ArcNews

Esri | Winter 2025 | Vol. 47, No. 1

Briefly Noted

Most Recent ACS Data Now in ArcGIS Living Atlas
The 2019–2023 American Community Survey (ACS) five-year estimates are now accessible in ArcGIS Living Atlas of the World. These ready-to-use, multiscale layers enable local officials, business owners, and researchers to understand what is happening in their communities and how best to allocate resources. ACS data is available at the state, county, and census tract levels.

NOAA, Esri Create Online Hub for Ocean, Coastal Data
The National Oceanic and Atmospheric Administration (NOAA) and Esri entered into a cooperative research and development agreement to increase the accessibility of ocean and coastal data. This partnership will combine NOAA's world-class data with Esri's geospatial technology to produce a first-of-its-kind open data platform with timely, relevant, user-friendly information that helps support sustainable development while also protecting and restoring marine ecosystems. The goal is to create a public-facing hub where visitors can find answers to wide-ranging questions, from "Where can I fish?" to "How are rising ocean temperatures impacting vital marine ecosystems?"

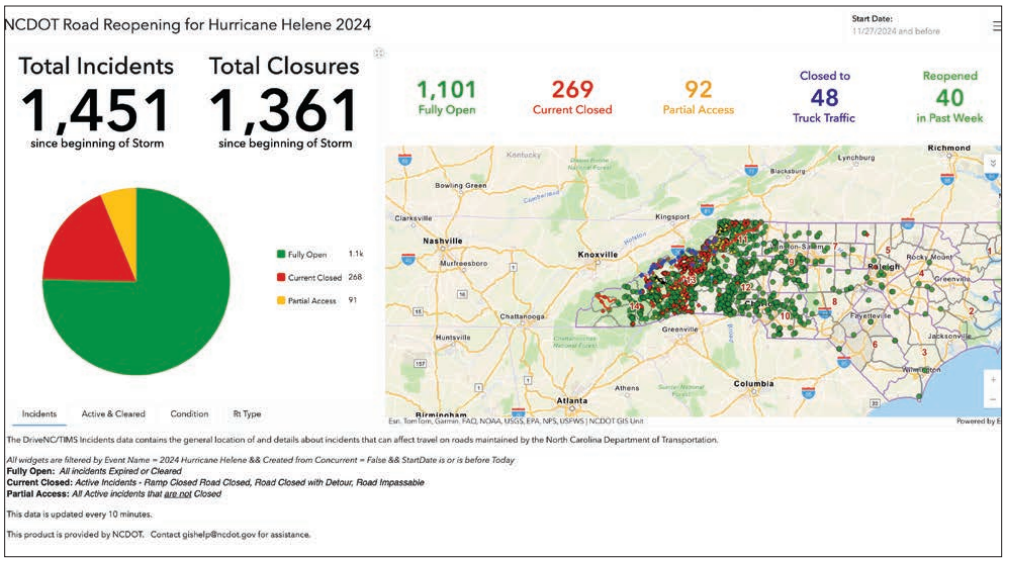
Geospatial Data Included in Autodesk Forma
In a deepening of their partnership, Esri and Autodesk agreed to integrate Esri's geospatial reference data into Autodesk Forma, cloud-based software that offers AI-powered tools to architecture, engineering, and construction (AEC) professionals. The inclusion of ArcGIS data—such as basemaps and ArcGIS Living Atlas data layers—in Autodesk Forma means that architects and planners can begin designing with quick access to comprehensive geographic context. Learn more about Esri and Autodesk's strategic alliance at go.esri.com/forma.

Navigating Devastation: GIS Aids Hurricane Helene Response

Hurricane Helene, which struck Florida in September 2024 with 140-mile-per-hour winds, caused extensive damage and progressed northwest into North Carolina and Tennessee. It ranks as one of the costliest and deadliest US storms since Hurricane Katrina in 2005. Helene claimed at least 232 lives, with damages estimated at $87.9 billion and broader economic impacts reaching $200 billion across six states.

Helene posed unique challenges as it brought torrential rain and wind to mountainous terrain. This phenomenon, called orographic uplift, occurs when air is pushed upward over geographic features, causing it to cool and release additional precipitation. Record-breaking rainfall led to catastrophic flooding in cities such as Asheville and Boone in North Carolina. The hurricane washed out roads and bridges, downed power lines and cell towers, and triggered landslides that cut off entire communities.

continued on page 4



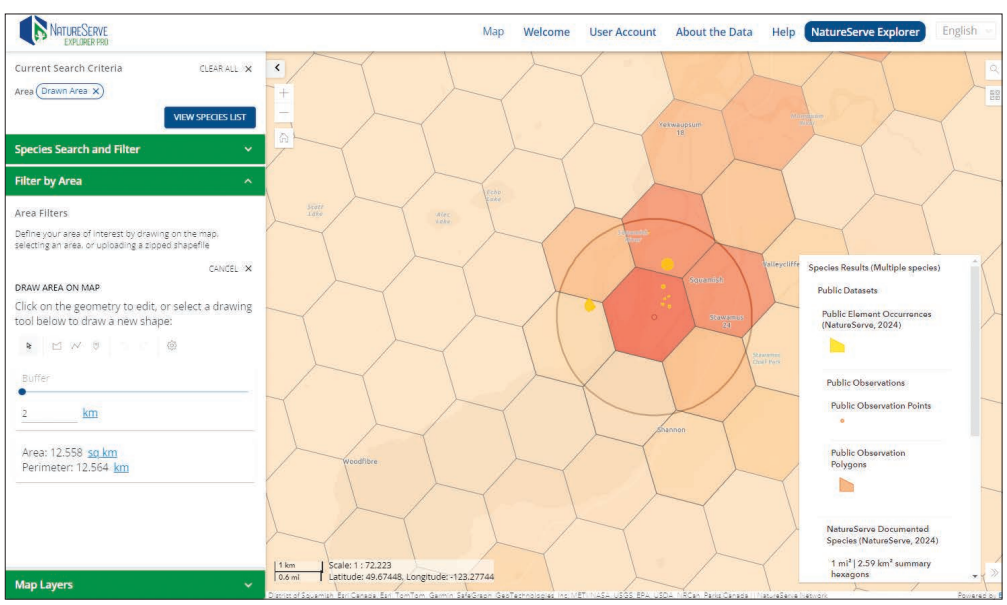
↑ The North Carolina Department of Transportation's (NCDOT) GIS team developed a publicly accessible dashboard that shows road closures related to Hurricane Helene. It allows users to track the status of road closures, view historical data, and stay updated on ongoing improvements in near real time.

Streamlining Access to Biodiversity Data in North America

By Lori Scott, NatureServe

For decades, scientists have known something startling about the natural world: that biodiversity—the diversity of life on Earth—is disappearing at an unprecedented rate. Species around the globe are going extinct up to 1,000 times faster than the average rate over the last 10 million years, and the current rate is accelerating.

To better understand and monitor biodiversity changes in the United States and Canada, conservation-focused nonprofit NatureServe collaborates with a network of more than 60 programs spread across the two countries to collect data on various plant and animal species. The NatureServe Network has compiled a database with more than a million mapped occurrences of rare species and their habitats.



↑ The radius tool in NatureServe Explorer Pro lets users build custom biodiversity reports for areas of interest.

But delivering data from multiple providers to users across many industries presents challenges. NatureServe's clients need access to information at a scale that informs action, yet location data that is owned by a state or other municipal entity must comply with various guidelines to protect sensitive species. For instance, if the location of a rare orchid is made widely known, someone could take it out of the wild, potentially leading to the loss of an entire population of orchids—or even that species' extinction.

As the nerve center of the NatureServe Network, NatureServe needs to ensure that data is comparable from one jurisdiction to the next and that decision-makers can access foundational biodiversity data—all while protecting sensitive data. That's why the organization relied on ArcGIS Enterprise to develop NatureServe Explorer Pro, a web app

continued on page 20

ArcNews

Esri | Winter 2025 | Vol. 47, No. 1

In 1921, a mob descended on Tulsa, Oklahoma's thriving Black neighborhood of Greenwood and went on a killing and burning spree. The names and burial places of the victims are still mostly unknown. Now, investigators are using GIS to create a geographically accurate 3D model of Section 20 of Oaklawn Cemetery, where victims are likely buried. "At the most human level...we just *[want]* to find these victims and reunite them with their families," said Tulsa mayor G.T. Bynum.

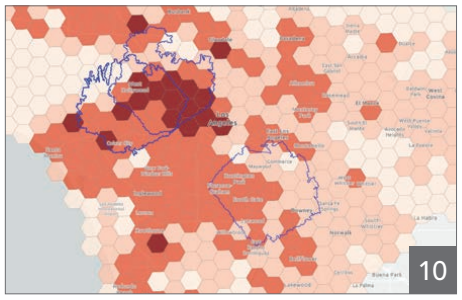


Table of Contents

Executive Editor
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Citabria Stevens

Graphic Designer
Takeshi Kanemura

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ArcNews
Esri
380 New York Street
Redlands, CA 92373-8100 USA
arcnews_editor@esri.com
Tel.: 909-793-2853, ext. 1-1430
Website: esri.com/arcnews

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Enhanced Drought Aware App Offers More Ways to Explore the Effects of Drought

The Drought Aware app, available in ArcGIS Living Atlas of the World, provides information about drought-affected areas in the United States over various time intervals from 2000 to today and across different drought intensities.

After a recent enhancement to the app, Drought Aware integrates critical information from additional data layers, including population, housing, river flow, reservoirs, crops, and agricultural labor. Now, users can engage with the app to gain comprehensive insight into the impacts that droughts have on communities across the United States.

Three Categories of Information

The Drought Aware app summarizes information in the following three main categories:

- Population: This displays the estimated number of people and households affected by drought at each intensity level. It also describes some vulnerable populations and lists the related drought risk indexes. The data is available at both county and state levels.
- Water: This depicts major local rivers, the average interannual river flow, and relevant local reservoirs. The data is available at the subregion hydrologic unit code level 4 (HUC4), which encompasses the areas river systems drain into, the reach of rivers and their tributaries, closed basins, and groups of streams that form coastal drainage areas.
- Agriculture: This shows the potential economic effects of droughts according to major crops, the affected labor, and the amount of agriculture that gets exposed to dry conditions.

Several Ways to Explore Drought

There are many ways to explore the phenomenon of drought in this app.

The topmost timeline shows categories of drought severity since the year 2000 as a proportion of the total amount of land in the United States. Users can choose a point in time to see that week's geographic ranges of drought.

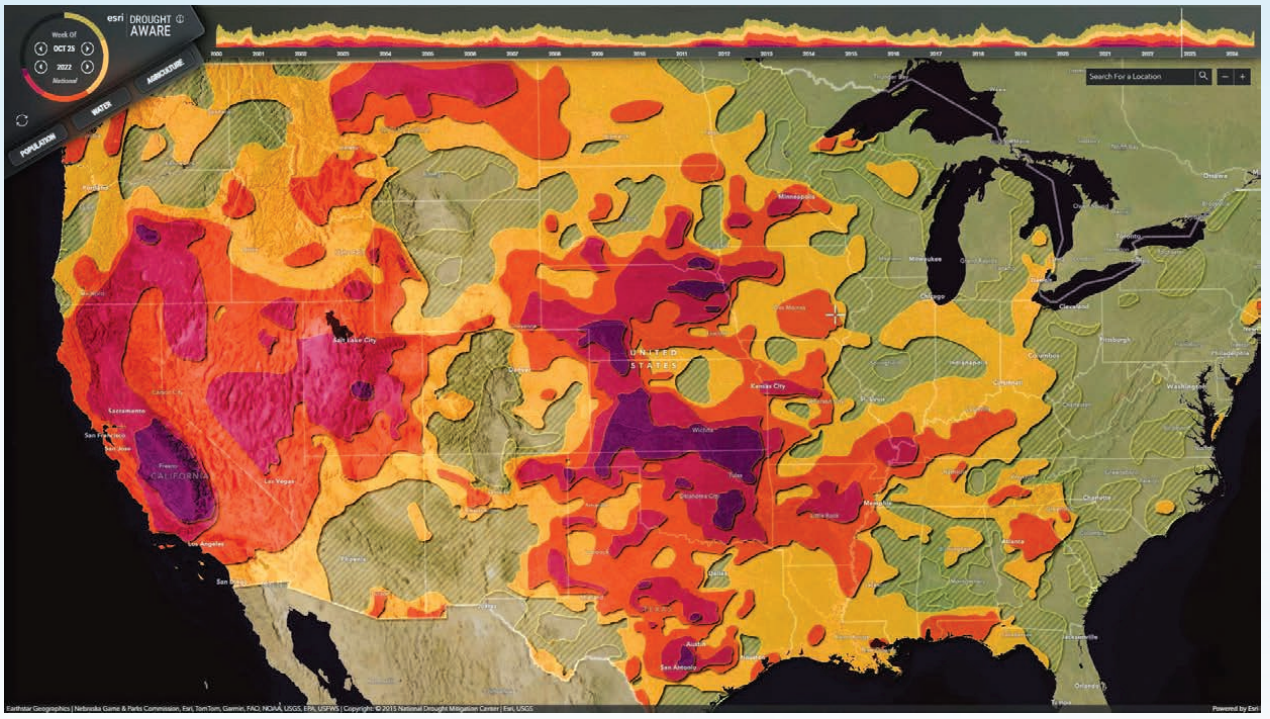
The sector chart in the top-left corner of the screen provides a detailed breakdown of the proportion of the nation experiencing drought at that time. Users can hover over any portion of the chart to see which areas of the country experienced various drought severities. Buttons indicating the week and the year let users go chronologically backward or forward by week or by year to get a comparative sense for drought in different areas of the country.

When no location is selected, the timeline and drought intensity class represent the extent of drought for the full area of the United States. When a state, county, or watershed is selected, these areas update to represent that more specific locale.

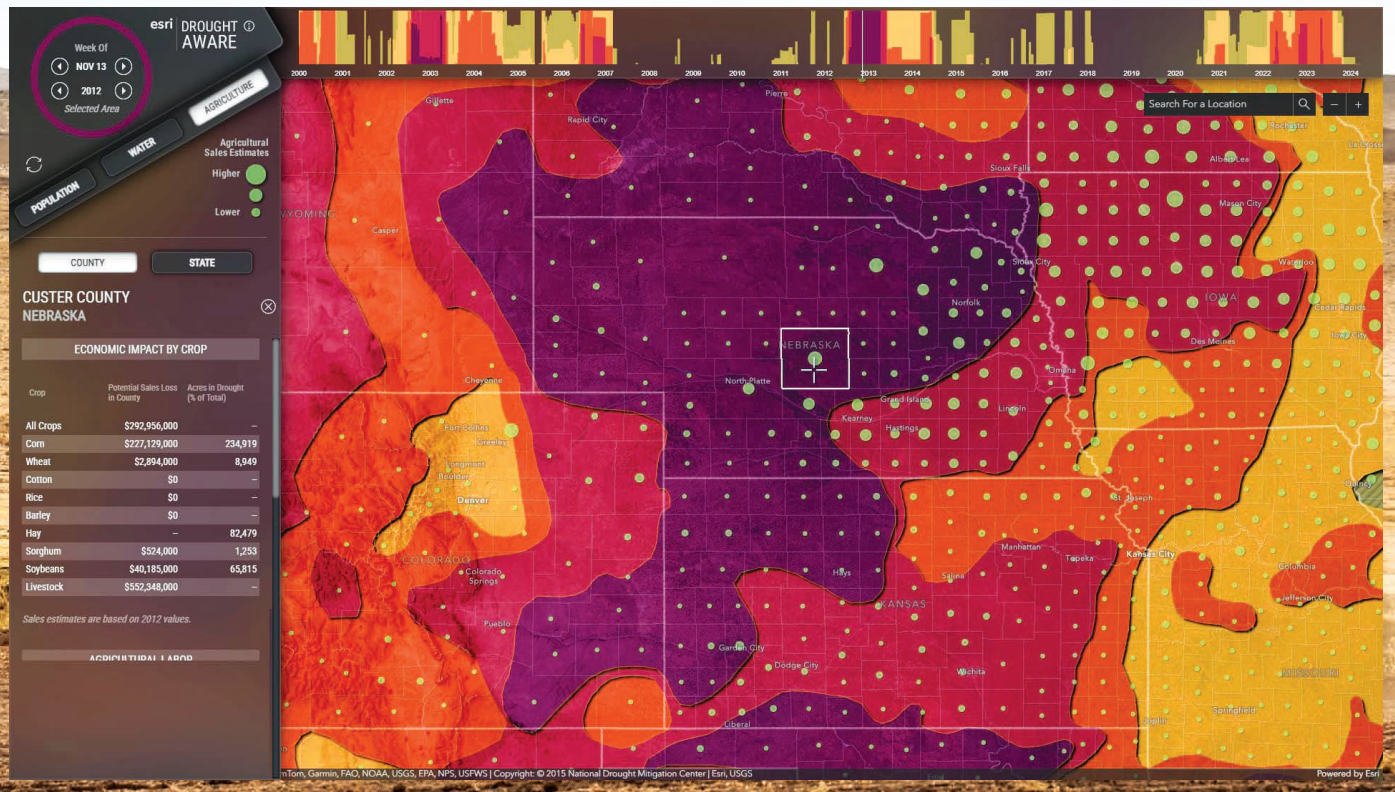
Automatic Data Updates

The data layers used in the app are drawn from sources ranging from the American Community Survey and the Federal Emergency Management Agency's National Risk Index to the National Water Model and the National Hydrography Dataset. All the data from these sources is available in ArcGIS Living Atlas.

