and manage its network with greater precision and leading to improved reliability and customer service. The Utility Network migration enabled DME to use advanced network analytics and provide detailed asset information to its advanced distribution management system, enhancing situational awareness and operational efficiency. It also reduced errors and the number of revisions while cutting costs and improving service, including shortening service-restoration times. These data quality and system standardization enhancements have streamlined operations, cut down on design and engineering time, and elevated productivity.

This network upgrade's success highlights solutions that accomplish utilities' goals of improving service delivery and customer engagement. The Utility Network migration has equipped DME for refined network analytics and detailed asset management and laid the groundwork for making informed, data-driven decisions, exemplifying the transformative impact of GIS technology in modern utility management.



→ An ArcGIS Pro screenshot shows electric devices (distribution transformers, fuses, and switch banks) and attributes.

Keeping Pace with Community Growth Using Esri and Trimble Cityworks

Rexburg is a bustling college town in eastern Idaho that has undergone considerable growth and expansion in recent years. The city uses ArcGIS Pro, ArcGIS Server, and ArcGIS Field Maps (for asset management activities), as well as Cityworks' Permitting, Licensing, and Land (PLL) solution from Esri partner **Trimble** (trimble.com) to keep up with the rising number of customer requests associated with the growth of the community.

In Trimble Cityworks, built on ArcGIS Pro and ArcGIS Server, GIS serves as a foundation that supports every step of the permitting, application, and inspection process for any construction or renovation project. ArcGIS is a critical component of Rexburg's community management operations. Together, Esri technology and the Trimble solution give Rexburg the ability to easily track and complete permitting, application, inspection, and asset management activities using location-based data.

"One of the neat things we can do with GIS is use the Search Cases feature when viewing Trimble Cityworks maps," said Faron Young, asset management system administrator for Rexburg's public works department. "This allows us to pull up the historical data of everything that has been done in a specified area."

With more than nine years of Cityworks PLL and GIS data under its belt, Rexburg is able to pull from an expansive repository of historical information to reference and gain a full scope on community projects, making permitting, reporting, and infrastructure management more efficient.

Rexburg is leveraging the Cityworks PLL solution to track and complete 38 types of permits, applications, and inspections—rezoning, city annexations, new construction, street excavation, hydrant use, and more. In tandem with ArcGIS Pro and ArcGIS Server, PLL greatly simplifies workflows and allows the city to organize and track work activities in one digital location.

"Going forward, everything will be searchable and digital," observed Bret Stoddard, building official for the City of Rexburg. "When people submit applications or plan reviews, it will never be on paper." The earlier permitting agencies go digital, he said, "the easier it is to populate historical data and keep track of future data."

↑ An inspector for the City of Rexburg inspects a new residential development using a mobile device with a digital solution powered by ArcGIS Pro, ArcGIS Server, and Trimble Cityworks.

← Interactive dashboards in Trimble Cityworks provide a map-based view of permitting and inspection activities.

Modernizing Water Utility Data Collection Workflows with ArcGIS Online

Hampton Shale Water Authority (HSWA) is a small water authority in western Pennsylvania that services eight municipalities and distributes more than five million gallons of water per day to about 29,000 customers.

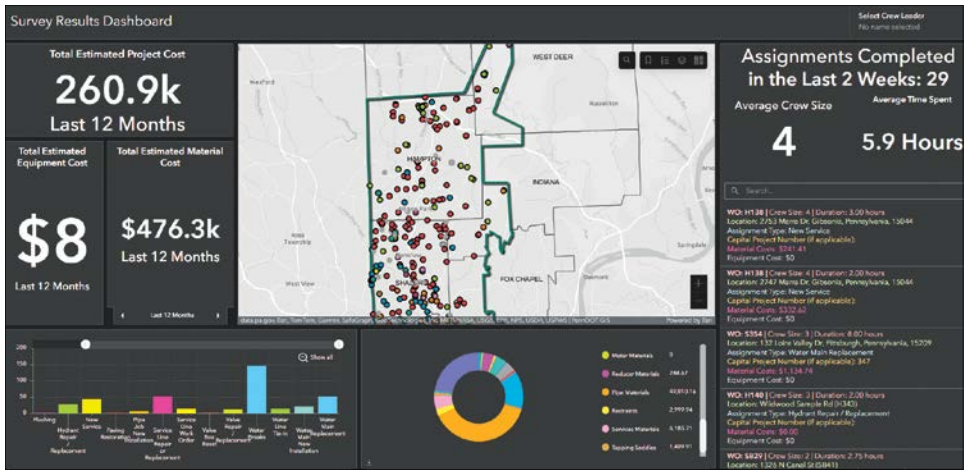
In early 2022, HSWA decided to better leverage its investment in GIS and streamline its workflow processes to reduce the time spent on outdated, paper-based forms and maps. HSWA identified several needs—improving GIS inventory, including hydrants, valves, and mains; tracking, analyzing, and reporting on water-related work assignments; and streamlining the organization's reporting and data analysis processes. However, there were limited funds and staff resources to identify, implement, and maintain the processes and associated tools to meet HSWA's goals.

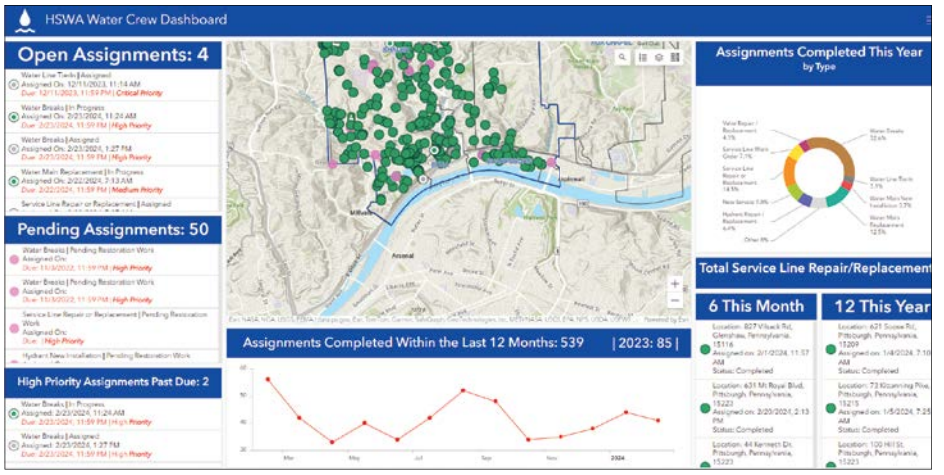
HSWA turned to Esri partner **EBA Engineering** (ebaengineering.com), a provider of engineering and management services. EBA studied how HSWA was already using GIS and then implemented several web applications in HSWA's ArcGIS Online environment. This enabled HSWA to collect field data while modifying and updating its existing apps.

EBA identified data-collection processes that could be automated, such as populating fields from an inspection or sending email notifications, using ArcGIS Arcade or Python scripts. This functionality was built into HSWA's ArcGIS Field Maps set of data collection maps. Automatically populating fields has saved time for mobile crews and saved time and money by reducing the likelihood of user input errors.

Configuring ArcGIS Workforce to capture work orders, EBA modernized the task assignment process. With ArcGIS Survey123 linked to Workforce, mobile crews can accurately account for the materials and equipment used on each job, and the survey automatically calculates the associated costs. EBA also created dashboards for visualizing collected data for hydrant and valve inspections, flushing activities, Workforce activities, and Survey123 results.

These solutions give management and other office staff easy access to the total project costs associated with each job. Combined with the ability to track work history at a location or asset over time, staff can now make better decisions about repairing or replacing assets. HSWA has better technology to collect information on assets, better apps and processes to collect the data, and clear and concise information dashboards, giving stakeholders a much clearer picture of the assets they manage, and the time and money associated with managing them.





↓→ Dashboards show ArcGIS Survey123 results for Workforce assignments, tracking material costs (left) and assignment types (right).