The data in the Drought Aware app is updated every week after the *US Drought Monitor* map is released. A live feed routine automatically downloads and processes the source data and then updates it in Drought Aware. The population, water, and agriculture summaries in the app are calculated by the live feed routine using the *US Drought Monitor* map and data source layers in ArcGIS Living Atlas.



↑ Drought Aware gives users insight into the effects of drought across the United States.



↓ The Agriculture button shows the potential economic effects of drought based on major crops, labor, and more.

To explore the Drought Aware app, go to links.esri.com/drought-aware. To learn more about ArcGIS Living Atlas of the World and ask questions of Esri experts, go to the ArcGIS Living Atlas of the World community on Esri Community at links.esri.com/LA-community.

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Navigating Devastation: GIS Aids Hurricane Helene Response

In Helene's early days, much of North Carolina was disconnected. It was crucial to know where people needed help, where there was damage, and which roads were closed. Agencies used GIS to collaborate and allocate resources effectively. Three days before Hurricane Helene hit Florida, Esri's Disaster Response Program (DRP) was activated, anticipating the needs of agencies and GIS users in the hurricane's path. Over three weeks, the DRP responded to more than 170 requests for assistance from various groups involved in relief efforts, including government agencies, utilities, companies, and nonprofits.

The Worst Natural Disaster in North Carolina's History

Hurricane Helene's extensive impact across North Carolina posed significant challenges for disaster response and recovery efforts. North Carolina governor Roy Cooper told state lawmakers in October 2024, while unveiling his request for $3.9 billion to help pay for repairs and revitalization, "It is no exaggeration to describe Helene as the deadliest and most damaging storm ever to hit North Carolina."

Days prior to the hurricane, Daniel Madding, IT manager for application development and GIS at North Carolina Emergency Management (NCEM), collected quantitative precipitation forecasts from the National Weather Service. NCEM's GIS team put this data into a Python script that compares it to the National Oceanic and Atmospheric Administration's (NOAA) *Atlas 14* data, which shows precipitation frequency information for the United States.

The team saw rain recurrence intervals that corresponded to 100- and 500-year rain events. Although a 100-year rain event does not directly correlate with a 100-year flood event, the GIS team used this data to strategically position search and rescue teams in areas predicted to have the highest likelihood of rainfall and flooding.

In addition to sharing their high-risk-area projections via the state's GIS LISTSERV, Madding and his team hosted a just-in-time training for local GIS professionals on NCEM's Flood Inundation Mapping and Alert Network (FIMAN). This web mapping tool shows decision-makers which rivers may experience significant flooding and which buildings and roads could get inundated. The team also demonstrated the North Carolina Department of Transportation's (NCDOT) Resilience Analysis Framework for Transportation (RAFT) tool, which assesses flood risks for roads and bridges.

All this forecast data was crucial to positioning emergency management teams—including swift-water rescue personnel, urban search and rescue teams, high-water clearance vehicles, and National Guard assets—in areas expected to be heavily hit. Two days before Helene even crossed into North Carolina, search and rescue teams were pulling people out of harm's way.

Throughout the hurricane, GIS team members employed GIS to ensure public access to crucial data, helping prevent delays during the crisis. They used GIS to identify and map isolated communities and directed local GIS professionals to the DRP program to ensure that software licensing and cost did not inhibit response efforts.

After the hurricane, the team collaborated with search and rescue teams using the Search and Rescue Common Operating Platform (SARCOP). This GIS-driven technology captures search and rescue workflows by taking data recorded with ArcGIS mobile apps and stored in ArcGIS Online and pulling it all together in an app built with ArcGIS Experience Builder. This collaboration helped collect more than 64,000 damage assessment points that were displayed on a dashboard for easy access. NCEM also used maps to facilitate supply deliveries in mountainous areas. Additionally, NCEM deployed GIS professionals to 10 of the most affected counties to improve data sharing and support local counties that lack GIS personnel.

The NCEM GIS team was able to respond the quickest in areas where it already had relationships with county emergency managers and local GIS staff. Madding strongly encourages GIS professionals to build relationships with staff at emergency management organizations before a crisis arises.

"During a natural disaster, GIS professionals will be called in to help local emergency managers, so it's good to get an understanding of their data and needs beforehand," Madding said.

A Coordinated Response from the Department of Transportation

In the days before Hurricane Helene made landfall as well as over the days that followed, NCDOT relied on GIS to manage preparations, response, and post-hurricane recovery.

Raquel Bensadoun, the geospatial services supervisor at NCDOT, said the department had been preparing for a storm like Helene since Hurricane Florence in 2018. She and her team created more effective tools for emergencies like hurricanes, including templated dashboards in ArcGIS Dashboards that combine important data such as weather radar and hydraulic gauges.

"One of the key lessons we've learned…is that having templates in place that can be easily configured for a particular event is crucial for these emergencies," said Bensadoun. "In this case, it allowed us to get a storm response website running quickly instead of asking each other what we wanted to show *[to people]*."

To work with other agencies, the GIS team used ArcGIS Survey123 to create damage and debris survey templates that were repeatedly adapted and enhanced. NCDOT staff were trained to inspect bridges, culverts, and roadways and complete the surveys within 48 hours of a storm.

The GIS team also has an ArcGIS Online training program for NCDOT staff and partners. And the team created a process to

Mapping the Way Home

When 48 hours had passed without contact from his parents in the aftermath of Hurricane Helene, Esri senior account manager Sam Perkins embarked on an arduous 11-mile hike to ensure they were OK. Perkins's parents, both in their 70s, live in a remote mountain town known as Little Switzerland, an hour's drive from Asheville.

Navigating through what he described as "postapocalyptic conditions," including destroyed roads and downed trees, Perkins overcame these fraught challenges using his expertise in geography and GIS. "I made sure I had offline maps downloaded so I knew where I was," he said. "I knew the progress I was making, and that was very comforting. That gave me a lot of confidence to keep going."

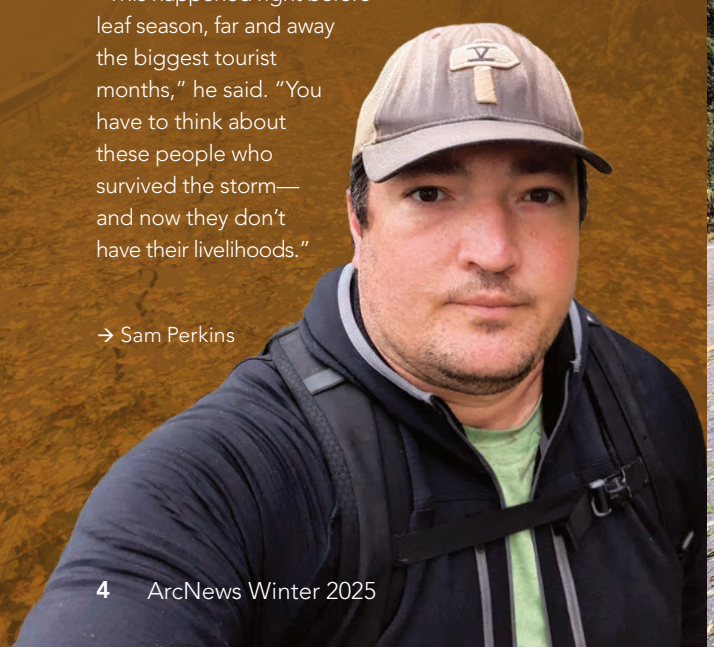
During his hike, Perkins grew increasingly concerned about the damage and residents' isolation from resources. He didn't just observe the destruction; he actively helped with recovery efforts. He used his skills to take geotagged photos to contribute to the state's damage assessment.

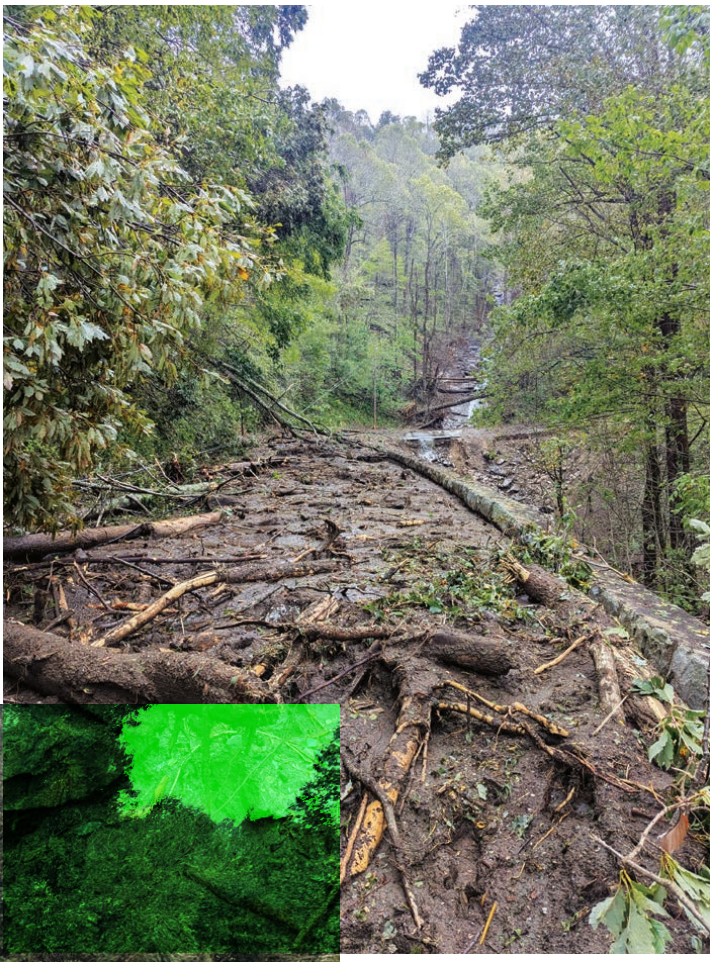
Finally, after hiking up 2,200 feet in elevation through debris, Perkins arrived at his parents' home to find them "OK but surrounded by devastation," he said. "I had never been so relieved to see everyone."

Perkins continues to be inspired by technology's role in his home state's long-term recovery. He created a map of all the choose-and-cut Christmas tree farms in North Carolina, since the area is a major source of Christmas trees for the United States. He is also working on an ArcGIS StoryMaps story of his favorite businesses between Asheville and Boone. These projects aim to revitalize the Little Switzerland community—a place Perkins feels a deep connection to—by attracting tourists and encouraging people to support the local economy.

"This happened right before leaf season, far and away the biggest tourist months," he said. "You have to think about these people who survived the storm—and now they don't have their livelihoods."

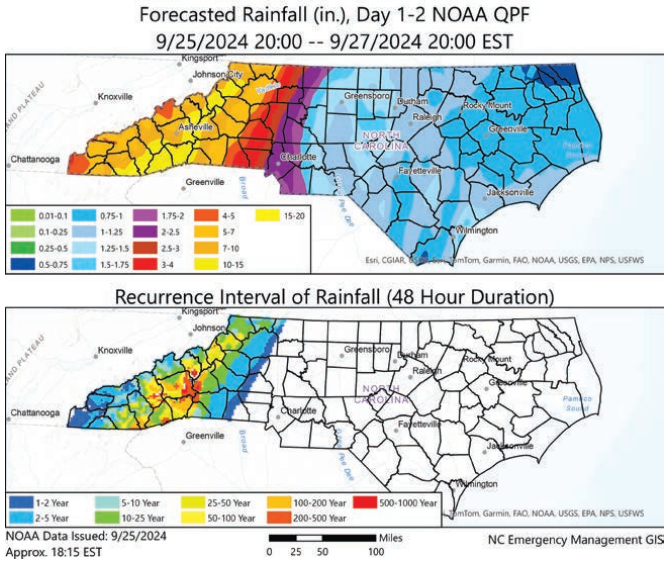
→ Sam Perkins



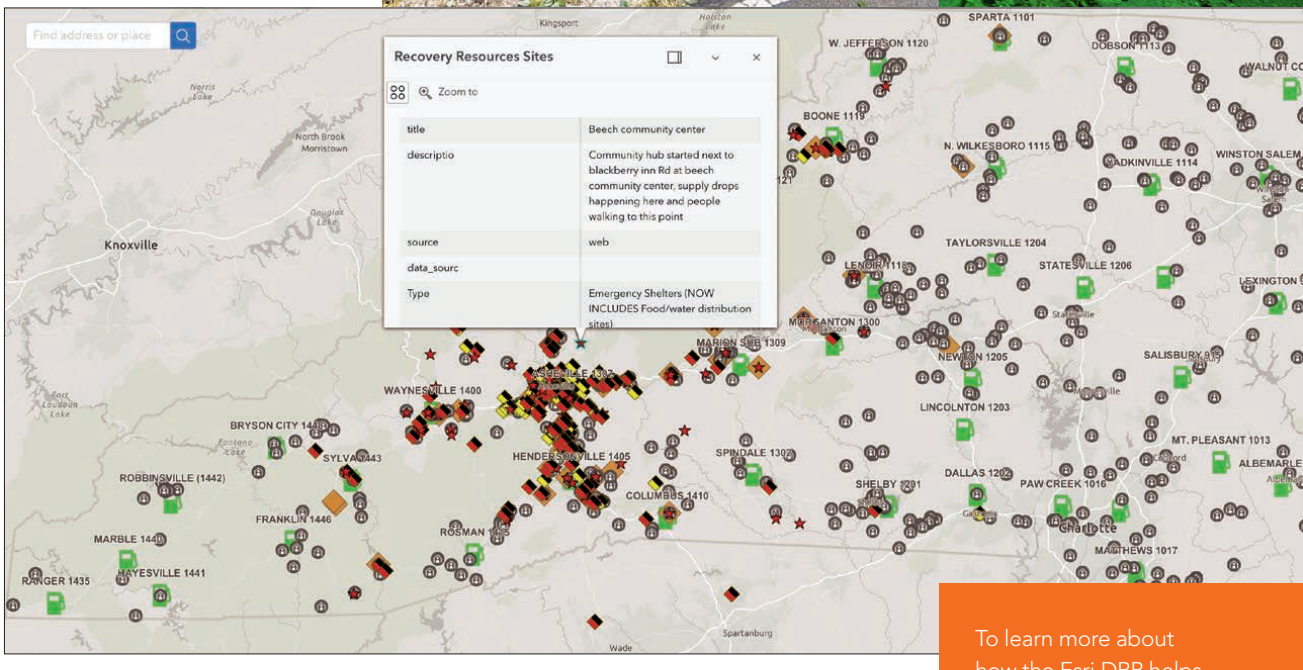


↑ During his trek, Perkins noticed many trees downed by the storm, describing the area as an obstacle course of trees.

← Throughout his 11-mile hike, Perkins had to navigate road failures, washed-out roads, and mudslides.



↑ The North Carolina Emergency Management (NCEM) GIS team analyzed precipitation forecasts to determine the type of rainfall event each county could expect from Hurricane Helene. This image, taken 24 hours before landfall, shows that some counties were predicted to receive up to 15 inches of rain, with some areas facing a 50- to 100-year flood risk.



↑ NCDOT provided emergency services maps that illustrated the locations of emergency shelters, food and water distribution sites, and other key resources.

To learn more about how the Esri DRP helps organizations respond to natural hazards and crises, or to request emergency GIS support, visit esri.com/disaster.

quickly add new users to its ArcGIS Online organization. During Hurricane Helene, 559 new users were added, including staff from local, federal, military, and private organizations, who all shared and collaborated on data.

To prepare for the hurricane, Bensadoun and her team contacted the Esri DRP. Through the program, NCDOT staff got help from a team that answered questions, offered advice to speed up services, and temporarily increased data storage to accommodate more users accessing GIS services.

"At one point, we had a million people hitting our ArcGIS Online services simultaneously," shared Bensadoun. She credits Esri's partnership as a crucial part of NCDOT's coordinated response.

When Hurricane Helene arrived, NCDOT staff faced huge issues, especially in western North Carolina. Power outages meant residents and rescuers had no communication, and debris blocked roads.

"It was really hard to gauge situational awareness," Bensadoun said. "We weren't even sure if NCDOT personnel were OK at some points, with reports of entire homes being washed away."

The department quickly adapted by first enhancing DriveNC, its official traffic information system. It introduced a GIS layer called the pink zone, which marked no-drive areas in the places most impacted by the hurricane. Initially, this layer—which was displayed on DriveNC and shared with platforms such as Google Maps and Waze to alert travelers—covered more than 20 counties in western North Carolina. Throughout the course of the storm, the department also continued to improve its Microsoft Azure functions that transfer data from DriveNC to public-facing dashboards built with ArcGIS Dashboards. This ensured that DriveNC and other web services were in sync and displaying data that matched.

In the days that followed the hurricane, travel restrictions were modified as NCDOT received drone imagery and damage reports. NCDOT staff used ArcGIS Pro and ModelBuilder to modify the pink zone layer to reflect the new information. This included identifying which roads were passable; which were restricted to emergency services; which had truck restrictions; and which were cleared for travel.

Post-hurricane, NCDOT GIS staff supported recovery efforts by creating visualizations of before-and-after scenarios using ArcGIS Instant Apps and images from the photogrammetry team. They continue to assist the department's Statewide Operations Center with handling information requests, building maps and dashboards, and conducting data analysis to boost rebuilding efforts and develop process improvements based on lessons learned from the event.

Remote Sensing, 3D Mapping Help Find Answers in Tulsa

It's been over a century since a mob descended on Tulsa, Oklahoma's thriving Black neighborhood of Greenwood and went on a killing and burning spree in 1921. In 18 hours, more than 1,000 homes and businesses were destroyed, and an estimated 30–300 people died. The names and burial places of the victims are still mostly unknown.

An important discovery in July 2024 brought the number of named victims to three. Through a painstaking investigation that employed innovative techniques for remote sensing and 3D mapping, the Tulsa graves investigation team located and identified the remains of C. L. Daniel in an unmarked grave at Oaklawn Cemetery.

Traditional archaeology, forensics, and genealogical methods also helped identify Daniel. The Georgia native and US Army veteran of World War I was likely about 25 years old when he died during one of the most violent racial attacks in American history.

Markers for two other known victims, Reuben Everett and Eddie Lockard, are found near Daniel's grave. Everett, Lockard, and other documented victims are included in a 2001 report from the Oklahoma Commission to Study the Tulsa Race Riot of 1921.

Over the decades, many have contributed to efforts to identify those murdered after a coverup took shape. Much remains to be done.

For current residents of Greenwood and descendants of those lost in the massacre, identifying the victims is an opportunity to rebuild family and community connections. The investigation has also ended years of silence. For too long, it was dangerous to discuss the massacre in public.

"This is something that my grandparents left this earth never realizing could ever happen," said Brenda Nails-Alford, a descendant of race massacre survivors and entrepreneurs from Greenwood, also known as Black Wall Street. "They lost friends and neighbors that they never saw again. And here we are today talking about the race massacre openly and looking for victims as well."

An Excavation of Hope

Tulsa mayor G.T. Bynum launched an investigation in 2018 to look for the graves of unnamed victims, based on the state commission's report. The current investigation focuses on locating and identifying 18–21 of those victims.

"At the most human level, for all of us who have worked on this search, we just wanted to find these victims and reunite them with their families," Bynum said at a news conference in July 2024.

The limited records that do exist to document the number of deaths include about a dozen death certificates, funeral home records, and a paid city invoice. These indicate that at least 20 adult males and one stillborn infant were buried in a segregated area at Oaklawn Cemetery known as Section 20, explained Dr. Kary Stackelbeck, state archaeologist from the University of Oklahoma and a member of the graves investigation team.

Few records exist for this part of the cemetery overall, which isn't unusual for segregated cemeteries, according to Stackelbeck. Researchers estimate that around 1,000 people—including some victims of the massacre—were buried here over the course of 30 years, she said.

Multiple layers of fill dirt were added to this western part of the cemetery over the years to make way for new burials. Those layers have made it more challenging to locate unmarked graves.

As work continues, investigators are mapping the location of each grave using geographic coordinates. These won't be just any maps. The project team's digital archaeologist, Dr. Alex Elvis Badillo, director of the Geospatial and Virtual Archaeology Laboratory and Studio at Indiana State University and a digital solutions specialist at Stantec, is building a geographically accurate 3D model of Section 20.

Archaeology Moves into the Digital Realm

The digital processes developed for this project offer a novel, modern framework for archaeology, Badillo said. GIS is the unifying technology.

One way the project is unique is that it combines the use of ArcGIS Pro, ArcGIS Online, ArcGIS Survey123, and ArcGIS Dashboards with other geospatial technology, including GPS and a total station, an instrument that measures distances and angles. Employing all this together enables researchers to identify target areas for excavation with great precision.

Historic aerial imagery and maps, ground-penetrating radar data, and excavation data from previous years are organized and accessed in a geodatabase. Compiling this information in one place makes it possible for the team to survey above and below the ground before digging.

Filled-out Survey123 forms help the team recognize spatial patterns that reflect the likely burial routines used in Section 20. Working with local volunteers, the team also used Survey123 to complete a headstone survey in the same area. In the future, the headstone library might become available to the public in some form as a historical record.

The headstone library and forensic records are also cataloged in the geodatabase. This dynamic archive will support and expedite work as it continues in future phases—though public and/or private funding will be necessary to keep the project moving beyond its current phase.

In addition to using traditional 2D maps in the excavation workflow, the team employs structure-from-motion (SfM) photogrammetry to document the excavation in 3D. This technique takes a series of 2D photos to create accurate and measurable 3D representations of the world. One advantage of this method is that the reconstructed 3D model is wrapped in a photorealistic texture that closely mimics real-world objects.

To reconstruct the excavation in 3D, the team mounts a camera on a drone and uses a digital single-lens reflex camera to take pictures throughout the excavation process. The photos are then georeferenced using spatial data from the total station. From there, the team employs photogrammetry software to make the 3D models. There is one model of the entire cemetery, as well as models of the excavated trenches and areas where heavy machinery was used to remove large amounts of dirt that covered the burial plots.

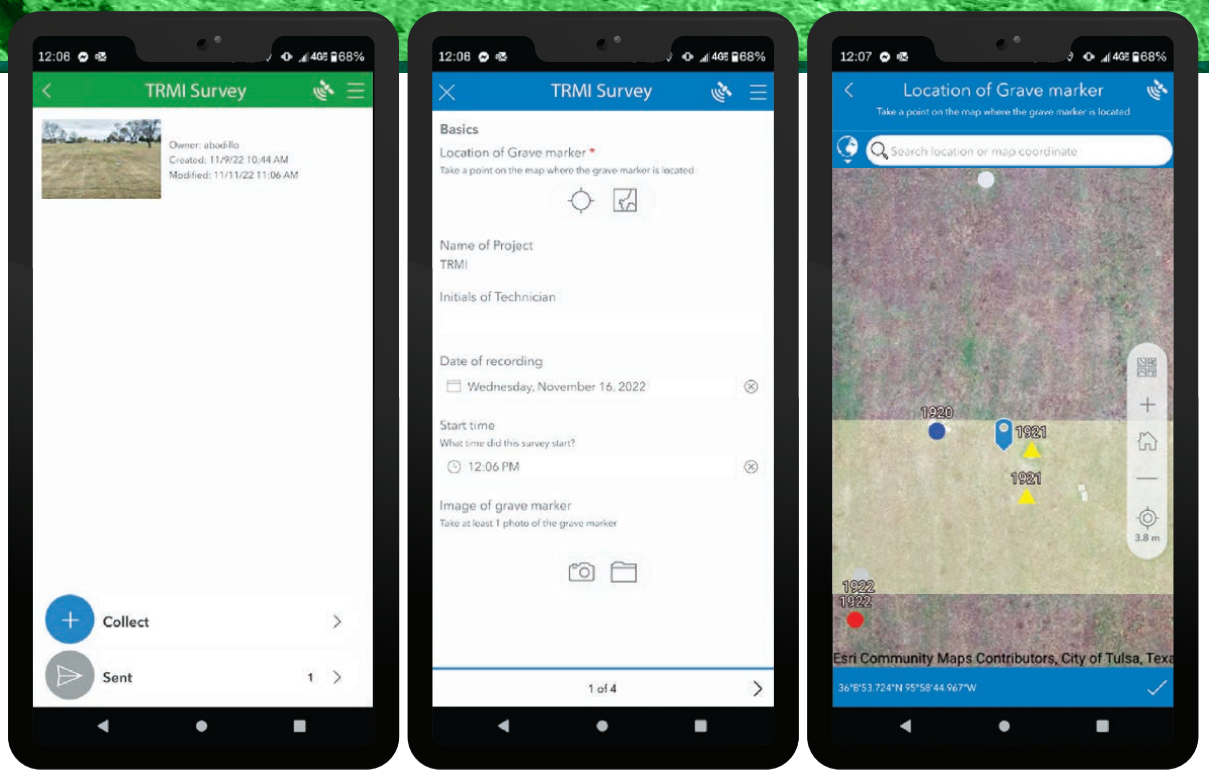
Each burial plot is carefully documented using SfM photogrammetry methods. The result is a 3D

↑ Green indicates graves that have been exhumed. Blue shows graves that are being excavated. Gray marks burial locations that haven't been exhumed.

geodatabase where the digital burials are shown within a large trench under a digital representation of the cemetery surface. Each 3D model retains its real-world coordinates and can be viewed and measured in ArcGIS Pro or ArcGIS Online.

Lastly, to make it easier to collaborate across teams, a dashboard built with ArcGIS Dashboards has been essential, according to Badillo. The dashboard allows team leaders to review files in the geodatabase—clicking through drone imagery, for example, to see the project's progress over time or images of excavated trenches.

"The dashboard is typically the most useful to people who are not specialists in GIS," said Badillo. "So I try to put a lot of effort into developing the dashboard and even the web scene. They can very quickly look at it, but if they need me to, I can open it up on the iPad and show them right there in the field to help with decisions."



← ArcGIS Survey123 was used to complete a headstone survey in the section of the cemetery where the team is working.

Reconnecting Fragmented Threads of Local History

Finding the graves of massacre victims is one of many stages of the investigation. Identifying those exhumed could take much longer—perhaps decades. It requires matching DNA samples to those of a living relative who has submitted DNA for ancestry analysis or other purposes.

Intermountain Forensics is the laboratory assisting the city with DNA analysis and helping create genetic genealogy profiles. The project leaders—Stackelbeck and forensic anthropologist Dr. Phoebe Stubblefield from the University of Florida—have also welcomed Nails-Alford, a community liaison, as a member of their team. Nails-Alford enriches their work in ways that are both personal and meaningful.

"She leads us in our morning prayer and our ending day devotions," Stackelbeck said. "She has excavated with us. She has screened dirt to look for artifacts. She has helped us monitor the backhoe work while we're looking for the graves. She has done all of that."

Being on-site and learning about investigation strategies has given Nails-Alford a greater appreciation for the complexity of the work required to identify victims.

"My great-grandmother is buried here at Oaklawn somewhere, but I may never know where," she said. "We're already giving a family the opportunity to know who their loved one was and to give them that opportunity to memorialize them in the way that they see fit. And for us to be working towards giving other families that opportunity means so much to me."

→ Using GIS allows researchers to identify target areas for excavation with precision.

↓ The Tulsa graves investigation team uses drones daily to record imagery.

A New Era for Creating Apps

The future of app building is here. As ArcGIS Configurable Apps and ArcGIS Web AppBuilder approach their retirement in ArcGIS Online in Q1 2026 and in ArcGIS Enterprise in Q2 2025, it's time to explore the vast possibilities offered by ArcGIS Experience Builder and ArcGIS Instant Apps.

These modern tools are designed to help users re-create their existing apps or build new ones with ease. The November 2024 ArcGIS Online update introduced several features that help users construct robust web apps with minimal effort.

Create an Immersive Web App

ArcGIS Experience Builder is a highly configurable app for building web apps optimized for mobile devices—and it requires little or no coding. Users can choose a template and create an immersive web experience for their target audience by unifying web apps, web pages, interconnected widgets, and both 2D and 3D data through a flexible drag-and-drop interface.

The November 2024 update to ArcGIS Online introduced express mode in Experience Builder. This feature simplifies the app-building process by enabling users to create mapcentric apps, with one map taking up one page. As many users transition their apps from Web AppBuilder to Experience Builder, express mode's familiar workflow makes the rebuilding process easier and more efficient.

In addition to the new express mode, Experience Builder offers a variety of widgets and features to support app migration. In the November update, the Draw widget added a text annotation tool for incorporating notes, and the Filter widget made it so that users can apply SQL expressions to filter layers at runtime. The Search widget enables users to easily locate places in a specific country or region on a map, and the Map widget allows users to zoom to selected features by attribute using URL parameters.

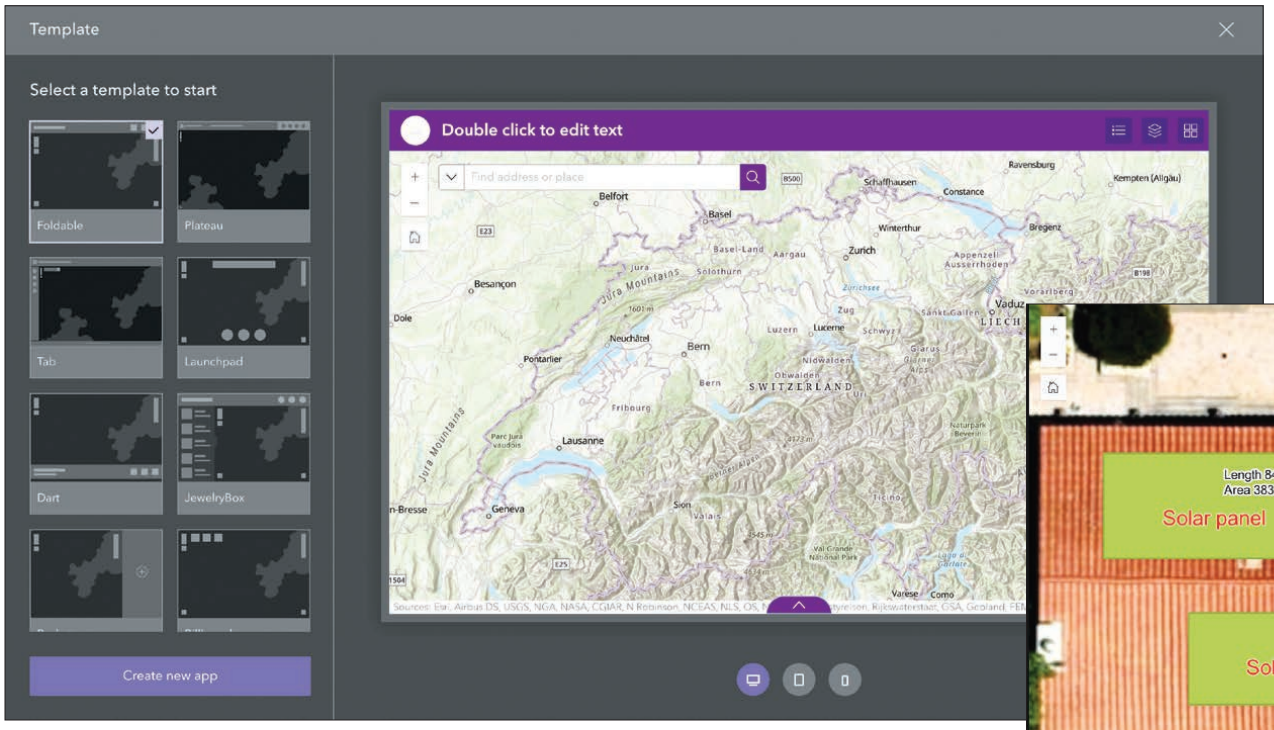
The November update also introduced the Accordion widget and enhancements to a few popular widgets that make it easier to build robust and modern apps.

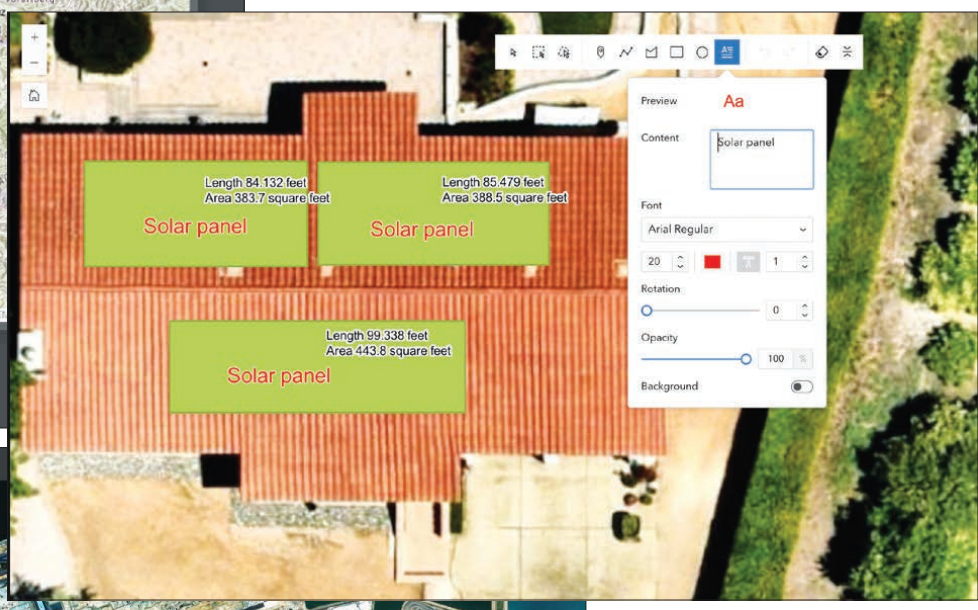
- The Accordion widget allows users to group other widgets one on top of another so they can be expanded or collapsed individually.
- The Elevation Profile widget now supports multiple elevation layers in the elevation profile graph, showing profile statistics for multiple elevation layers and the volumetric objects profile.
- The Business Analyst widget now supports drive-time options that enable users to activate travel modes and traffic options when creating drive times.
- The Near Me widget has been enhanced to offer several new capabilities, including the ability to search results as input locations, display results on a map regardless of layer visibility, automatically update an app based on the map extent, and return only intersecting features on a map.

These are just a few examples of the portfolio of widgets available to help users rebuild their apps and make new ones in Experience Builder.

Experience Builder is built on Esri's latest web mapping technology, ArcGIS Maps SDK for JavaScript. This means that users can expect optimized performance and expanded capabilities that will enhance the app creation process.

↓ Express mode in ArcGIS Experience Builder makes the app-building process simple.