Getting Lead Out of Drinking Water with Predictive Modeling and GIS

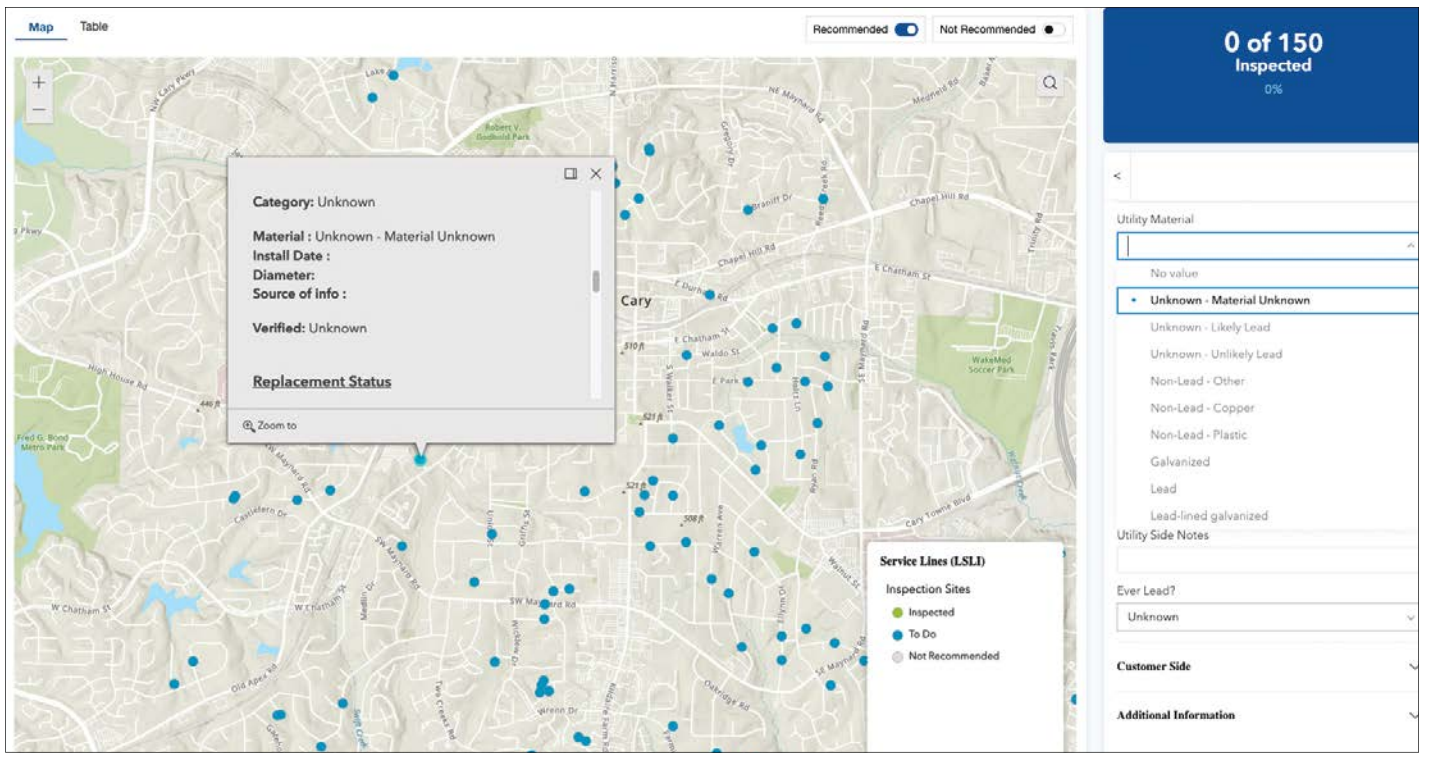
Lead pipes present a critical public health issue, according to the US Environmental Protection Agency (EPA), with lead in drinking water linked to kidney issues, reproductive problems, and more. This is why the Cary Utilities Department, serving Cary and Morrisville, North Carolina, is actively mapping its service lines. Despite these being "low-lead" communities, the department is determined to track down and eliminate all lead service lines in the system for public safety and compliance with the EPA's Lead and Copper Rule deadline in October 2024.

The department's challenge was tracking down a small number of lead service lines in a vast system. In 2023, Cary turned to Esri partner **BlueConduit** (blueconduit.com) for its expertise. Based in Ann Arbor, Michigan, BlueConduit has developed a cutting-edge, predictive machine learning approach to locate lead service lines. BlueConduit serves more than 275 communities in the United States and Canada, and has analyzed more than 4.2 million service lines to date.

BlueConduit's predictive analytics is delivered via Esri's Lead Service Line Inventory solution on ArcGIS Enterprise. This solution helps inventory lead service lines, validate service line materials in the field, monitor replacement activities and regulatory compliance, and share information with the public. BlueConduit then adds predictive modeling capabilities and dashboards, combining local GIS data with machine learning analytics. This integration streamlines inventory creation and management, guides visual inspections, adds predictive data, accelerates lead line replacement, and improves staff efficiency.

The Cary Utilities Department is currently conducting visual inspections to determine service line materials. The information will feed into BlueConduit's platform, providing predictions via ArcGIS Online. Updates are made as new data enriches the predictive model.

Dylan Winger, Cary's utilities engineering GIS coordinator, said, "We're dedicated to using the best tools available to achieve our goals." Speaking of BlueConduit's predictions platform, Winger said, "I'm really excited to see it in production and can't wait to see how it dynamically updates."



← As the Cary Utilities Department performs inspections using ArcGIS Online to build a predictive model, it also updates its service line materials in ArcGIS Online, giving Cary and BlueConduit a single, shared source for lead pipe inventory data.

Esri partners represent the rich ecosystem of organizations around the world that work together to amplify The Science of Where by extending the ArcGIS system and implementing it in distinct ways to solve specific problems. Find partners that meet your needs at **esri.com/partners**.

Esri Startup Graduate Agere Integrity Helps Company Manage Pipeline Data

For organizations such as Diversified Energy Company (DEC, div.energy), a gas and oil production company operating in the eastern-central United States, mapping and managing underground energy pipelines are crucial to ensure efficiency and safety.

The manual methods previously used by DEC's pipeline integrity group were often imprecise, which led to inaccuracies and delays in maintenance and repair. Since 2018, DEC staff have used ArcGIS products such as ArcGIS Enterprise, ArcGIS Online, and ArcGIS Field Maps to manage the company's growing gas and oil pipeline dataset, including analysis to ensure system integrity and effectively run operations.

In 2021, DEC staff realized they needed to improve their system even more. They wanted a solution that could support analysis for determining pipeline locations and "classes" (official classifications based on characteristics such as pipe diameter and pressure ratings, local population density, and environmental sensitivity). Having this information would enable DEC staff to more quickly run new pipelines and perform system-wide analysis.

The solution needed to run on the latest ArcGIS products, support analysis of pipelines ranging from production sites to collection points to destinations such as refineries and processing centers, and be flexible enough to perform analysis on datasets undergoing data review and cleanup. In 2021, DEC turned to Agere Integrity.

> "Agere Integrity's solution has given us the ability to quickly navigate through our piping system during state audits."
>
> **Jason Stanley**
> DEC Lead GIS Analyst

Managing Operations with Cutting-Edge Technology

Based in Atlanta, Georgia, Esri Startup Program graduate Agere Integrity (agereintegrity.com) was founded in 2020 to provide companies like DEC with the tools to manage operations safely, reliably, and efficiently, using the latest technology. Agere provides Esri-based applications to perform and manage pipeline system analysis as part of an enterprise solution, allowing for continued improvement of data over time.

With Agere's help, DEC launched an application that supports all requirements of the Pipeline and Hazardous Materials Safety Administration, a US Department of Transportation agency that develops and enforces regulations for transporting energy and other hazardous materials. Agere's solution worked with the existing components of DEC's ArcGIS Enterprise solution and included an ArcGIS Pro add-in. This add-in provided basic interfaces to create and manage various pipeline class analysis projects. An Agere high consequence area server was added to analyze various pipeline characteristics.

The new system allows DEC to efficiently run thousands of routes quickly and accurately through algorithms for different pipeline types, storing results using the ArcGIS Pipeline Referencing extension.

Now DEC staff can identify data gaps and errors that need to be addressed, including GIS-based issues such as overlapping pipelines and missing critical attributes. DEC staff can also incorporate new dwellings and structures (captured with ArcGIS Field Maps) or newly acquired assets. This helps staff understand the full scope of DEC operations and target focus areas. Up-to-date results are shown on ArcGIS Dashboards.

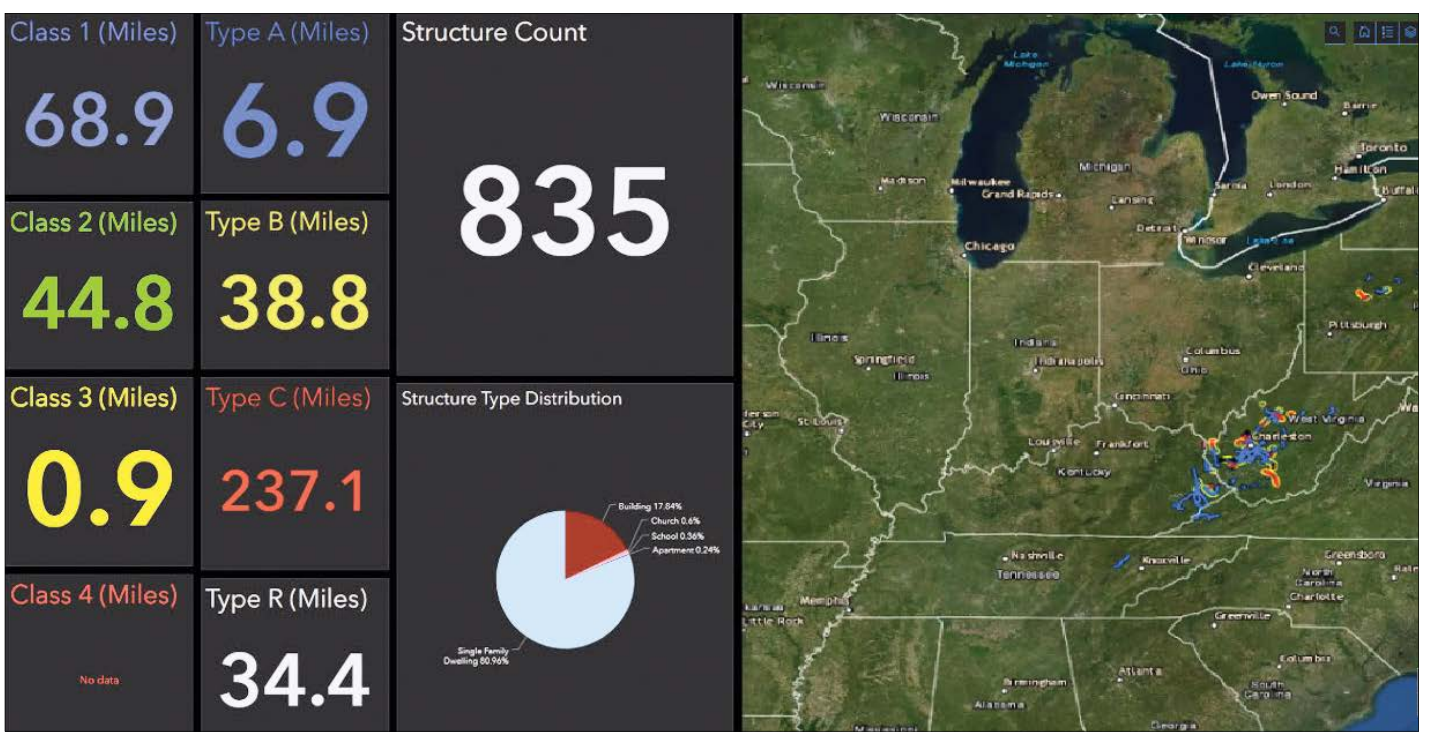
By partnering with Agere, DEC has been able to perform and manage class location and consequence analysis of its entire piping system across nine states and over different pipeline types and classes, according to DEC lead GIS analyst Jason Stanley.

The Agere solution has assisted DEC staff with about 20 asset acquisitions by enabling analysis that helps quickly identify key focus areas such as gathering lines, which are pipelines that are used to move natural gas from wells and production facilities to transmission pipelines, which then transport the gas to downstream distribution systems. Since the results are archived after each run, DEC staff can review the changes in an area over time, allowing trend evaluation for high-growth areas to prepare for future reclassifications.

"Agere Integrity's solution has given us the ability to quickly navigate through our piping system during state audits," Stanley said. "It has also given us a data repository that can be used for operations to make real-time decisions during abnormal operations. We use it during acquisitions to give us a quick and easy way to see the regulatory impact to the company."

Deploying the Agere solution in conjunction with ArcGIS allowed DEC to have a central data repository where everyone in the organization can view the latest results. DEC staff now have a central and up-to-date dataset that can be demonstrated to auditors when requested.

↑ DEC compares pipeline runs over time to see differences in classification results, such as the pipeline color change from green (left) to blue (right).



↑ The extent and location of DEC's various pipeline types are shown on ArcGIS Dashboards.

America's Commerce Corps: Using Esri Technology to Strengthen Communities

In an era marked by rapidly evolving technology and shifting consumer preferences, promoting local businesses and fostering pride in our communities is more important than ever. The Esri-powered America's Commerce Corps (ACC) program has embarked on a mission to revitalize local commerce by connecting consumers with local businesses, including mobile businesses such as food trucks. According to Tim Palmer, ACC program ambassador, ACC's flagship application, Community Connection, or ComCon (ComCon.mobi), is changing the way communities engage with businesses in their vicinity.

"Imagine you're flying in to a city for the first time and want to immerse yourself in the local scene and can immediately access truly local businesses and events," Palmer said. "ComCon can help make that happen."

Empowering Local Economies

The ACC program, founded on the belief that the heart of any community is its local businesses, helps boost local economies by promoting and supporting local businesses. To support this mission, Esri's ArcGIS Experience Builder was used to create a dynamic platform that connects consumers with a variety of local businesses, from brick-and-mortar establishments to mobile businesses.

ComCon users can search for members (classified as Eats, Libations, Lodging, Salons, Services, and Shops) and partners (classified as Biz Champions, Bizs on the GO!, Happenings, and Community Banks) using the dynamic map or more traditional information profiles. The only requirement for a local business to be on ComCon is that it must be a member of a local chamber of commerce, Main Street America Program, or another local business association.

Founded in 2014 and reimagined during the COVID-19 pandemic in early 2020, the ACC program started with web-based mapping applications that showed active members of these organizations and details such as if they were open, had restricted hours, or offered curbside pickup only. As local business organizations soon saw the power of mapping applications, they saw the value of consumers easily accessing local information about businesses and events via a QR Code.

One such local business association was the Bel Air Downtown Alliance, an accredited Main Street America organization in Bel Air, Maryland, led by executive director Jenny Erhard.

"I wanted a way to promote our downtown businesses by informing and attracting consumers through a digital, mobile marketing tool," Erhard said. "Traditionally, we've used brochures and stationary map kiosks to show visitors the businesses in downtown Bel Air." With ComCon, she said, "visitors scan the provided QR Code with their phone and are taken directly to our downtown map."