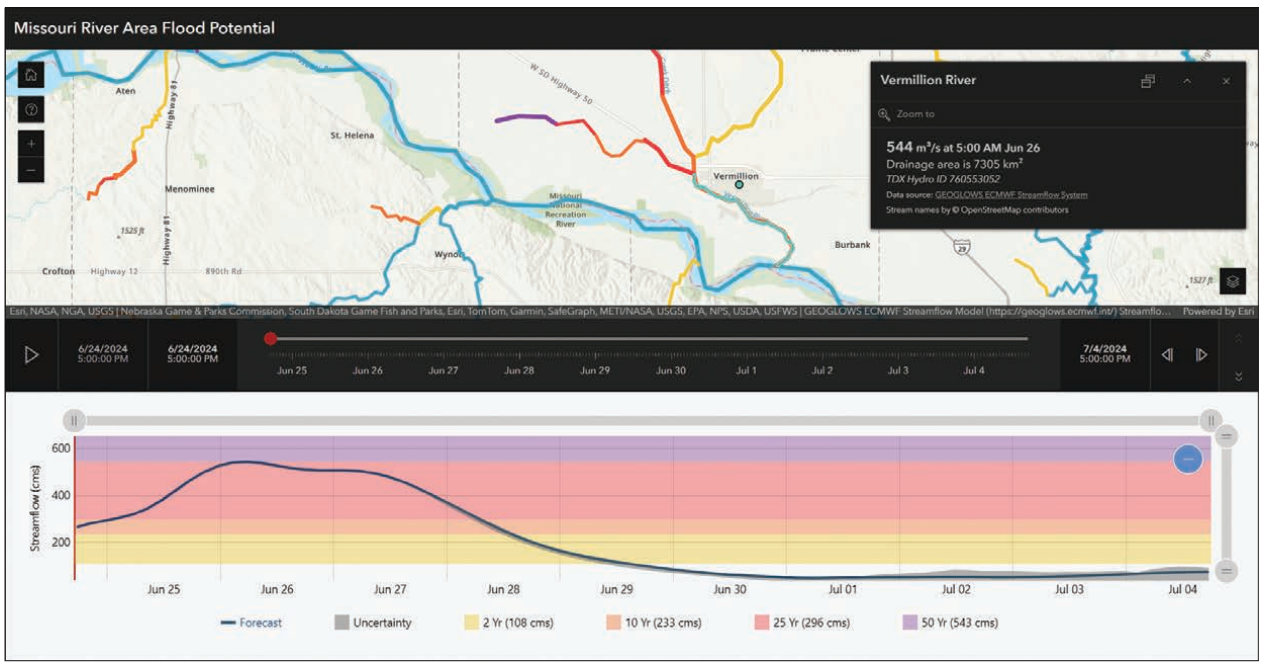




↑ The Draw widget lets users add notes to their maps in Experience Builder.

← The Elevation Profile widget in Experience Builder shows multiple elevation layers.

↑ The Compare template in ArcGIS Instant Apps allows users to compare multiple maps and scenes.



↑ In the Streamflow Viewer template in Instant Apps, the chart and time slider are both interactive.

Build Apps in Minutes with Templates

ArcGIS Instant Apps empowers users to rapidly create interactive web apps for diverse GIS workflows without doing any coding. By choosing from a library of more than 20 preconfigured templates, users can create focused web apps in minutes that serve the needs of distinct audiences. Prebuilt customization options enable users to make accessible web apps that are optimized for mobile devices without needing to have specialized skills or experience in GIS.

Several new templates released last year were designed to simplify workflows and aid users in the app migration process. The new language switcher function enables users to create multilingual instant apps, expanding the reach of their apps. Additionally, two of Esri's most popular Configurable Apps templates, Crowdsource Manager and Crowdsource Reporter, now have replacements in Instant Apps:

- The Manager template allows users to edit geometry on a map or modify data in a table view within multiple maps if there are editable layers.
- The Reporter template enables users to submit reports; interact with existing reports; and collect feedback through comments, likes, and dislikes.

Instant Apps continues to evolve to help users quickly build advanced web apps. The November 2024 update of ArcGIS Online included the following three new templates, which are designed to expand users' app-building capabilities:

- The Compare template allows users to compare multiple maps and scenes at the same location or multiple locations on the same map.
- The Streamflow Viewer template enables users to explore streamflow forecasts around the world through an interactive graph and time slider, as well as access streamflow forecasts over a 10-day period.
- The Observer template lets users examine 3D data with an attribute filter, a summary statistics scoreboard, and a time slider to demonstrate impact over time.

As with Experience Builder, Instant Apps is built on JavaScript Maps SDK, which provides a more advanced and modern app-building experience.

Important App Retirement Dates to Note

For ArcGIS Online users, the last version of ArcGIS Online that will allow users to create apps with Configurable Apps and Web AppBuilder in their organizations will be the October 2025 update to ArcGIS Online. Both Configurable Apps and Web AppBuilder will be retired from ArcGIS Online in the Q1 2026 release. Apps made with Configurable Apps will no longer be accessible after the retirement date. Existing Web AppBuilder apps will continue to function postretirement, though updates to browsers could introduce functionality or security issues that Esri will not be able to address.

For ArcGIS Enterprise users, the final version of ArcGIS Enterprise that will support Configurable Apps and Web AppBuilder will be the Q2 2025 release. Users will be able to access apps built with Configurable Apps in older versions of ArcGIS Enterprise, since those apps are self-hosted. Newer versions of ArcGIS Enterprise, however, won't allow access to existing apps built with Configurable Apps, nor will users be able to create new apps with it. Web AppBuilder users will be able to access their existing apps in newer versions of ArcGIS Enterprise, but they will not be able to produce new apps with the product. ArcGIS Enterprise users will receive limited support for their Configurable Apps and Web AppBuilder apps, in accordance with the ArcGIS Enterprise lifecycle.

Esri is planning to retire classic Esri Story Maps in ArcGIS Online in Q1 of 2026, and any stories created with classic Esri Story Maps will no longer be available. These stories should be transitioned to ArcGIS StoryMaps, which is built on Esri's most up-to-date web mapping technology. Classic Esri Story Maps was retired in ArcGIS Enterprise at version 11. Published stories will still be available in ArcGIS Enterprise 10 and below.

Map Viewer Classic is being retired in Q1 of 2026 and will be removed from ArcGIS Online. Esri recommends that all users switch over to the new Map Viewer, which is built on Esri's latest web mapping technology. The final version of ArcGIS Enterprise that will include Map Viewer Classic will be released in the first half of 2025.

For additional information about the migration process, read "ArcGIS Configurable Apps Roadmap for Retirement" at links.esri.com/config-apps and "ArcGIS Web AppBuilder retirement" at links.esri.com/wab-retire.

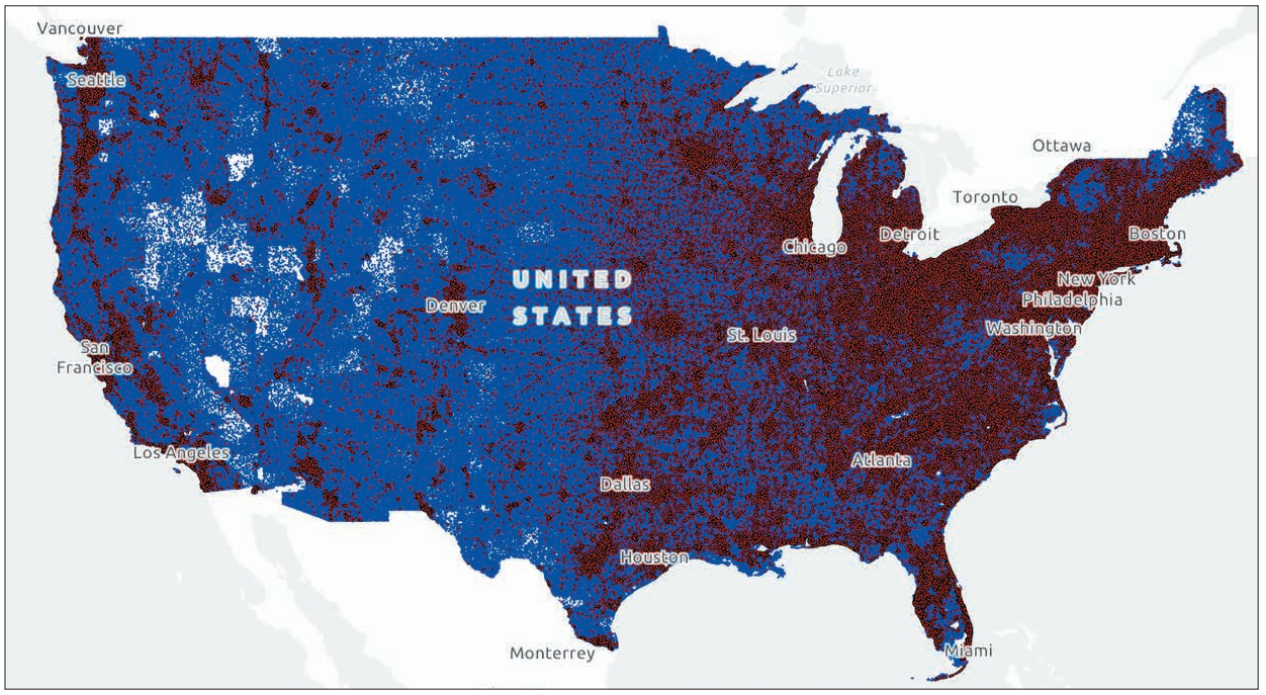
To Survey Health-Care Adequacy, ArcGIS GeoAnalytics Engine Simplifies Analysis

Health insurance plans need to provide policy holders with a sufficient number of in-network providers and services. This is called network adequacy, and it ensures that patients can access necessary medical care when they need it, without having to travel far.

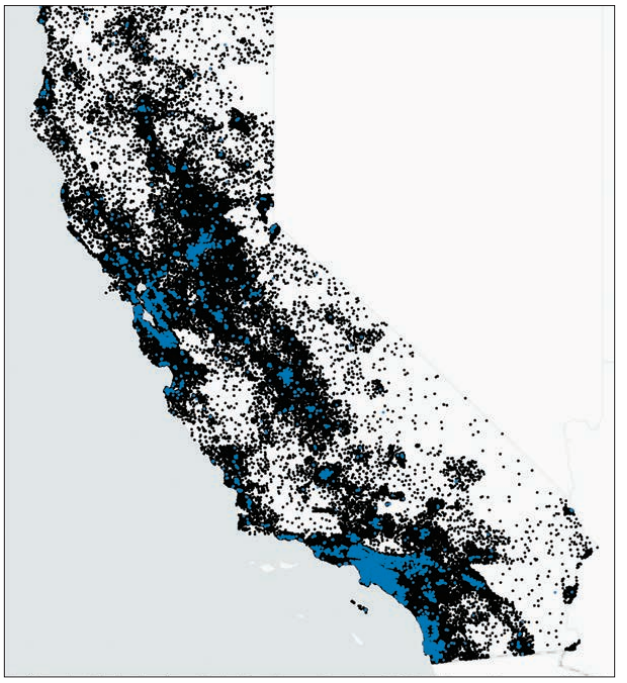
Monitoring network adequacy involves large datasets and complex calculations to confirm that health plan networks—including doctors, hospitals, and specialized centers—are within reach for all members. Understanding network adequacy is challenging due to the stringent federal and state regulations that govern health care.

To simplify the process of calculating network adequacy, health-care companies can employ advanced tools such as ArcGIS GeoAnalytics Engine. This library for Apache Spark, which provides a collection of spatial SQL functions and analysis tools, efficiently processes large geospatial datasets and enables users to apply smart spatial heuristics—ways to minimize the number of calculations that need to be made.

For perspective, a brute-force approach to calculating network adequacy might require GeoAnalytics Engine to perform up to 768 trillion network calculations at the national level. Even determining network adequacy for regional health-care plans often requires conducting billions of calculations. But techniques such as using spatial partitioning and creating service areas can optimize the geographic relationship between patients and providers and make it easier for health-care organizations to run these calculations more regularly. And that's what GeoAnalytics Engine does well.



↑ Visualizing the number of potential households (in blue) and providers (in red) across the United States shows how complex it is to calculate network adequacy.



↑ The scale of calculations that have to be done to compute network adequacy in just the state of California—as seen in this map, where potential households are shown in black and providers are in blue—is still vast. (Provider locations obtained from the National Plan and Provider Enumeration System.)

How to Break Down a Very Large Issue

To demonstrate how health-care organizations can tackle this issue, let's conduct a simulated study on primary care providers in California and the organizations' distance standards.

California has more than 13 million households. In the network we're simulating, there are more than 24,000 health-care providers. Determining the network adequacy of this group of providers yields well over 300 billion potential calculations—so this is a very large issue.

To explore this problem at scale, we'll leverage the elasticity of GeoAnalytics Engine along with the scalable computing

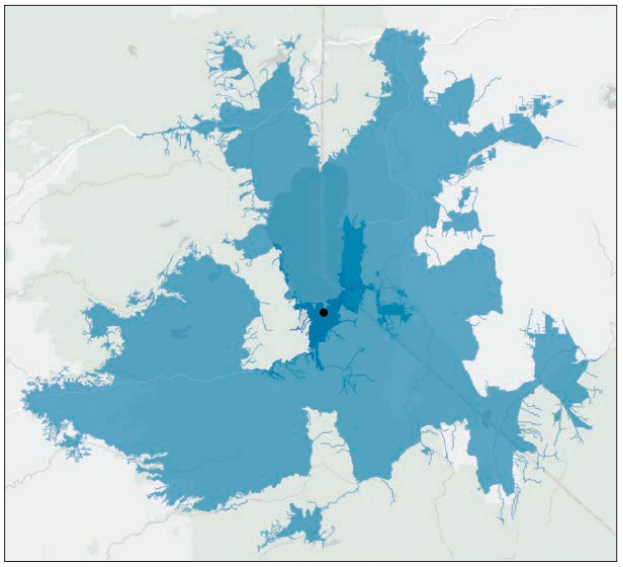
environment provided by the Spark-based Databricks Data Intelligence Platform. In addition to using scalable spatial functions and tools that take advantage of Spark's distributed processing capabilities, we'll use smart spatial heuristics such as using partitioning, creating service areas, and employing binning to make the problem smaller.

Smart Spatial Partitioning

The first heuristic we can apply to this problem is Euclidean distance—the measurement of the straight-line distance between two points—to identify which facilities (representing one or more providers) are near enough to each county to potentially demonstrate network adequacy. For example, if a health-care provider requires that 90 percent of its members in a particular county have a primary care provider within 15 miles of where they live, then all facilities offering primary care that are located in the county as well as those up to 15 miles away from it could meet that standard.

To identify these providers, we first use GeoAnalytics Engine to create buffers around each county that corresponds to this accessibility standard. Then we apply a spatial join to match which facilities are within 15 miles of each county's border. The calculation shows how many facilities there are and includes the primary care providers who practice there.

↑ The light blue buffer around Sonoma County, California, incorporates providers (the black points) that correspond to our specifications.



↑ Light blue boundaries around one facility (the black point) represent drive-time distances from this facility at 10, 20, and 60 miles.

By matching each facility that is inside a county or up to 15 miles from it, we have substantially reduced the number of origin-destination calculations—or how far patients living on the edge of each county would have to drive to get to a medical provider—needed to complete the adequacy analysis. Applying a brute-force approach to this would have required more than 300 billion calculations. Snapping providers to facilities would have reduced that to around 54.2 billion calculations. But employing smart partitioning using county buffers reduces the number of required calculations to 4.5 billion, eliminating more than 90 percent of the calculations that would have had to be done using either of the other methods.

Creating Service Areas

In many cases, network adequacy is determined based on Boolean criteria, which employ true-or-false logic to measure whether a provider is located within or outside a specified distance. In our example, if 90 percent of members must have a primary care provider within 15 miles of their home, then we can measure adequacy by distinguishing how many members are within 15 miles of a provider compared to how many members are farther away. Rather than calculating the distance between each member and each provider, we can use GeoAnalytics Engine to create service areas to delineate the 15-mile boundary around each provider.

By applying the Spatiotemporal Join tool or the SQL function ST_Within, these service areas can be dissolved together into one geometry to determine who is inside versus outside the service area. Moreover, when nearby counties have the same standard, we can use the same service area to perform multiple county-level analyses instead of analyzing each county individually.

Employing this heuristic, followed by a spatial join and a dissolve, to determine which households are within the service area and which are not means that 4,000 service area calculations need to be done—rather than hundreds of millions of network distance calculations, which would then need to be filtered.

Aggregating Points Using Bins

Instead of using spatial joins and dissolves, we can apply another heuristic to simplify our problem: We can create a hexagon tessellation grid—a grid of cells with an area and shape that cover a specified extent—to calculate the average distance or time it takes to travel across an entire network.