ComCon is an immersive, interactive application that seamlessly connects consumers with local businesses and provides a one-stop shop for residents and visitors to discover, interact with, and support them. Esri technologies helped in the following ways:

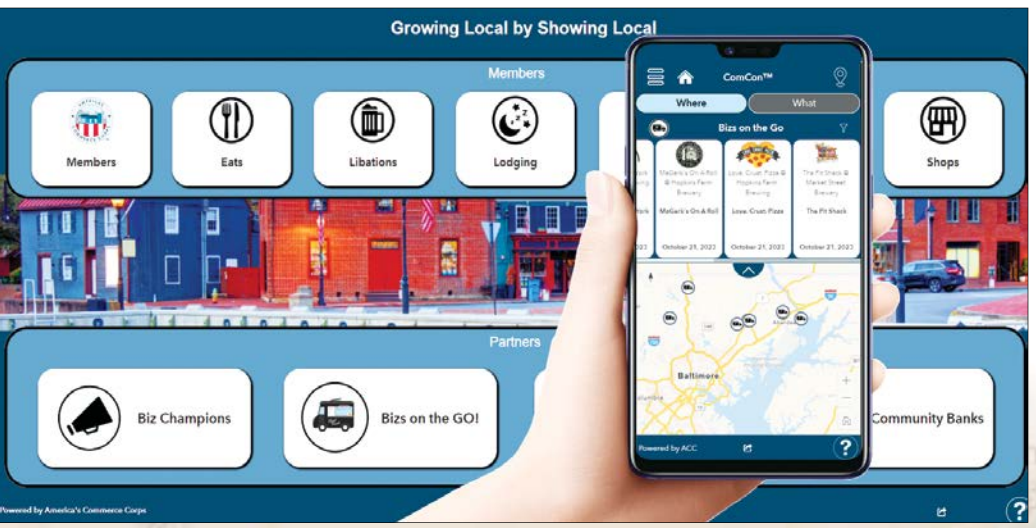
- Dynamic mapping: The robust mapping capabilities in Experience Builder provide a visual interface for ComCon users to explore businesses in their area. Consumers can search for businesses, view locations on an interactive map, and get social media information.
- Business profiles: Each business featured on ComCon has a dedicated "card" with essential information such as contact details and products or services offered.

For more information on ACC, contact Tim Palmer at tpalmer@americascommercecorps.org.

See an ArcGIS StoryMaps story on ACC at links.esri.com/acc-story.

- Event happenings: ComCon also showcases local events and activities, making it a comprehensive resource for community engagement. Users can find information about local fairs, markets, and food truck festivals happening nearby.
- Mobile businesses spotlight: One of the standout features of ComCon is a focus on mobile businesses. These businesses often face unique challenges such as varying locations and schedules. ComCon helps mobile business owners share their location with users and provides updates on current offerings.
- Marketing and promotions: ComCon provides local business associations with a way to promote members and events.
- Community engagement: ComCon strengthens community bonds by facilitating interaction between local businesses and residents.

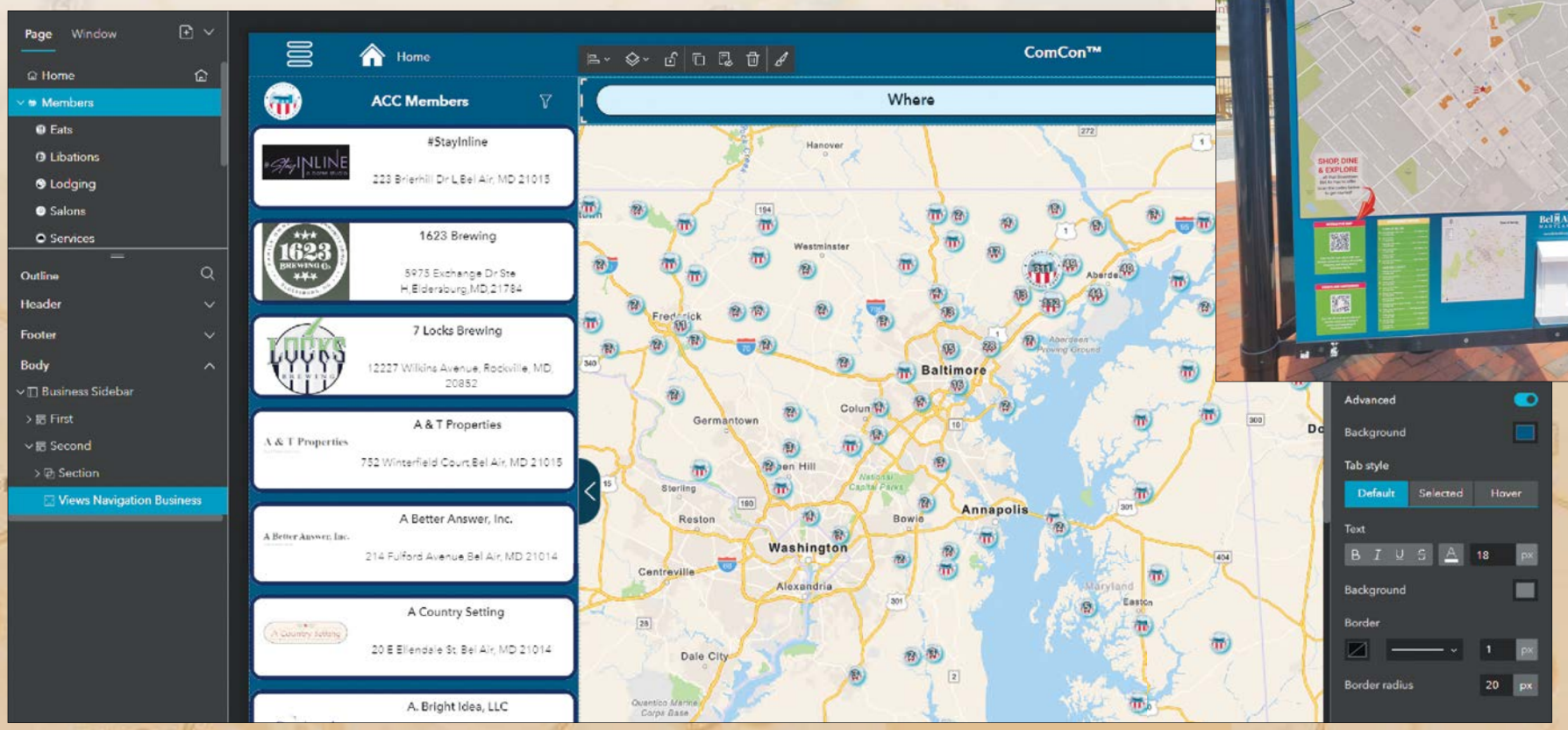
According to Palmer, "These key elements were all made possible because of Experience Builder. Building a compelling web application without writing code was not only made possible, but it allowed for a robust web experience that helped fuel ACC's mission without having to hire developers."



← The ability to easily customize ComCon desktop and mobile versions was critical to help get information out to consumers regardless of device platform.

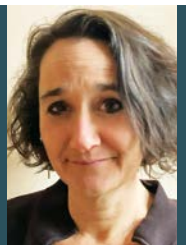
→ QR Codes are now used on downtown map kiosks, saving time and money on updating paper maps with new business and event information.

↓ ArcGIS Experience Builder has no-code/low-code capabilities that allow for quick implementation.



From the Meridian

By Dr. Rebecca Lave
President, American Association of Geographers



Reciprocal Scholarship Is Better Science

I'm a firm believer in science in the service of the public. Our work as geographers and GIScientists should make the world a better place. And yet the way I and many others were trained assumed that it was the *results* of our work that mattered, not the *process* by which we gathered our data in the first place.

The common practice (often described as helicopter or parachute science) has been to arrive at a field site, extract needed data, and leave without building reciprocal relationships to the communities and landscapes being studied. Researchers benefit via publications and grants but have not been expected to give anything back in return. And because scientists centered their work on Western knowledge and training rather than on thinking collaboratively with local and Indigenous knowledge holders, their results were less robust than they could have been.

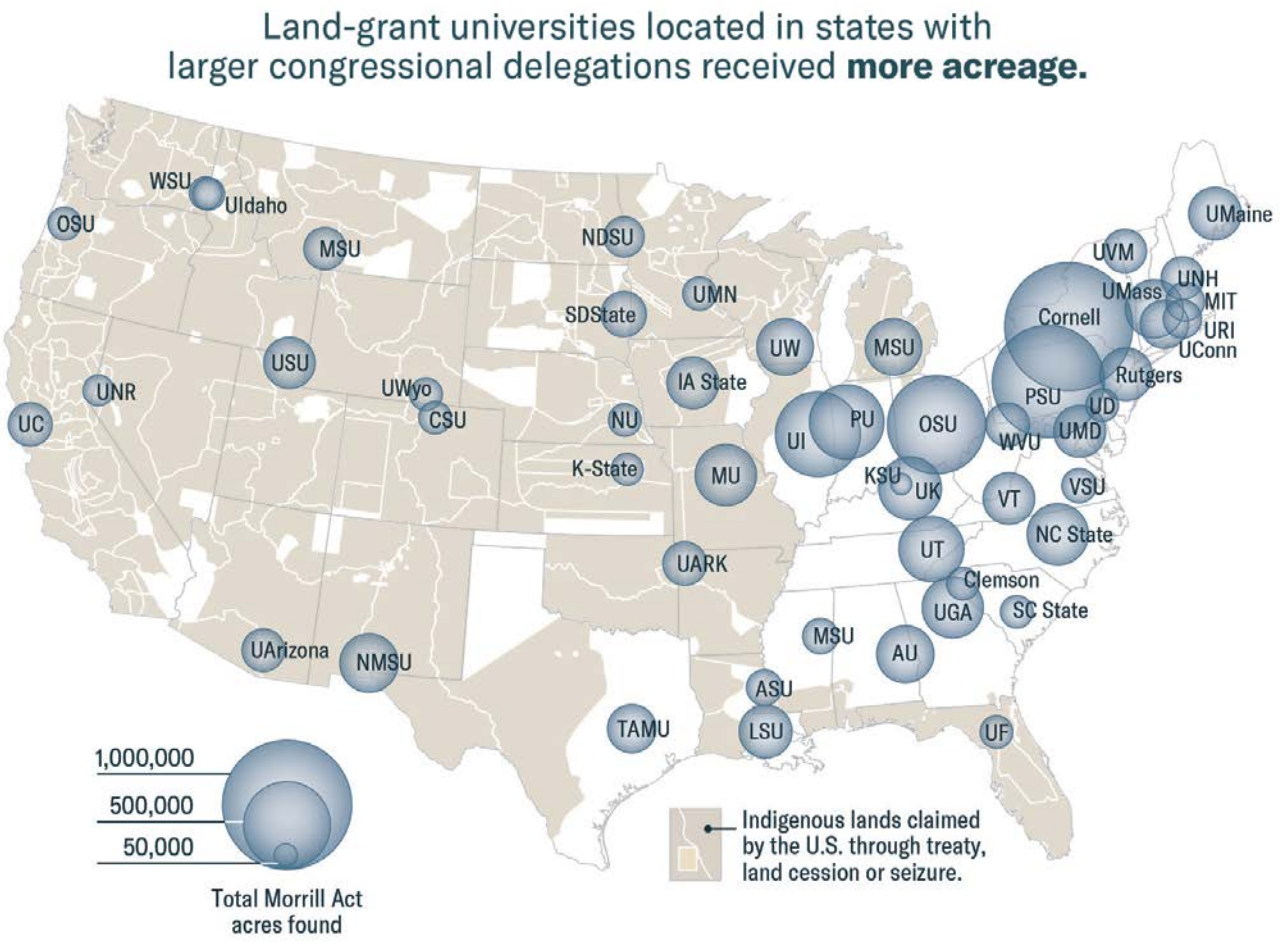
Happily, the tide is starting to turn. Geographers and GIScientists are embracing a range of approaches that engage more reciprocally with the communities we study by working together to develop questions, conduct research, and analyze results; protecting communities' right to control what happens to data produced about them; and even honoring their right to refuse that they or their biophysical environment be studied at all.

These practices go by many names, such as participatory action research, public science, co-production, participatory GIS, and data sovereignty. Some are relatively new; others have long histories. They extend across geographic fields, from geomorphology to GIS and from climatology to cultural geography. Students and early-career scholars are increasingly seeking these reciprocal approaches in hopes of making more meaningful contributions through their work. The implications of this extend into many geographic fields and practices in the public and private sectors, from community planning to large industrial site decisions and from environmental restoration projects to public health programs and food systems.

GeoScience with an Open Hand

Some of the reciprocal scholarship that I find most inspiring is directly in or enabled by GISciences. For example, the Anti-Eviction Mapping Project (links.esri.com/aemp) is an all-volunteer nonprofit collective that works with low-income communities to illustrate the extent and impacts of evictions and work to prevent them. Operating mainly in the San Francisco Bay Area, Los Angeles, and New York City, volunteers work with residents who are at risk of eviction to visualize data and tell the stories of evictions, successful interventions, and active resistance to displacement. Likewise, as part of the British Columbia Caribou Project (links.esri.com/caribou-sm), three geography students used ArcGIS StoryMaps to call out state subsidies for oil projects that further imperiled endangered woodland caribou by funding oil-well digging in protected habitat areas.

A third example comes from Dr. Margaret Wickens Pearce, 2024 winner of the Stanley Brunn Award for Creativity in Geography, one of the most prestigious awards the American Association of Geographers (AAG) bestows. Pearce is a Citizen Potawatomi Nation member and cartographer who engages with Indigenous communities to produce beautiful and thought-provoking maps that recover and celebrate Indigenous languages (studio1to1.net/work); illustrate settler colonialism impact; and show the relationship between land expropriation, Indigenous dispossession, and the US system of land-grant universities.



SOURCES: Andrews 1918; GLO, BLM; Royce 1896–1897; USFS; USGS; Natural Earth.

↑ Dr. Margaret Wickens Pearce, a Citizen Potawatomi Nation member and cartographer, has created maps that show the relationship between land expropriation, Indigenous dispossession, and the US system of land-grant universities (1 acre = 4,047 square meters; map by Margaret Pearce for *High Country News*. For more information, see landgrabu.org.)

Protecting and Valuing Reciprocal Work

Despite the intellectual and political impact of these and many other community-engaged projects, reciprocal scholarship is undervalued in geography, both inside and outside academia. Examples of this work are lauded as publicly relevant scholarship, but often do not count when it comes to promotion or hiring decisions. In academia, reciprocal scholarship is most often classified as service rather than research, and thus does not count toward the work that graduate students are required to produce to earn advanced degrees and that faculty need for tenure and promotion. Similarly, public agencies and nonprofit organizations rarely combine effective science communication and community-engaged environmental management with their internal promotion processes.

In response, AAG is working to support individual geographers and GIScientists who want to strengthen their public engagement skills via the Elevate the Discipline (links.esri.com/aag-elevate) program while promoting and protecting reciprocal scholarship more broadly via the AAG Public and Engaged Scholarship Task Force. The task force's goal is to protect and value reciprocal scholarship by developing the following:

- Recommendations for how AAG can reward and protect public and engaged scholarship (PES) by geographers and GIScientists inside and outside academia
- Sample policies and best practices for incorporating PES in hiring, personnel evaluations, theses, dissertations, and tenure and promotion cases
- Guidelines for external reviewers, funding agencies, and others evaluating PES
- Best practices for overcoming common institutional barriers to PES, such as compensation for community partners

Strikingly, the task force has found no examples of policies or practices for valuing and protecting reciprocal work in hiring and personnel reviews outside the academy in public agencies, nonprofits, and the R&D sections of private companies where many geographers and GIScientists are employed.

I would love to see the GIScience community take this on. For example, guidelines from universities such as the University of California, Los Angeles (links.esri.com/ucla-community) could be adapted to nonacademic workplaces. To help leaders in public agencies, nonprofits, and private businesses understand why reciprocal scholarship is worth supporting, readings from books such as Faith Kearns's *Getting to the Heart of Science Communication* can help explain the effort involved in working reciprocally and its enormous benefits in building community trust and engagement.