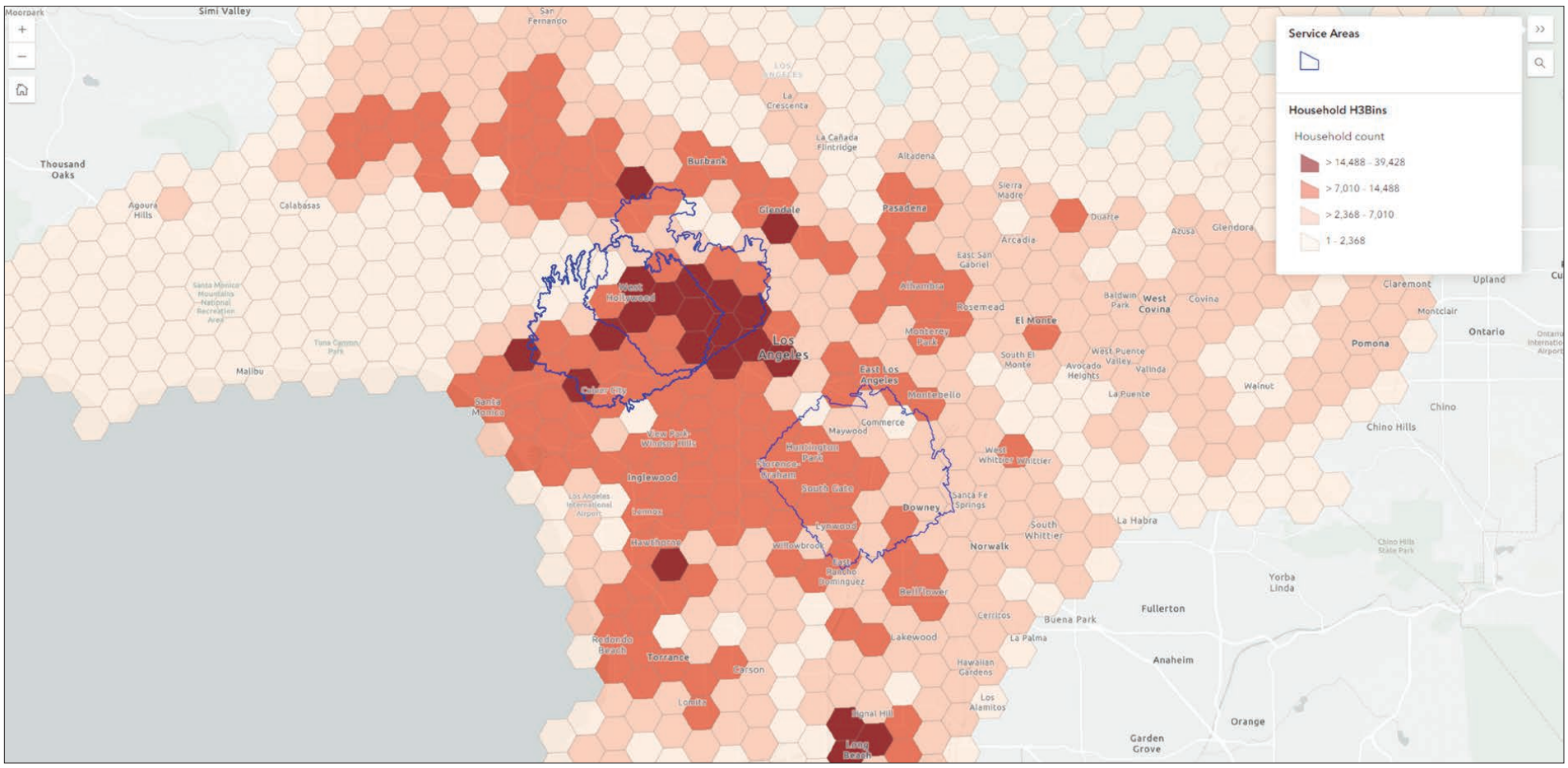
GeoAnalytics Engine provides SQL functions such as ST_H3Bin and tools like Aggregate Points that use standardized hexagon bins to aggregate, for example, the number of insurance plan members in a bin. This method simplifies the process of calculating network adequacy by allowing attribute joins based on bin IDs.

Let's say we have 50 bins with 100 members in each of them, plus 20 providers. Performing a spatial join would involve testing 5,000 member points against 20 provider service areas, which would warrant 100,000 comparisons. With bins, however, we only have to test 50 bin centers against 20 provider bins, which results in making 1,000 comparisons. Then we multiply the results for each bin by the number of members. This reduces the computational load significantly compared to performing spatial joins.

Faster, More Precise Results

Using GeoAnalytics Engine to calculate network adequacy for health-care plans speeds up the analysis process and enhances the precision of the results. It is a valuable tool for health-care companies to use to improve service accessibility.

To learn more about how to conduct both simple and complex analyses using GeoAnalytics Engine, head to go.esri.com/healthcare-geoanalytics.



↑ Each bin shows the number of households near a service area that is within the specified distance or drive time to meet network adequacy rules.

In Africa, Sustainable Development Hinges on Having Accurate Basemaps

↑ Accurate basemaps help governments and organizations encourage development, improve sustainability, stimulate economic growth, and build climate resilience.

Without accurate and up-to-date basemaps, governments and other organizations face significant challenges. It is difficult to monitor crops to ensure food security, respond quickly and efficiently to natural disasters, track species to boost conservation, and plan critical infrastructure upgrades. Reliable basemaps are the foundation for efforts to protect people; advance economic growth; safeguard animals, plants, and their habitats; maintain facilities, roads, and utilities; and develop climate resilience.

Unfortunately, many African countries lack sufficient basemaps. That's why—in addition to leading programs in Africa that promote the use of geospatial technology, geographic literacy, and data sharing—Esri is spearheading the new Map Africa initiative to create detailed, authoritative basemaps for every single country on the continent.

"It's going to be a transformational project to ensure that every African country has access to reliable and up-to-date basemap data," said Sohail Elabd, Esri's director of international strategies. "Once countries have these basemaps, they can leverage them to plan infrastructure projects, manage land and cadastres, prepare for extreme weather, and build resilient cities. The opportunities for positive impact are endless."

Breaking Down Geospatial Barriers Throughout Africa

Esri's existing 2D and 3D basemaps cover the globe—but basemaps are better in some areas of the world than others, depending on how advanced mapping operations are in each country. In many African nations, structural and economic challenges have hindered the development of robust GIS at the national level.

To help modernize mapping operations throughout Africa and in other low-income economies, Esri has offered its technology—including maintenance updates and support resources—at a fraction of the normal price to qualifying land administration and cadastral agencies for the past decade.

In addition, in 2019, Esri launched the Africa GeoPortal, a free platform that gives users across the continent access to ArcGIS technology, Esri's e-Learning resources, and collaborative data-sharing tools. This initiative was designed to eliminate barriers to accessing geospatial technology and empower users to address local challenges using GIS.

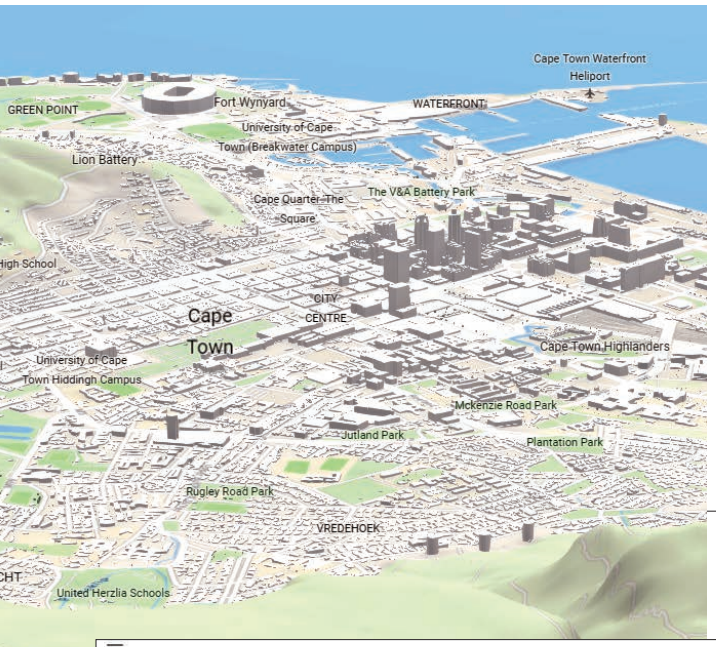
"The idea behind the Africa GeoPortal is to make geospatial technology accessible to everyone," said Elabd, the visionary behind the Africa GeoPortal. "It removes the obstacles that exist throughout much of Africa and allows people to focus their energy on building local solutions to address local problems."

The Africa GeoPortal—which has more than 10,000 active accounts and records an average of 4,500 unique sessions per month—has greatly expanded access to geospatial technology and training across the continent. But it hasn't resolved one critical issue: that African countries need reliable and comprehensive basemaps to encourage development, improve sustainability, stimulate economic growth, and more.

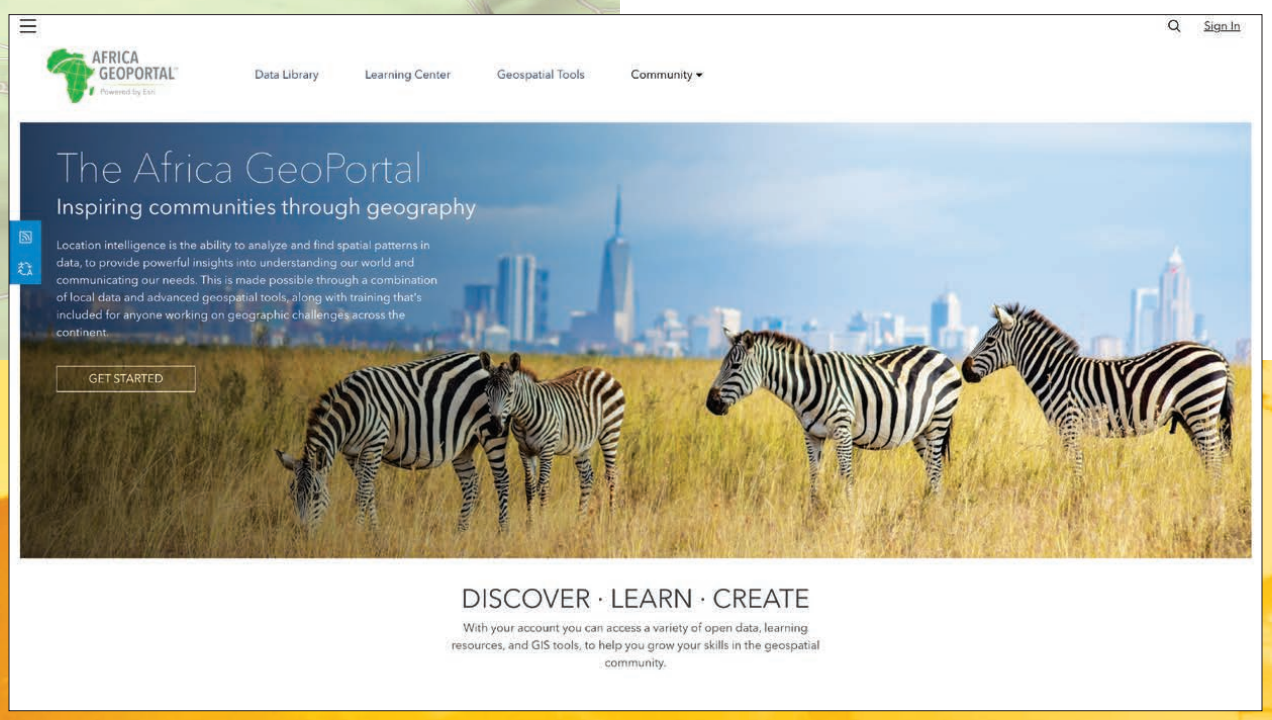
Developing Comprehensive Basemaps for Africa's Future

Esri's next major initiative, Map Africa, aims to create high-quality basemaps for every African country and provide them free of charge. These basemaps will leverage the latest ArcGIS technology, geospatial artificial intelligence (GeoAI), and partnerships with leading imagery providers to deliver a transformative resource for the continent.

"This will substantially raise the bar in terms of the quality of basemaps available in Africa," said Deane Kensok, Esri's chief technology officer for ArcGIS content. "It's not just about providing maps; it's about empowering local agencies to maintain and enhance those basemaps over time, ensuring their long-term value."



← The Map Africa initiative will create high-quality basemaps for every African country and provide them free of charge.



↓ The Africa GeoPortal gives users working in Africa free access to ArcGIS technology, Esri's e-Learning resources, and data-sharing tools.

The project is designed with sustainability and capacity building at its core. Esri plans to establish regional data production hubs in northern, eastern, western, and southern Africa, where local professionals will gather and process data. These hubs will also host trainings for national mapping agency staff to learn how to update, maintain, and secure their basemaps. This will enable national governments to use the basemaps for infrastructure planning, economic development, and strengthened climate resilience.

The first year of the initiative will focus on setting up the hubs and producing the initial basemaps. The next two years will be spent rolling out the basemaps to African countries, incorporating technological enhancements, and refining data layers. By 2030, Esri aims to have every African country using and maintaining comprehensive national basemaps.

A long-term goal of Map Africa is to encourage the development of a continent-wide spatial data infrastructure (SDI) to support intercontinental trade, collaboration, and planning. This SDI would allow African nations to share consistent, high-quality geospatial data across borders, enabling joint efforts in key areas such as disaster response, drought management, climate adaptation, and infrastructure development.

"For the first time, Africa will have high-quality basemaps that cover the entire continent," said Elabd. "This could open the door to unprecedented regional collaboration, fostering sustainability and planning initiatives that will benefit all the nations involved."

The Time to Act Is Now

Esri is actively working with a range of partners to secure the funding required for the Map Africa initiative. Collaboration with regional organizations, governments, and private-sector partners will ensure that the initiative aligns with local priorities and delivers maximum impact.

"We are working with stakeholders across Africa to ensure that Map Africa not only delivers high-quality basemaps but also creates a sustainable framework for their ongoing use and development," Elabd emphasized.

The Map Africa initiative, alongside the Africa GeoPortal, represents a remarkable opportunity for African governments, regional organizations, and development partners to shape the continent's future. By collaborating with Esri, stakeholders can leverage cutting-edge technology and comprehensive basemaps to drive domestic development and foster intercontinental cooperation.

Now is the time to act. Join Esri in building a reliable geospatial foundation for Africa that empowers nations to address local challenges, unlock regional opportunities, and pave the way for a prosperous future. Anyone interested in this project can email MapForAfrica@esri.com or reach out to their local Esri representative with inquiries or to share ideas.

Working together, this vision can become a reality.

Outsmart the Weather.

Free weather data has limitations, it can be too scattered, vague, and confusing – making confident decisions difficult.

Baron's historical, current, and forecast data delivers precise weather insights exactly when and where you need them.

Our solution is tailored to your needs and maximizes your Esri® GIS asset and location data so you get the information you need to act confidently and quickly.

Combining Baron Weather and Esri platforms empowers mission-critical decision-making and safeguards property and lives.
Let's outsmart the weather together.

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Real Estate Advisers Use GIS to Connect Systems, Automate Data Integration

For businesses of any size, the decision to expand can help increase profits and reach new customers. This may involve adding physical locations or obtaining new spaces to produce goods. KBC Advisors assists clients with managing and executing the best real estate outcomes for their businesses using data-backed guidance. With a focus on premier industrial space, KBC's full-service platform caters to tenant, landlord, and investor needs.

To show the availability of commercial sites and their locations, the location intelligence team at KBC Advisors used to use an external app to track existing assets and land sites, export the files, and then upload the information into a separate system for visualization. This process was time-consuming and required team members to focus to avoid making errors while moving information from system to system.

In search of a better solution, KBC's location intelligence team implemented ArcGIS Data Pipelines for more seamless data integration with ArcGIS. This has improved the accuracy of data and automated processes—saving time, enhancing efficiency, and enabling the location intelligence team to more effectively deliver clients and real estate brokerage professionals the data they need.

A Disconnected, Manual Process

In KBC's old workflow, the location intelligence team would create data and track projects and business deals in external platforms. A GIS analyst would then use ArcGIS Pro to plot the coordinates of available site locations and publish them to ArcGIS Online. The web layers displaying the data were then showcased in client-facing apps—but they would quickly become out-of-date.

The disconnected systems translated to too many manual steps, leading to inefficiencies and errors. Information was extracted dozens of times a week, so KBC's GIS team wanted a more efficient process for data visualization.

"*[The process]* was too slow," said James Drumm, director of services and technology at KBC Advisors. "Edits in either application weren't always being tracked in the other application."

This was critical when tracking whether a potential site was available or unavailable. The most current status was not always reflected in the system because the data was based on a static spreadsheet downloaded at the time rather than on real-time data.

Streamlined Data Integration

Drumm began searching for a new solution that would help integrate outside apps with ArcGIS. After receiving email notifications about a new Esri product, Drumm and the GIS team became early adopters of ArcGIS Data Pipelines. This app streamlines data integration in ArcGIS Online by offering an efficient way to ingest, prepare, and maintain data—even if it's in a separate system.

The group still needed to use a mediary data storage solution, however. When Drumm saw that Data Pipelines supported Microsoft Azure Blob Storage as an input data source, he chose that as the intermediate connector between ArcGIS Online and an outside platform.

Drumm and KBC's team of GIS analysts began using Data Pipelines in late 2023, and use "exploded" after they established a connection to their Azure Blob Storage container, said Drumm. He added that the team found Data Pipelines easy to learn and use and that connecting the cloud storage container was very straightforward.

The implementation process began by having KBC's internal Microsoft Azure specialist set up a job that would push the data from an external platform to Azure Blob Storage. From there, Data Pipelines can access the latest data.

The integration process is now automated and set to a schedule. Azure Blob Storage refreshes multiple times per day, and the respective data pipelines are scheduled to run at the same cadence. Using this process, the data in ArcGIS Online is updated every few hours, ensuring that the latest changes are reflected throughout the day.

Real-Time Data Reflection

The revamped workflow with Data Pipelines has streamlined operations and offered many benefits to the location intelligence team's daily workflows, according to Selena Lawson, GIS manager at KBC Advisors. The use of Data Pipelines has saved time, and many of the data pipelines run multiple times per day, Monday through Friday. So instead of having the team spend time on manual extract, transform, and load (ETL) processes, any data updates get automatically reflected in ArcGIS Online.

"This real-time reflection of the data ensures our users have the most up-to-date information we can provide," said Lawson.

Data Pipelines has vastly improved the team's speed and reliability, according to Drumm. The scheduling feature that lets the location intelligence team schedule data updates based on a specified time frame is critical and helps ensure the availability of current data. The recurring Azure Blob Storage refresh operation takes only seven minutes, and then the data pipelines that are connected automatically kick off shortly afterward to update the feature services in ArcGIS Online. In total, the updates take less than 20 minutes.

"Due to the scheduling function, we can redirect much of our focus from repeat tasks to more intricate analyses and deliverables," said Lawson.