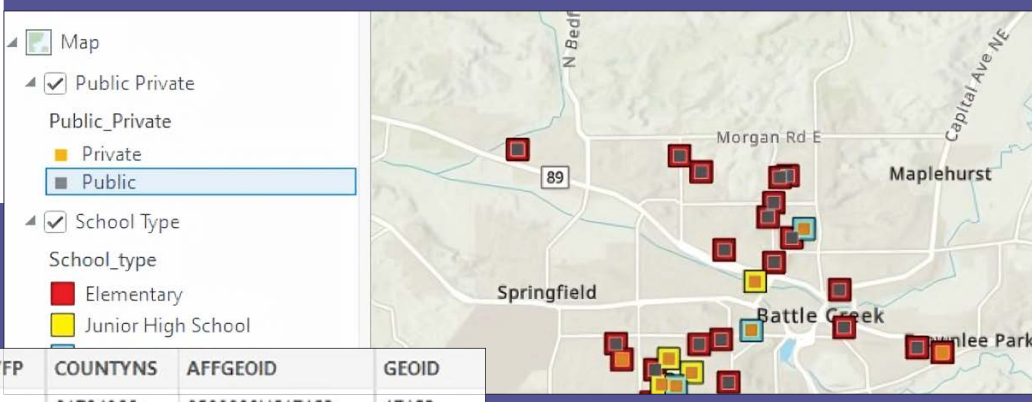
GIScience already has a strong track record of reciprocal scholarship. It would be great to deepen that, and to better protect it.

About the Author

Dr. Rebecca Lave is the current president of the AAG. She is associate dean for social and historical sciences and a professor in the department of geography at Indiana University, Bloomington.

Managing GIS Workflows

By Tom Scholten, IFF



↑ Layering symbology to show multiple attributes can be effective, but remember to use a balance of color, symbology shapes, and size.

↓ When working with attribute table fields, remember which field or fields you're using for operations such as calculations or joining to shapefiles as well as the data type.

OBJECTID *	Shape *	STATEFP	COUNTYFP	COUNTYNS	AFFGEOID	GEOID
1	Polygon ZM	17	153	01784966	0500000US17153	17153
2	Polygon ZM	18	019	00450340	0500000US18019	18019
3	Polygon ZM	18	129	00450383	0500000US18129	18129
4	Polygon ZM	18	173	00450335	0500000US18173	18173
5	Polygon ZM	17	007	00424205	0500000US17007	17007
6	Polygon ZM	21	007	00516850	0500000US21007	21007
7	Polygon ZM	21	003	00516848	0500000US21003	21003
8	Polygon ZM	21	147	00516926	0500000US21147	21147

Beginning a project that calls your GIS skills into action can be exciting—and occasionally overwhelming. Often, when I've begun a project, I've jumped right into it and started gathering or cleaning data, bringing it into a GIS application, and resorting to my typical mapping and analysis methods. Sometimes this is fine, but as a project progresses, there may be limited time to readjust and tweak the project to better fit expectations.

Thankfully, there are some simple topics that you can consider to provide clarity and reduce the likelihood of delays or even having to start over.

Understanding What Questions You're Trying to Answer

When beginning a project, it can be tempting to jump in and begin gathering and analyzing the data and creating map products. But take a few minutes to consider several questions:

- Why are you making this product?
- What do you want to get out of this product?
- What should the end user get out of this product?
- What are the primary content requirements? Do they lend themselves to a simple static map; a StoryMaps story; a multipage report describing analysis, methods, and data; or something else?
- What are the functional requirements?
- What are the data sources? Will you need to search for the required data, and if so, is it relatively easy to obtain? Will the client provide the data, and if they do, is it formatted with the necessary fields?
- What are the technology and tools stack (such as tools, languages, plug-ins, or web tools) used in the project? Note the tools or software needed to prepare the data and make sure you understand your work sequence.

What the Final Product Will Look Like

There have been many times when I've begun a project only to learn that an interactive web map is required in addition to a static map, or that a small-scale map needs to show more detail and therefore multiple larger-scale maps are required.

Depending on your data and audience, be mindful of potential sensitive information such as names, addresses, and specific data of a personal nature, especially if the finished product will be a publicly available web map. For example, I had a case where I was asked to share an "internal-only" web map with outside entities. Because of some sensitive information, I had to duplicate the dataset and remove any personally identifiable information and create a separate web map for public access.

You should also consider what the final deliverable will be. A static map in the form of a PDF or as an image in a report or PowerPoint deck will require significantly different time investments. Also think about what—if any—user interaction you will enable, such as pop-up boxes, panning, and a selectable legend.

If your project involves a StoryMaps story, make sure you know if it can be shared publicly or only with certain persons or groups. Consider whether sensitive or personably identifiable information will be shown. Finally, do you have a link that you can share and others can access?

Geoprocessing Tools to Use

Often your project will use at least one geoprocessing tool. Common ones that I have used include geocoding tools to create drive-time areas and buffers and spatial joins. Thinking back to your initial map questions, consider what your project needs to show or produce and what tools you will need. If you're unfamiliar with a tool, there are multiple resources for help. Search the ArcGIS Pro website's Help section, consult esri.com for help documents, or consider posting a question to the Esri Support forum or Esri Community. If you have web-based tools that are your go-to's, make sure you know your username and password and possibly your API key, depending on the tool.

Field Names and Settings

Often in my quick-moving workflow, I forget a parameter or field name for a spatial join. For example, when working with US census-related data, there can be fields that are candidates to join to census data, but it's easy to lose track of what those fields are. Pay attention to the geographic unit of analysis (such as state, county, or census tract) that you are working with. In addition, one field might be a text type while another might be numeric. Do yourself a favor and make a note to help you remember the field names and the data types that you're working with.

Symbology: Color Ramps, Symbol Size/Shape/Color

Will you use an existing color ramp or other map symbology, either chosen from personal preference or specified by your client or employer? If the answer is no, you might consider creating your symbology by using new icons or colors. Lately, I've been creating maps that show multiple layers and symbology, so I need to be sure not to visually overwhelm important elements.

It's also helpful to jot down symbology size if you're going to overlap. For example, if I want to visualize school levels by elementary, junior, and senior high as well as by public or private schools, I might show school level as a colored square and overlay a layer and symbolize the public/private attribute as a square or other symbol.

Communication

When it comes to working in the GIS industry, clear communication is often as necessary as knowing ArcPy, ModelBuilder, or R scripts. Whether you need to update colleagues, clients, or your organization, clear and frequent communication is important to helping a project progress smoothly with few misunderstandings.

Remember to update colleagues on workflow or specification parameters such as color ramp, color values, or the ramp style.

Also, be able to explain how you obtained data or created and calculated new fields. This is important to document somewhere, preferably in the metadata. For example, if you're calculating some phenomena per geographic unit, such as the number of people, homeowners, or single-parent households per square mile, remember the field names and what calculation you performed. If you've joined external data and are using it to calculate a new field, be sure you remember your source and the data obtained.

Finally, document your data sources (including a URL and the date obtained). Make this part of your mapping notes for future reference.

Archiving Data and Project Notes and Documents

I remember very well one of the first and best pieces of advice from my graduate school mentor—"Know thy data." I have tried to make this a habit in my GIS projects because inevitably I'll need to return to the source to verify a field or metadata. The handful of times that I've failed to do this and got burned reinforced my motivation to resume my habit. As you work with and save or archive your project data, think about where the original and working dataset is archived, what element of the project it's related to, and what the original data source is.

Project Closing/Debriefing

You might think that once the due date has been met, the presentation has concluded, and your boss has offered congratulations, you're done with the project. Not quite! It can be valuable to close out the project by meeting with everyone who had a hand in the project to broadly review what went right and what could be changed or improved. This can be a valuable time to meet and process others' opinions and feedback. Remember to document what went right so that it can be repeated and note what could be improved the next time around. And confirm that all files from the project are compiled, appropriately stored, and kept easily accessible.

URISA Resources

Finally, don't forget the great resources that URISA provides, including mentoring; education; and various workshops, webinars, and conferences. If you haven't logged in to your URISA account lately, you're missing out on some great resources. Some of us may be in supervisory positions, and implementing these questions and processes can help others better focus their time and effort on delivering an excellent product. Be sure to check out the URISA Members Dashboard for recent posts or to post your own question about a GIS tool, process, or conundrum. There are more than 2,400 URISA members from all over the United States and around the world who have a wealth of knowledge and experience. Visit the URISA website at urisa.org for links to various educational programs and resources.