Automation Improves Accuracy

Data accuracy has improved with Data Pipelines as well. Now, after researchers enter the data into KBC's main database, Data Pipelines moves it into ArcGIS Online without any additional human interaction. According to Lawson, this ensures that "the schemas match, data is formatted correctly, and no time is spent correcting transformation errors."

If an error is made when data gets entered, however, the data pipeline will catch and correct it, and the cleaned data will be reflected in ArcGIS Online.

"The data update capability enables us to no longer rely on multiple sources and users for data input. Because of this, there are virtually no human errors or manual time spent on the Esri side of things," said Lawson. "This saves an average of 75 percent of our analysts' total time spent on data update requests."

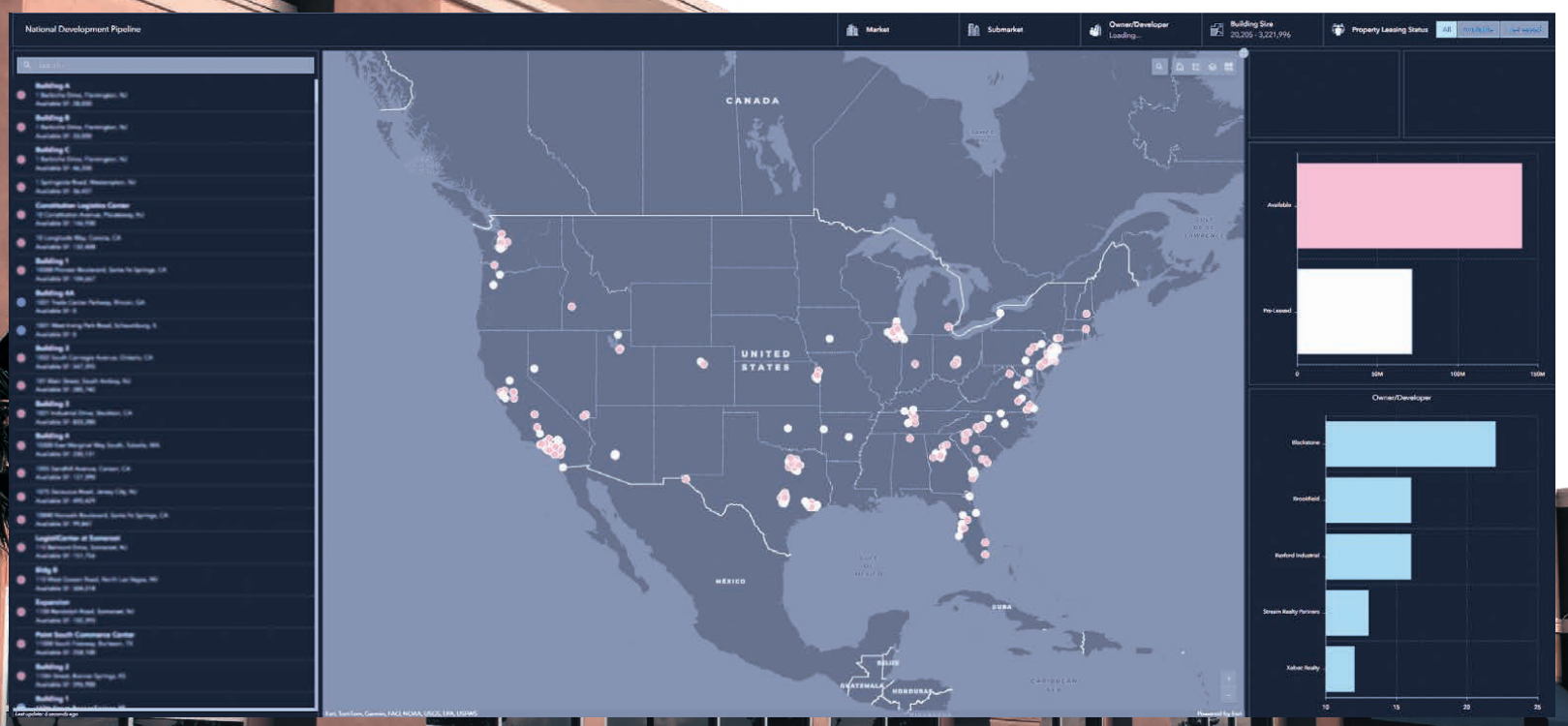
Moving data is no longer an issue for the team, either, because it is automated.

"This saved time allows our analysts to focus on location analysis, serving our clients, and building custom applications instead of data cleanup and updates," said Drumm.

Plotting the coordinates of commercial sites comprises 99 percent of the location intelligence team's workflow, according to Drumm, so it is critical work. The new workflow with Data Pipelines means that the team is no longer converting tabular locations into a feature service to show it on a map. The Create geometry tool in Data Pipelines is used instead to create a point geometry field from a tabular dataset that contains longitude and latitude fields and then update an existing feature service automatically.

The GIS team has now created hundreds of feature layers with Data Pipelines. With all that data being connected, accurate, and available in ArcGIS Online, deliverables such as a labor study or a site survey comparison can be done in a day, not weeks, helping KBC better serve its clients.

"One of the most important things in our industry…is speed combined with accuracy. So if I can cut out manual steps, if I can cut out extra people doing things, if I can cut out you having to enter data in four different systems, that just vastly improves our speed to a solution," said Drumm. "My personal goal for the team is speed and accuracy, and we can meet that."



← Having real-time site availability data connected to ArcGIS Online has improved accuracy and efficiency.

Pittsburgh Lights an Innovative Path to Streetlight Design

By Nick Mesler, Evari GIS Consulting

Pittsburgh, Pennsylvania, has more than 35,000 overhead streetlights, including many that are old and historic. Some are cobrahead light fixtures that extend over the street, with different mast arm lengths, heights, and orientations. Others are decorative and come in various shapes and sizes.

The city also has significant elevation variability. For example, Pittsburgh's Canton Avenue has a 37 percent grade, making it the steepest officially recorded public street in the United States. To light this street properly, the lighting at the top of the hill must not distract drivers by shining directly into their eyes.

When city staff members created a plan to install 3,000–15,000 new streetlights, they needed maps that showed not just the locations of existing and proposed streetlights but also where lighting was most needed. In addition, mobility experts required lighting data to evaluate lighting on infrastructure such as bike lanes, and environmental professionals needed information to assess lighting impacts on protected and sensitive habitats across Pittsburgh. City staff also had to determine where to add or remove lighting and evaluate which streetlight manufacturer to choose.

All these requirements called for implementing a new GIS solution—a specialized ArcGIS Pro script tool created for the project by Esri partner Evari GIS Consulting.

Adjusting to Twists and Turns

In general, utility or traffic engineers employ the same computer-aided design (CAD)-based tools that are often used for indoor lighting to decide where to install streetlights. Street and roadway lighting designs are based on 10–20 typical layouts that represent various public rights-of-way. For example, lighting a four-lane arterial roadway is usually done in the same way everywhere in the United States, regardless of context.

While this process generally works, it doesn't account for Pittsburgh's complexities, including the city's elevation variations, twists and turns, and mix of decorative and utilitarian lights. So city staff began considering a more innovative, context-sensitive approach to complement conventional designs.

Using GIS for this seemed like a good option, but there was a problem. GIS has often been used to show streetlight locations—and sometimes even connections to circuits and other aspects of the electric grid—as mapped points. But it was much less common—if it had ever been done at all—to show, at scale on a map, the distribution of light from street lighting.

A New Way to Analyze Lighting

To help optimize street lighting for Pittsburgh's particular conditions, a team at Evari developed a specialized ArcGIS Pro script tool called EvariLUX that assesses ground-level illumination using standard lighting specification files. The tool integrates horizontal and vertical angles from these files with elevation data from the US Geological Survey's 3D Elevation Program to calculate light distribution from streetlights.

The resultant 3D "illumination surface," generated in ArcGIS Pro, is hosted in ArcGIS Online and expressed by points and contours with scale-dependent symbology. This allows lighting designers to quantify how much illumination reaches the roadway, bike lanes, sidewalks, and private property. It also lets city staff analyze the data at small and large scales.

Using GIS-native data related to the streetlight infrastructure and the quantity of lighting across the city, the Evari team also examined street lighting inequities from neighborhood to neighborhood. For each neighborhood, the team considered nighttime and twilight collision history, environmentally sensitive areas, land-use needs, the presence of bike lanes and transit stops, proximity to schools and parks, and historical redlining—the practice of denying services to neighborhoods that have large racial and ethnic minority populations. The Evari team conducted these comprehensive analyses using ArcGIS Pro.

To evaluate collision history, the team considered a US Federal Highway Administration guideline that recommends upgrading lighting if at least twice as many traffic disruptions occur when lighting provides visibility compared to during daylight hours. Streetlight improvements can reduce collisions by up to 42 percent, according to Federal Highway Administration estimates. Using multiyear crash data, the team from Evari found that this guideline applied to 281 intersections across Pittsburgh.

Once the project team determined proposed lighting levels throughout the city, it compared existing lighting levels to each lighting manufacturer's designs and specifications. The team used a web app built with ArcGIS Experience Builder to create directly comparable web maps for each manufacturer's products, including how they would work in challenging locations such as Canton Avenue or Pittsburgh's major-league baseball stadium. Evaluation metrics for each lighting product included the following:

- Does it deliver the most illumination to the public right-of-way?
- Will it create the least light trespass, meaning the light and energy that leaves the right-of-way?
- Does it address nighttime high-frequency crash locations?
- Can it improve lighting conditions in underserved areas?

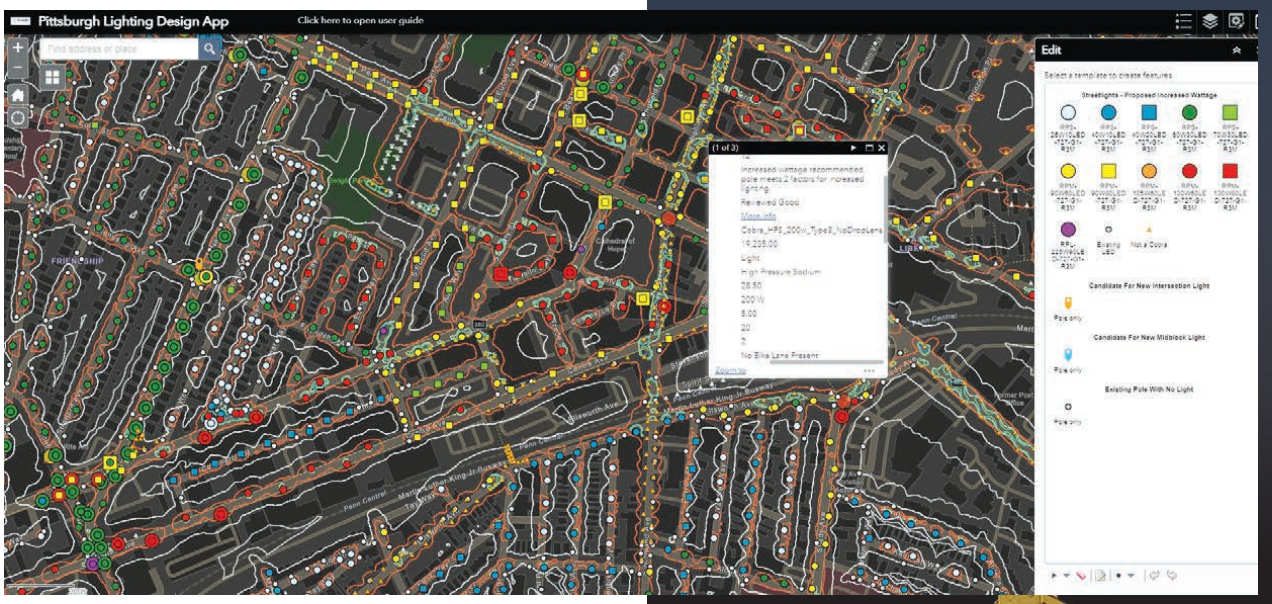
Tangible Benefits for Urban Areas After Dark

When city staff members compared street lighting gaps with the illumination results from Evari's script tool and specific lighting options from different manufacturers, it became clear that the city only needed to install about 1,100 new streetlights throughout Pittsburgh while upgrading others.

In addition to reducing construction costs by millions of dollars, this GIS-based approach has enhanced city staff's ability to make informed, data-driven choices. Likely benefits from this project will include millions of dollars in savings; the prevention of injuries and deaths on roadways over the lifetime of the fixtures; and improved quality of life and travel for people walking, biking, riding on public transit, and driving around Pittsburgh.

To learn more about EvariLUX, go to evariluxsolutions.com.

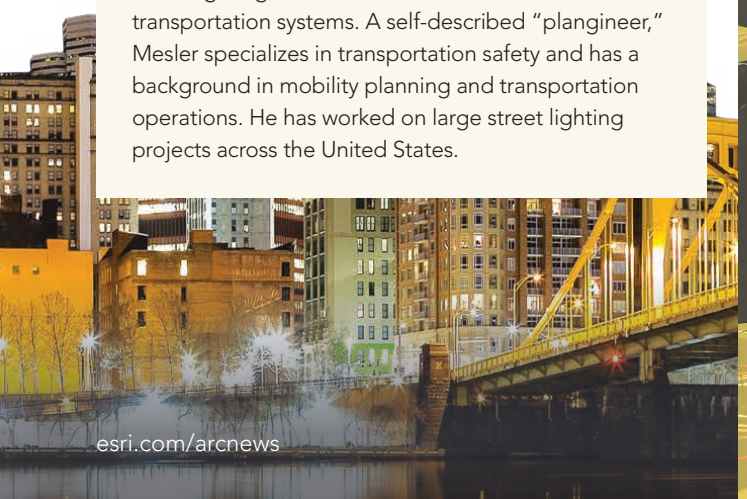
↓ A lighting design app identifies existing lighting and significant gaps in lighting and recommends where to upgrade lighting.



↓ Canton Avenue (center), officially the steepest street in the United States, has a unique streetlight illumination profile.

About the Author

Nick Mesler is a director at Evari GIS Consulting, where he takes a data-driven approach to designing street lighting, livable communities, and active transportation systems. A self-described "plangineer," Mesler specializes in transportation safety and has a background in mobility planning and transportation operations. He has worked on large street lighting projects across the United States.



ArcGIS Technology Bolsters Community Wildfire Protection Plans

By Victoria Amato, Anne Russell, Liz Hitzfelder, Sam Lashley, Montiel Ayala, and Arianna Porter, SWCA Environmental Consultants

Communities across the United States face an escalating threat from wildfires—a risk no longer confined to western states. In three of the last nine years, wildfires have scorched more than 10 million acres across the country—a figure that hadn't been reached in the three prior decades, according to the National Interagency Fire Center.

To adapt to and mitigate this growing risk, communities are moving toward more collaborative and transparent approaches to wildfire risk mitigation, enabling residents to more actively participate in the process. In line with these efforts, wildfire and GIS experts at Esri partner SWCA Environmental Consultants are using Esri products such as ArcGIS Survey123, ArcGIS Field Maps, ArcGIS Experience Builder, ArcGIS StoryMaps, and ArcGIS Hub to help residents create community wildfire protection plans (CWPPs)—reports that outline local priorities for wildfire risk mitigation.

Digitizing Wildfire Risk Assessments

Traditionally, communities across the United States have assessed their wildfire risk using paper forms adapted from National Fire Protection Association protocols. The assessment involves evaluating conditions in the wildland-urban interface—the transition zone between unoccupied land and land that's been developed by humans.

Using Survey123, SWCA's GIS team digitizes these forms, enabling risk assessment participants to input data in real time in the field and include notes and photos linked to their locations. In places such as Gilpin County, Colorado, SWCA has trained emergency management employees and other local stakeholders to use Survey123 to assess structural hazards related to potential wildfires.

The use of Field Maps enhances these assessments by giving participants mobile access to crucial data layers, offering baseline information and contextual understanding. The app also allows users to easily note significant on-the-ground details, such as ponds, stock tanks, narrow bridges, and closed roads, that might not be reflected in previously existing imagery. Users can also employ Field Maps to quickly create text-format data summaries that they can then share.

With Experience Builder, SWCA and its clients can tailor collected data and analysis results to present wildfire risks and mitigation strategies in easily accessible formats. The web apps created with Experience Builder let users navigate through various data levels—from community-specific insights to countywide overviews—that can improve residents' understanding of wildfire risks and engagement with mitigation plans.

In Inyo County, California, for instance, SWCA performed wildfire risk assessments for more than 40 communities where accessing specific community risk information would have traditionally involved navigating through extensive paper-based documentation. SWCA developed a custom Experience Builder app to simplify this process, enabling county residents and officials to easily locate their community's information—including risk levels, mitigation actions, and relevant geographic details—by simply typing in a town's name or navigating to it on a map. The app streamlined information storage, centralized the county's wildfire preparedness plans, and yielded a readily accessible system that can be updated at any time.

↑ The data portal on Santa Clara County's hub site helps share updated information across jurisdictions quickly and efficiently.