About the Author

Tom Scholten is a senior community data analyst with IFF, a nonprofit community development financial institution based in Chicago. He has more than 17 years of experience with GIS and spatial analysis, much of it acquired as a civilian crime analyst. He obtained a master's degree in geography and GIS from the University of North Carolina, Greensboro, and has been a URISA member since 2021.

The Relevance of Cartography

A Cartographer's Perspective

By Georg Gartner
President, International Cartographic Association

About Maps, Emotions, and Trust

I've always felt an affinity for maps. This ultimately led me to a career in cartography. As a student, I learned to make maps by literally drawing contour lines, rivers, and streets, and then experimenting with graphic variables to visualize different map objects. This helped me learn to focus on accuracy and precision in mapmaking. However, the results made me aware of the enormous gap between simply drawing lines and polygons and creating visually appealing and well-designed maps that rely on artistic elements, design skills, and a clear focus on user-friendly products.

Many decisions are made in the creation of an effective map. This may not always leave the map user feeling inspired, with a newfound understanding, or with a sense of enjoyment. But maps can be powerful and they can inspire change. This is often due to a map's ability to show more than lines and polygons, allowing the user to become emotionally engaged in how the world is depicted.

The magic of good maps is to offer the potential for such emotional engagement. Maps should blend art and cartography to evoke emotions and reactions, igniting a desire to explore the map and examine its details. At the same time, the overall composition should be cohesive and harmonious, immersing the user in the depiction immediately. Often, such maps look clean, ordered, and visually pleasing.

In this respect, illustrative maps offer a much richer form of information presentation compared to many others that I can think of. Ideally, the elements the user is supposed to see are presented clearly while less important elements may be deselected, distorted, or marginalized. The objects and phenomena in the real world that may disrupt the intended story or topic may be completely left out or organized in a structured way with defined placement and boundaries.

Cartography as a discipline is generally concerned with communicating spatial information to human users. In most cases, this is accomplished by applying methods to communicate spatial information by visually perceivable graphical codes such as points, lines, polygons, and symbols that may vary by size, color, shape, or texture. Subsequently, cartographic methods may sacrifice the accuracy, homogeneity, and integrity of processed spatial data to show information that is more easily understandable by humans. Usually this results in representation models—specifically maps—being among the most effective methods of communicating spatial information.

It can be argued that despite our knowledge about map production and modeling, we ultimately are unable to say if a map is "good" in terms of satisfying the needs and demands of a specific user in a given situation and context. This refers to the concept of map quality in a functional sense. Although a map can be well-designed to be easily perceivable, free of graphic conflicts, and effectively communicate spatial information, it may not evoke the same level of satisfaction as another map depicting the same spatial information in a different design.

This can be seen as similar to other communication forms such as spoken human language. Although two people might express something similar, there can be differences in the words they used, how they are used, how they are pronounced, how quickly or slowly they were spoken, who expressed them, and the context of the situation in which they were expressed. These factors all influence whether one communication is more effective and successful than the other.

Ultimately, we may need to expand our understanding of maps as having a variety of functions. Some factors are related to the accuracy and completeness of the data and the information depicted in the map. Other factors pertain to how the data is visualized and graphically depicted (such as clarity and perception), while some are influenced by the user as well as context, such as the map's visual appeal, engagement, usefulness, and informative qualities.

Maps are designed to help us gain spatial awareness, understand and attract attention, provide illustrative information intuitively, and ultimately instill feelings of satisfaction. This also allows maps to be seen as trustworthy—and, if done properly, effective.

About the Author

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

Esri Press

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Fieldwork Handbook: A Practical Guide on the Go

Written by Marika Vertzonis

Make your mobile work more efficient and productive.

A biologist in a rainforest observing indigenous frogs, an engineer maintaining utility equipment, or a citizen scientist taking water samples from a creek—they're all doing mobile work. Their work is anchored by location. No matter what electronic tools they take into the field, they all take a notebook or a guidebook. As you head into the field along with all your equipment, be sure to include this practical guide. *Fieldwork Handbook: A Practical Guide on the Go* provides tips, best practices, and activities that make your mobile work more productive and successful. No matter how you use location intelligence in the field, you can up your game with this book and improve your experience. Covering preparation, equipment, workflows, and data, this book teaches how to organize and reconcile field data, effectively coordinate and dispatch field resources, refine workflows, and sync the office with the field. Author and Esri product engineer Marika Vertzonis learned about geospatial technology in the field, and she explains what you need to know. March 2024. 200 pp. Ebook ISBN: 9781589487185 and paperback ISBN: 9781589487178.

Prepare, Respond, Renew: GIS for Wildland Fire

Edited by Anthony Schultz, Matt Ball, and Matt Artz

Discover a geographic approach to resilience strategies for wildland fire.

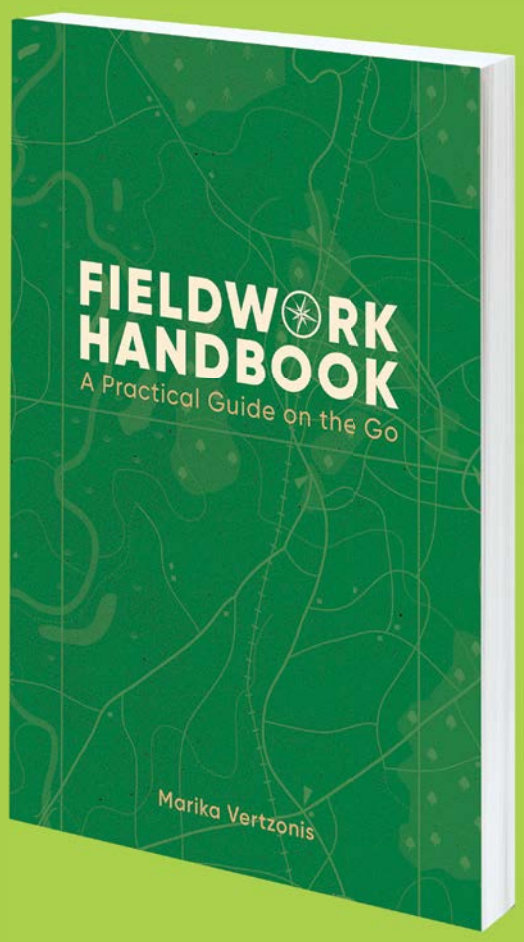
A natural and necessary component of many ecosystems, wildfires can also claim lives, destroy structures, and devastate communities and landscapes. The increasing areas where development meets nature—and more days of hot and dry weather—have magnified the negative impact of wildfires. The response to and recovery from increasingly complex firestorms stress budgets, economies, communities, and environments. Responders use the latest GIS tools to analyze wildfires via data that can be modeled to visualize threats in real time. *Prepare, Respond, Renew: GIS for Wildland Fire* explores real-life stories about wildland fire agencies successfully using GIS technology for preparedness, mitigation, response, and recovery/rehabilitation workflows. GIS helps firefighters model how wildfires will spread depending on weather, geologic features, and human development. Using predictive analytics and mapping technologies, firefighters can model the direction and rate of spread of wildfire to give a community, a nature preserve, a fire department, or a homeowner time to prepare for or even prevent or help control the next wildland fire. As they identify priorities and reduce fire vulnerabilities, agencies can visualize, record, and track the status of their acco mplishments in the field. The book also includes a section that provides ideas, strategies, tools, and actions to help jump-start your own use of GIS for wildland fire management. A collection of online resources, including additional stories, videos, new ideas and concepts, and downloadable tools and content, complements this book. March 2024. 120 pp. Ebook ISBN: 9781589487727 and paperback ISBN: 9781589487703.

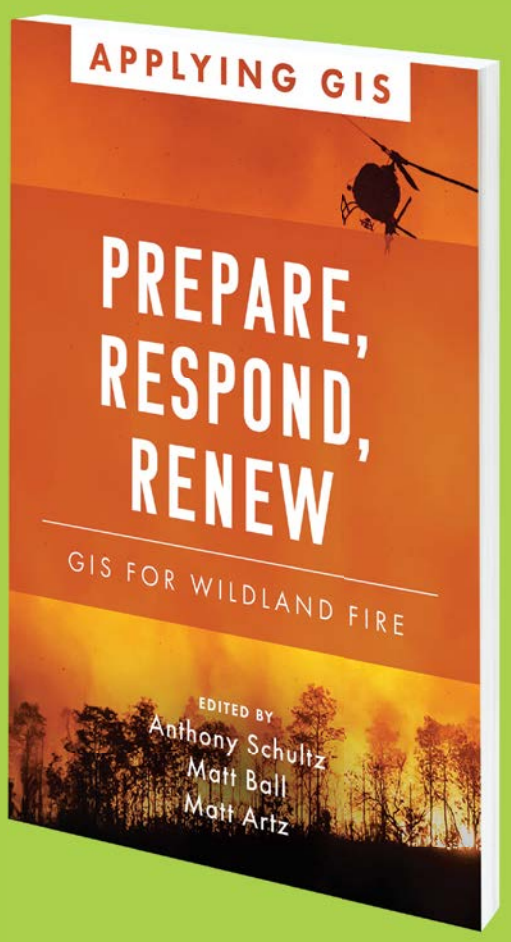
Working Beyond Borders: GIS for Geospatial Collaboration

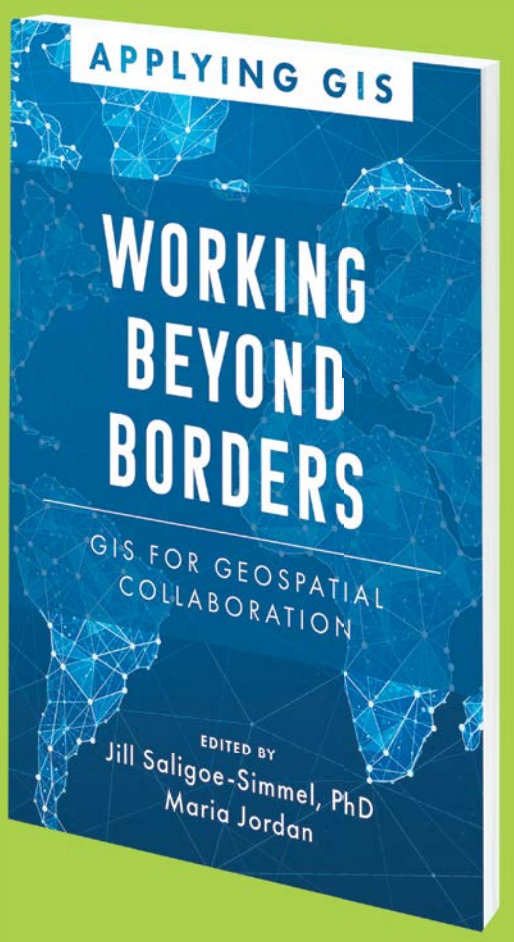
Edited by Dr. Jill Saligoe-Simmel and Maria Jordan

In today's world, organizations face a multitude of problems that create an unprecedented need for tools to share information and work better together.

In *Working Beyond Borders: GIS for Geospatial Collaboration*, readers will see how government, industries, and others are using location intelligence and GIS to interconnect people across jurisdictions and sectors to respond to some of the world's most critical issues, such as climate change, sustainable development, racial equity, emergency management, conservation, and public health and safety. Readers will also see how organizations are integrating geospatial infrastructure to improve efficiency, drive innovation, and empower everyday decision-making in communities around the world. February 2024. 145 pp. Ebook ISBN: 9781589487635 and paperback ISBN: 9781589487628.







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New Training and Certification Offerings

Training

Grow Your Professional GIS Skills

Developed and delivered by in-house experts, Esri's instructor-led courses serve experienced GIS users and novices alike. They benefit anyone who uses ArcGIS software to support their daily workflows, enhance projects with geographic context, and create information that supports better decision-making. Classes are taught in person, online, and as private training events for a group. These new and updated courses are available now.

- **Get Started with ArcGIS Arcade—**This new two-day course introduces the Arcade expression language and concepts that underlie writing and executing Arcade scripts across the ArcGIS system (ArcGIS Online, ArcGIS Pro, ArcGIS Enterprise, and ArcGIS apps). Course exercises include building Arcade expressions to customize map labels and pop-ups, create field calculations, and enable data validation. Explore course details at go.esri.com/arcgis-arcade-course.
- **Creating Python Scripts for ArcGIS—**This popular three-day course introduces the Python environment in ArcGIS Pro and teaches how to automate common data management tasks and geoprocessing workflows. Explore course details and upcoming class dates at go.esri.com/python-for-arcgis.

Enjoy the Convenience of Prepaid Training Days

When instructor-led training will be needed throughout the year to train GIS users and support key projects, budget planning can be simplified and class registrations can be streamlined by purchasing an Esri Training Pass. Learn more at go.esri.com/training-pass-details.

Expand Your GIS Horizons in a MOOC

Esri's massive open online courses (MOOCs) are informative, fun, and available at no cost. The following courses are back by popular demand and include access to the latest ArcGIS software. A certificate is awarded for course completion.

- **Cartography.—**In progress now and running from April 3 to May 15, this fan-favorite MOOC features a panel of experienced cartographers sharing techniques that can bring your data to life in 2D and 3D maps. If you're interested in this topic, you can still join the course and practice making high-quality maps using ArcGIS Pro. Register by April 17 to join the course at go.esri.com/cartography-mooc.
- **GIS for Climate Action—**If you missed the debut offering of Esri's newest MOOC last year, join the second cohort from May 1 to June 12 to learn how GIS is making a positive impact on climate change. Hear from climate experts; explore climate change scenarios; and build skills to create data that supports informed decisions using ArcGIS Pro, ArcGIS Online, ArcGIS Dashboards, and ArcGIS StoryMaps. Register for the course at go.esri.com/climatemooc.

Learn New GIS Tips and Tricks

Every four to six weeks, Esri Academy hosts a no-cost live training seminar on a technology topic. Over the course of one hour, Esri subject matter experts discuss new ArcGIS capabilities, demonstrate GIS workflows, and share their favorite tips to work efficiently and get better results with ArcGIS software. Recent and upcoming topics include ArcGIS Experience Builder (March 28), Survey123 Connect (May 2), and Python (June 13). All seminars are recorded and available on demand at Esri Academy after the live event. View the live training seminar schedule and request calendar reminders at esri.com/lts.

Certification

Validate Developer Expertise

The Esri Technical Certification Program validates knowledge and skills applying ArcGIS software and developer technologies. The new certification exams below are available now.

- **ArcGIS API for Python Associate 2024—**This exam is for GIS professionals, data analysts, data scientists, and others who have two to four years of experience using ArcGIS API for Python to perform analysis, visualization, editing, and web GIS administration. Explore exam details at go.esri.com/python-cert-2024.
- **ArcGIS Maps SDK for JavaScript Associate 2024—**This exam is for individuals who develop web applications that include mapping and visualization and are proficient in handling asynchronous events, applying security and authentication workflows for data access, and integrating with other ArcGIS components. Learn more about this exam at go.esri.com/arcgis-maps-sdk-cert.

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

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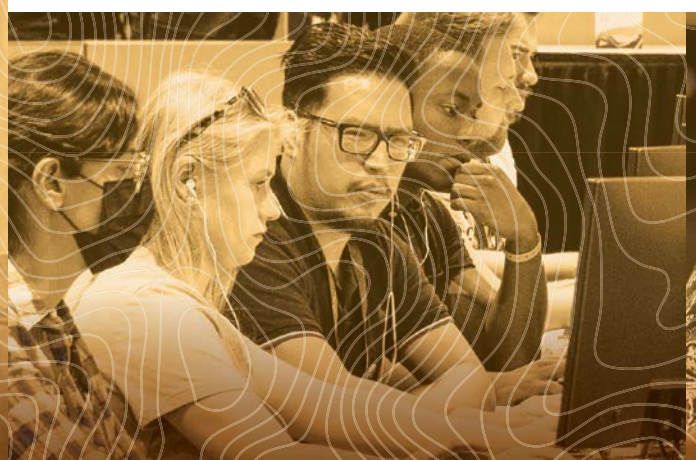

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