Hub Sites Communicate Plans

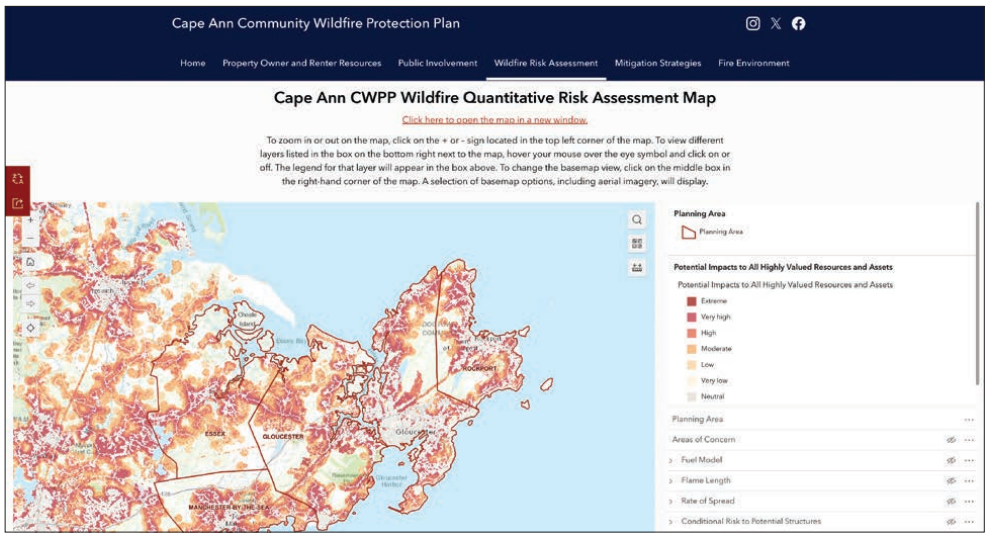
SWCA uses hub sites created with ArcGIS Hub to collect and display wildfire planning information for diverse community audiences. Whether a user seeks a high-level overview of wildfire planning efforts, ongoing projects, and financial expenditures or is looking for granular details of specific community engagement initiatives, the hub sites are a key tool for managing and communicating wildfire risk information.

In New Mexico, communities in the Sangre de Cristo Mountains faced unprecedented challenges in 2022 following the Hermit's Peak/Calf Canyon Fire—the largest wildfire in the state's history—which burned 341,735 acres. In partnership with SWCA, the New Mexico Forest and Watershed Restoration Institute created a hub site after the fire to serve as a central repository for vital information and to show the community's resilience and proactive stance after the disaster. The hub site, available at links.esri.com/hermit-calf, provides residents and stakeholders with comprehensive information, including updates on recovery efforts, new mitigation strategies, and community support initiatives.

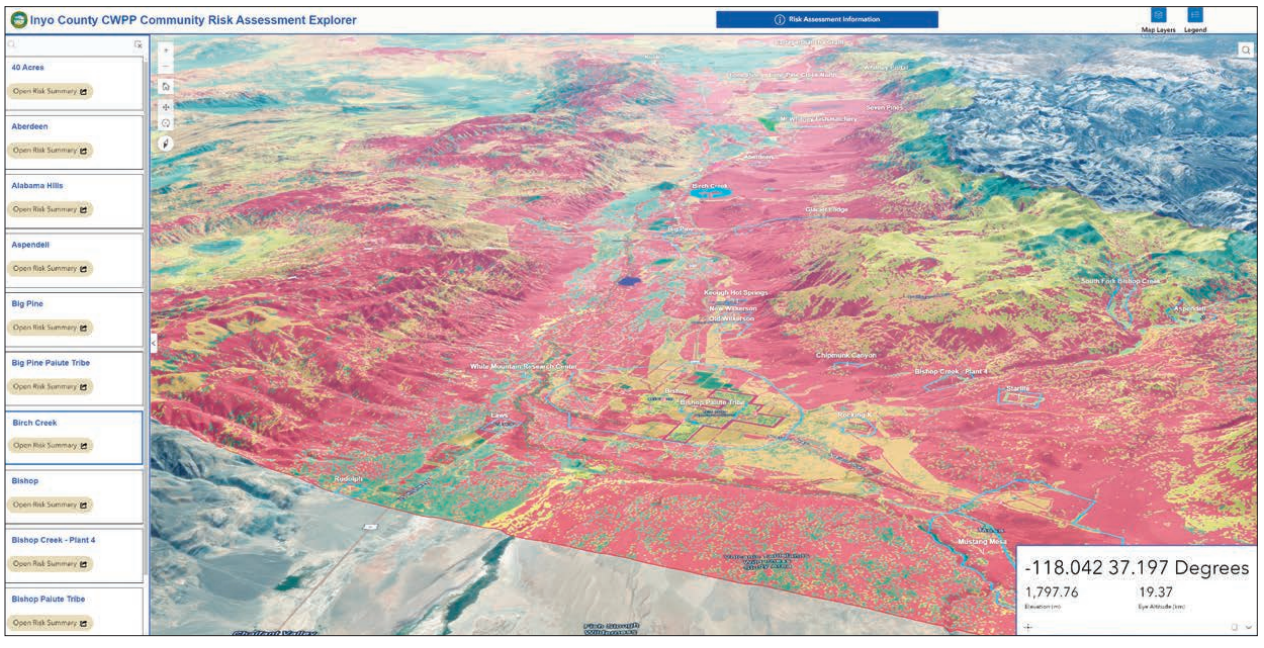
In Massachusetts, Cape Ann's fire mitigation challenges stem from its dense forests and coastal proximity. The Cape Ann CWPP addresses these risks with tailored strategies for mitigation, community engagement, and emergency preparedness. The town's CWPP hub site—links.esri.com/cape-ann—aggregates crucial data and resources to ensure that the community stays informed and is prepared for wildfire threats.

In California, the team at SWCA also helped the Santa Clara County FireSafe Council quickly and efficiently share updated information across agencies and jurisdictions via a hub site, available at links.esri.com/santa-clara. The data is organized, accessible, and easy to share with stakeholder agencies and neighboring municipalities and jurisdictions.

→ The Cape Ann community wildfire protection plan displays tailored strategies for wildfire mitigation, community engagement, and emergency preparedness.



↓ In Inyo County, SWCA used ArcGIS Experience Builder to create an app that allows users to easily locate wildfire information about their community.



Benefits for Communities Across the Country

By embracing the advanced capabilities of ArcGIS apps and software and fostering close-knit collaboration among community members, SWCA continues to elevate wildfire planning efforts and improve CWPPs—undertakings that benefit wildfire-prone areas across the United States.

For more information on applying GIS to CWPPs, email SWCA principal planner Victoria Amato at vamato@swca.com.

About the Authors

Victoria Amato is a principal planner for fire and forestry at SWCA. Anne Russell is a principal geospatial sciences program lead at SWCA. Liz Hitzfelder is a lead geospatial scientist at SWCA. Sam Lashley is an assistant project manager at SWCA. Montiel Ayala is an assistant project biologist at SWCA. And Arianna Porter is a lead project manager for disaster and resilience at SWCA.

Gamifying Earth Day with ArcGIS Extends the Celebration Beyond Just a Day

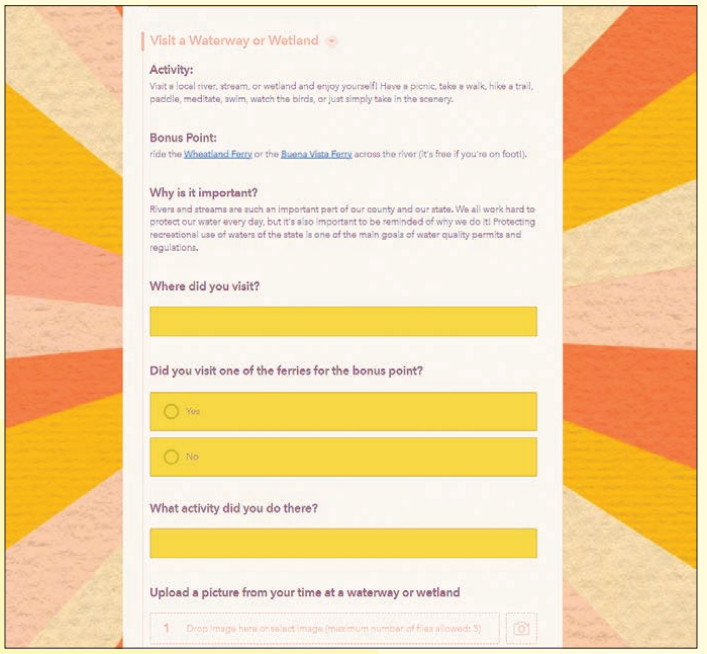
By Yancee Gordon, Marion County, Oregon, Public Works Department

Marion County, Oregon, which includes the state capital of Salem, is nestled among agricultural landscapes and residential communities that are home to nearly 350,000 people. One government department that supports this vibrant community is Marion County Public Works, which provides essential services such as road and bridge construction and maintenance, environmental stewardship, and outreach programs.

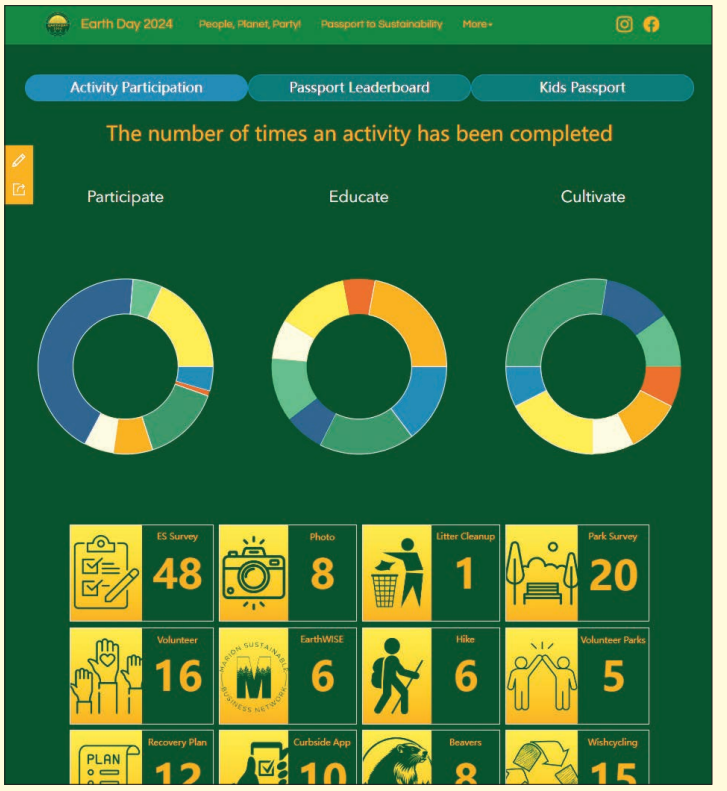
Among Marion County's most celebrated events is its annual Earth Day Party in the Park, a cornerstone of community engagement and environmental education. Initially organized by the public works department's Environmental Services Division in 2021, just as the community began returning to events and activities after the COVID-19 pandemic, the free Party in the Park is a more inclusive and community-oriented Earth Day celebration than past events. The party includes interactive educational opportunities, a terrarium-building activity, guided nature walks, face painting, and even a baby goat petting zoo.

"Our Earth Day celebration is more than just a gathering; it's a reflection of our deep-rooted commitment to our community and the environment we call home," said Stephanie Pulvers, an environmental specialist for Marion County. "Through engaging activities and digital initiatives, we aimed to not only connect residents with the beauty of Marion County but also foster a sense of ownership and responsibility towards its preservation."

The challenge lay in extending the reach of this event beyond a single day. So staff at Marion County Public Works sought to implement a digital solution to share event details, engage with the community on a more regular basis, and spotlight ongoing sustainability initiatives. ArcGIS Hub ended up being the ideal product for the job.



↑ The Passport to Sustainability encouraged residents to participate in activities, such as visiting a local watershed, and earn points when they completed each task.



→ Interactive pie charts showed the county how popular the Passport to Sustainability activities were.

A Dynamic, Interactive Digital Resource

The Environmental Services Division wanted to have a website that was interactive, user-friendly, mobile ready, and able to house links to multiple resources. Chosen for its versatility and ability to integrate mapping, Hub enabled the team to consolidate event and other information in a single digital space. Its customizable features allowed staff to tailor the site to the annual Earth Day theme and ensured a cohesive and engaging experience for the community.

To create the hub site, subject matter experts from Environmental Services, the GIS team, and the communications department came together to share their unique skill sets. Following a brainstorming session, the GIS team decided that the hub site needed to portray educational and event-related information in a user-friendly way to encourage community participation.

Graphic design played a crucial role in establishing the hub site's visual appeal while ensuring that its look remained consistent with other communication materials. Most design elements were crafted using graphic design software and then added to Hub. The customizations worked with Hub's thematic elements and created a cohesive aesthetic, ensuring that community members could easily recognize and connect with the event no matter how or where they accessed the information.

Throughout the development process, team members collaborated closely, sharing insight and learning from one another. The resultant hub site is a dynamic and interactive digital resource that showcases Marion County's commitment to environmental stewardship and community involvement.

Activities Strengthen Community Connection

One of the sections of the hub site is the Passport to Sustainability, a keystone for extending Marion County's 2023 Earth Day celebration throughout the month of April. It is a digital activity tracker that leveraged ArcGIS Survey123 to enable participants to complete various sustainability-themed activities. ArcGIS Experience Builder was used to display the results on the hub site in an appealing and accessible way.

Designed to combine educational goals with a game-like structure, the Passport to Sustainability made learning about environmental topics fun and rewarding. Participants engaged in activities crafted by subject matter experts from the Environmental Services Division—including cleaning up litter or using the Environmental Protection Agency's How's My Waterway app to learn about local watersheds—and earned points when they completed each task. Participants then redeemed the points for sustainable prizes from the county.

"The Passport to Sustainability was designed to make education engaging and to strengthen our connection with the community. We cover a wide range of environmental topics within our Environmental Services Division, and this initiative allowed people to explore many of them in a short amount of time in a fun and interactive way," said Pulvers. "By gamifying the learning process, we aimed to inspire sustainable behavior change while ensuring participants enjoyed the experience. It's a great way for the community to learn something new and see the breadth of what we do, all while having a good time."

A Tracker for Participants and the County

The formcentric tools in Survey123 enabled the GIS team to consolidate all 24 activities in the passport into a single survey. By leveraging the app's URL parameters, the team made sure that the survey only displayed the relevant questions for each activity on the website. Within the survey, participants created unique usernames that helped the county track individual user engagement. By employing hidden calculations, the survey seamlessly aggregated participants' earned points based on their interactions with the questions.

"Upon survey submission, the results were instantly accessible as a hosted feature layer in ArcGIS Online," said Chelsey Aiton, a GIS analyst for Marion County. "A filtered public feature layer view then exhibits essential details, such as usernames, activities, and point totals, while ensuring the confidentiality of other responses."

To present the cumulative passport participation results to the public, the team built a web app using Experience Builder. The app, which was embedded in a page on the hub site, had a dynamic bar chart that succinctly summarized the points each user had earned in a leaderboard format. This enabled participants to track their points and see what prizes they had earned. Additionally, interactive pie charts automatically computed and presented details on activity participation, showing the county how popular the activities were.

Ultimately, the Passport to Sustainability succeeded in engaging community members beyond a single day in 2023, giving way to a month of activities that fostered environmental stewardship. By integrating educational topics with fun activities, Marion County Public Works promoted sustainable practices, strengthened the community's connection to the environment, and collected valuable feedback from residents.

Award-Winning Ideas and Technology

Marion County's 2023 Earth Day hub site won two prestigious awards from the City-County Communications & Marketing Association (3CMA). The Earth Day event, along with its associated communication tools, won the Award of Excellence in the Go Green Communication Program Efforts category, while the Passport to Sustainability was honored with the Award of Excellence for Most Innovative Communications.

The Environmental Services Division put together another hub site for Earth Day activities in 2024 that garnered strong engagement again. Looking ahead, Marion County is committed to leveraging new ideas and technologies to further enrich its Earth Day events and broader program initiatives. Using ArcGIS to foster connections with community members empowers them to be environmental stewards and make a positive difference all year round.

About the Author

Yancee Gordon is the former communications coordinator for Marion County Public Works. She has a bachelor's degree in rhetoric and media studies from Lewis & Clark College in Portland, Oregon, and enjoys using GIS for public outreach.

GeoAI Helps Stave Off Pest Infestation of Hemlock Trees

↑ The hemlock woolly adelgid lays eggs at the base of the hemlock tree's needles.

In the large, urbanized area southwest of Washington, DC, residents of Fairfax County, Virginia, enjoy vast canopies of evergreen trees—including hemlocks—year-round. Unfortunately, there is a pest devastating hemlock trees throughout the southeastern United States. The hemlock woolly adelgid feeds on the sap and water storage cells at the base of a tree's needles, where the pests also lay eggs, causing an infestation. The "woolly" part of the pest's name comes from the fluffy white appearance of the insect's egg masses.

The Forest Pest Branch of the county's Urban Forest Management Division (UFMD) is responsible for monitoring a variety of forest insect pests and tree diseases and provides public outreach and education to help residents take part in tree preservation efforts. Staff at the Forest Pest Branch understood that managing the hemlock woolly adelgid infestation and preserving Fairfax County's existing contiguous tree canopy were critical.

Staff also recognized that mapping plays an important role in these endeavors. They needed to inventory the hemlocks and map out their locations as part of the management plan, but searching through aerial photography of thousands of acres to find them was going to be too time-consuming and labor-intensive. Staff needed a way to quickly prioritize field visits to areas that were likely to have large numbers of hemlock trees. From there, they could target areas for protective measures against infestation.

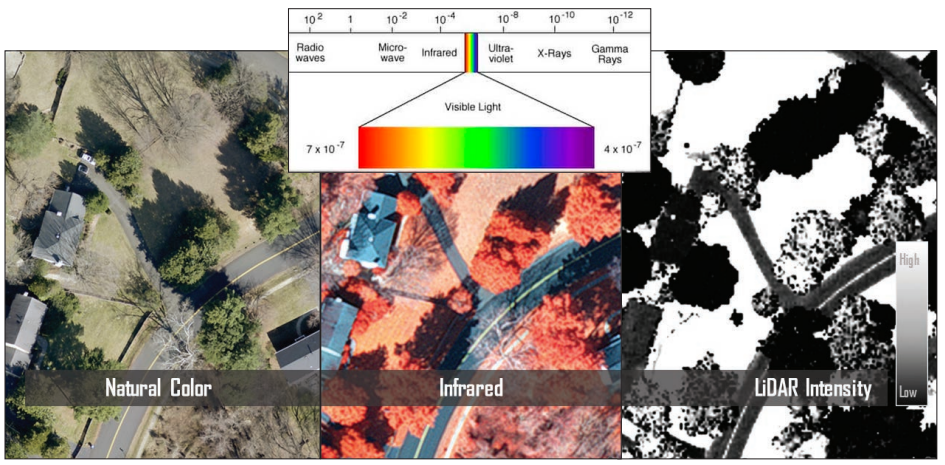
To do this, in 2023, UFMD urban forester Patrick O'Brien enlisted the county's GIS Division. Fairfax County GIS analyst Greg Bacon decided to use ArcGIS technology and geospatial artificial intelligence (GeoAI) to automate the search for evergreens in aerial photography in hopes of finding the hemlocks among them.

Automating Tree Detection with a Deep Learning Model

Leveraging the analytical power of ArcGIS Pro alongside ArcGIS Image Analyst, Bacon created a unique workflow to find the hemlocks.

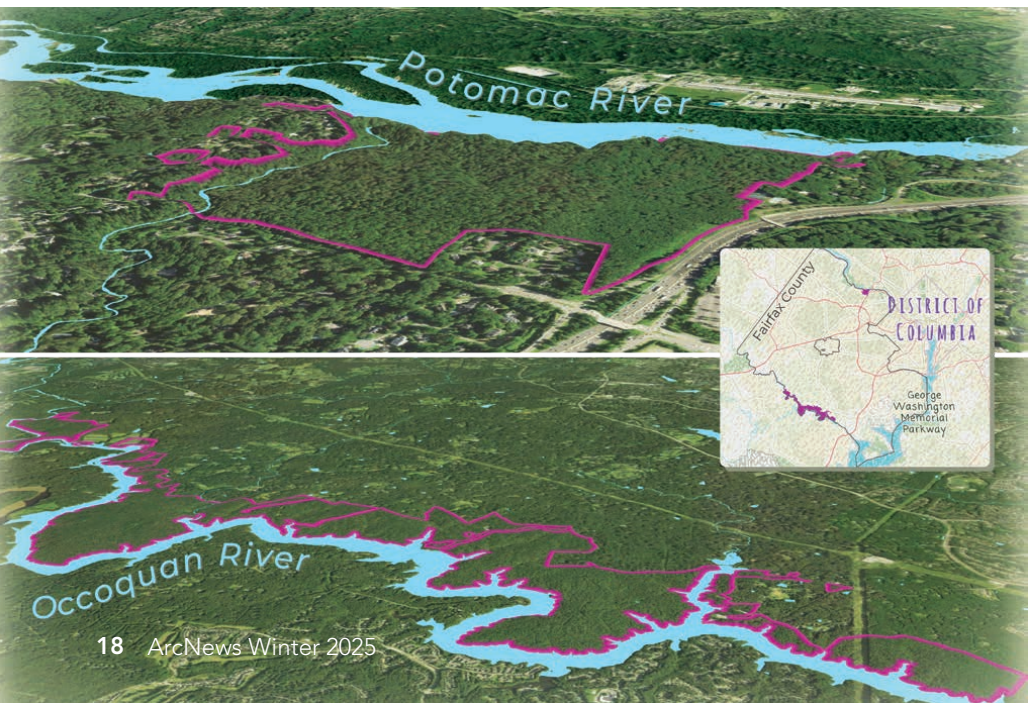
"UFMD is a longtime user of the county's aerial photography. They've used the data in desktop and mobile mapping but have also worked with the GIS Division on more advanced projects such as land-cover classification," said Bacon. "This project continued our collaboration in finding new ways for aerial photography to enhance their work and address evolving needs."

Bacon selected leaf-off aerial orthophotography from 2022 as the input for a tree-detection deep learning model that is currently available as a pretrained model in ArcGIS Living Atlas of the World. ArcGIS pretrained models automate the process of digitizing and extracting geographic features from imagery and point cloud datasets.



↑ The team filtered the tree data by analyzing the greenness of pixels, infrared information, and lidar intensity values within the imagery.

↓ The study areas were adjacent to the Potomac River and the Occoquan River.



This model was a great starting point for creating tree detection geometries on a variety of supported imagery. The model produced great results—yet it was just one part within a larger analysis pipeline. While the model was good at defining tree boundaries, the goal was to identify evergreen trees where foliage remains green and functional year-round.

To account for this, Bacon employed a series of ancillary data and techniques to further filter the data and identify areas with evergreens that potentially needed treatment. He used a variety of methods to aid in these selections, including the size of tree patches, the greenness of pixels within the imagery, infrared information within the source imagery, and lidar intensity values. This combination of factors allowed him to further distinguish between evergreen and deciduous tree species.

Working in a More Precise Target Area

All the data processing results were queried to provide a comprehensive picture of not only where Fairfax County's evergreen trees were but also where hemlock trees were likely to be located. Once Bacon and the GIS Division made their selections in the imagery and generated outputs, the observations were converted to density surfaces. In the end, staff identified 33,110 evergreens out of 116,521 trees in the project zone—drastically narrowing the project down to a more precise target area.

The GIS Division shared its results with the Forest Pest Branch management team via a file geodatabase, and the urban foresters published the data to ArcGIS Online. This helped inform a treatment plan. From there, the Forest Pest Branch's mobile team used ArcGIS Collector, which has since been replaced by ArcGIS Field Maps, to locate and treat infected trees in the study area.

While analysis of imagery data formed the core of the treatment plan, employing a well-rounded combination of GIS tools kept stakeholders informed and helped them quickly and efficiently allocate resources. The GIS Division will use imagery and conduct additional on-the-ground work to monitor the effectiveness of the treatment.

Using One Model to Train Another

The results of the hemlock woolly adelgid operation laid the groundwork for Fairfax County to do additional projects that involve using imagery to detect evergreen trees.

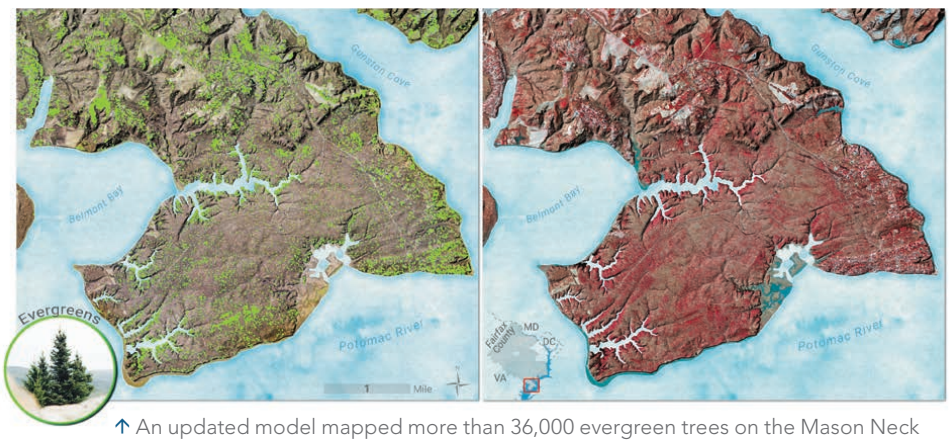
"Automating the process of mapping trees of interest, and doing that successfully with help from ArcGIS software and apps, established a benchmark for more efficient identification and monitoring moving forward," said Bacon.

In 2024, the county used a selection of evergreen tree boxes to train a new deep learning model to find only evergreens. Staff employed the same three-band, three-inch-resolution imagery from 2022 that they used in the hemlock project to train the new model by creating image chips containing a variety of evergreen samples.

The resultant model was then run against images of the Mason Neck peninsula in southern Fairfax County—an area of approximately 9,000 acres that is nearly three times the size of UFMD's hemlock project. The model mapped more than 36,000 evergreen trees throughout Mason Neck, and it performed best in underdeveloped areas that have dense clusters of evergreens.

Once again, having automated the process of using imagery to detect characteristics that separate evergreen trees from deciduous ones, UFMD was able to effectively plan more targeted mobile work in Mason Neck.

For more information on Fairfax County's use of deep learning to target pest management work, explore the ArcGIS StoryMaps story *Finding the Evergreen Needles in the Forest Haystack* at links.esri.com/evergreen.



↑ An updated model mapped more than 36,000 evergreen trees on the Mason Neck peninsula. The 2022 natural-color imagery that was used to train the model is shown on the left, while 2021 infrared imagery to enhance the identification of evergreens is shown on the right.

Scientific Currents

By Dr. Paul C. West
Project Drawdown and the University of Minnesota

Geodesign for the Climate, People, and Nature

Recent reports from the United Nations describe a grim state of the world for the climate, people, and nature. Humans are not on track to meet the goals defined in international conventions to limit rising temperatures, eliminate hunger and poverty, or stop biodiversity loss.

While these assessments are accurate, there are evidence-based reasons to have hope. Progress has been made on all three of these interwoven challenges. It needs to accelerate, yes, but the world already has all the necessary tools to accomplish these goals. Some of those tools are familiar to GIS practitioners who are wired to use ecological, physical, and social maps and data to solve problems.

I'm an ecologist working at Project Drawdown, which is on a mission to help the world stop climate change as quickly, safely, and equitably as possible. The world's leading resource for climate solutions, Project Drawdown advances science-based products and services, fosters bold leadership, and promotes new voices and leaders who too often go unheard.

Greenhouse gas emissions, for example, come from many sources across many sectors. Solutions to stop climate change must address the full suite of greenhouse gas-emitting sources and sectors. At Project Drawdown, our past research identified about 100 climate solutions that, if implemented collectively, can stop climate change. Many of those solutions—such as producing power from wind and solar energy sources, driving electric cars, and updating heat sources in buildings—are well-known.

Interestingly, the forestry, agriculture, and land-use sectors are absent from most climate discussions. Yet these industries account for 22 percent of global greenhouse gas emissions, with the largest sources coming from the deforestation that occurs to make way for expanding agricultural commodities and cattle production.

To illustrate how important the forestry, agriculture, and land-use sectors are to achieving climate goals, my colleagues and I worked with Esri's ArcGIS StoryMaps team to produce stories such as *The Living Land* (links.esri.com/living-land), which shows how agriculture has transformed the planet, and *The Cost of Beef* (links.esri.com/cost-beef), which outlines the environmental impacts that people's food choices have on water, land, nature, and the climate. Protecting tropical forests and eating healthier, plant-rich diets are two of the most effective solutions for stopping climate change.

Knowing it's possible to stop climate change with the tools that are already on hand is an essential first step. But planners, decision-makers, and practitioners want to see actions and need answers to the following questions:

- Which solutions work well where?
- How do people and nature fit in?

Both questions highlight what Project Drawdown has planned next.

First, the science community needs to shift its focus away from describing the problem and toward guiding decision-makers on where to allocate their time and funding. Data and GIS can be used to do this—by mapping solutions' relative suitability and their impact in different locations.

Next, climate scientists and conservationists need to use socioeconomic data to assess solutions' feasibility and costs. Again, data and GIS can be used for this. For example, Project Drawdown's executive director, Dr. Jonathan Foley, has worked with Esri chief scientist Dr. Dawn Wright and other climate leaders to teach Esri's free GIS for Climate Action massive open online course (MOOC). The MOOC shares tools and methods for using GIS to monitor climate indicators, assess risk, evaluate solutions, and track progress.

Finally, the climate and conservation communities need to place people at the center of their discussions. While I value all animate and inanimate beings and ecological processes on Earth, I realize that my views are not the norm. In surveys done worldwide, people's needs for food, water, income, and rights always take priority over stopping climate change and preserving nature. Misaligning priorities can create tension—particularly in lower-income countries in the Global South—when international funding and priorities favor climate change mitigation and conservation over meeting people's basic needs. Priorities in these regions, especially, need realigning.

At Esri's Geodesign Summit in April 2024, I shared ideas for how to put this realignment into practice using widely available data and GIS tools. By mapping social challenges and modeling the suitability and impact of potential actions, GIS practitioners can drive how quickly common challenges across sub-Saharan Africa and other regions in the Global South get solved, including eradicating hunger and poverty, improving health, and increasing access to clean water and electricity.

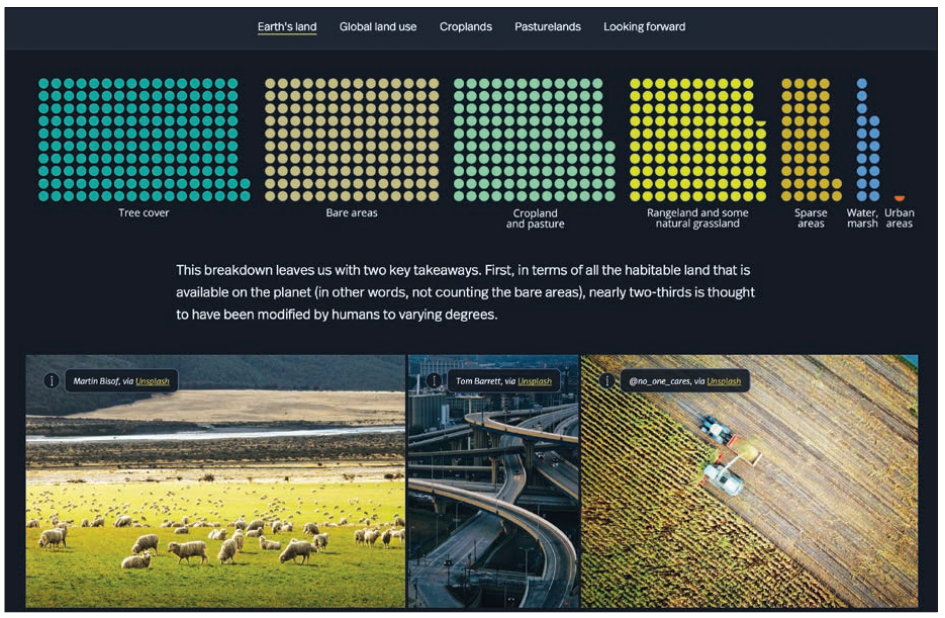
With support from the US Agency for International Development's (USAID) Feed the Future Innovation Lab for Collaborative Research on Sustainable Intensification, which is managed by Kansas State University, Project Drawdown conducted a pilot study in Senegal to see which actions in food production could be targeted to have the most significant effects on the country's food system. The study took a broader view of the food system than simply on-farm food production. This is because many studies show the following:

- Food security is often driven as much by off-farm income as on-farm production. This is particularly true in semiarid countries where much of the food consumed domestically is imported.
- Opportunities to increase income are tightly linked to having electricity.
- Electricity enables better education and health care.
- Most premature deaths are caused by poor indoor air quality due to using fuelwood and charcoal to cook food.

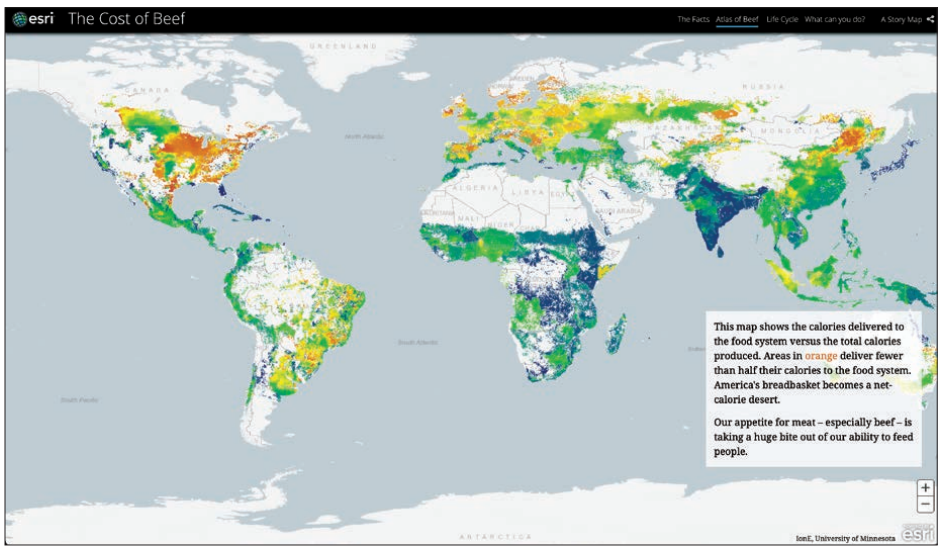
Indicators of food security, income, health, and many other aspects of people's well-being are available in USAID's Demographic and Health Surveys (DHS) Program (links.esri.com/usaid-dhs). This program has operated for more than 30 years and collected data across 90 countries. As Project Drawdown did with its Senegal pilot study, the science community can use GIS tools to interpolate this data and create countrywide maps that identify the targeted actions that have the most consequential impact. This allows the potential wins and trade-offs for climate and nature to be assessed.

The work that Project Drawdown did for Senegal is summarized in an ArcGIS StoryMaps story called *Improving Food Security in Senegal*, available at links.esri.com/senegal-food and made with guidance from Esri's ArcGIS StoryMaps team. The project had a six-month timeline, so members of the team did not have enough time to fully engage with many partners. The next step is to work with partners to assess the utility of the maps and data and collaborate to make them more useful.

GIS-based solutions that are aimed at improving people's lives, protecting nature, and stopping climate change can help decision-makers more effectively target actions to maximize wins in all three categories and minimize the trade-offs. Project Drawdown's Senegal study illustrates a process that is widely applicable to other contexts and uses readily available open-access data. Employing approaches like these can help accelerate the process of designing and creating a sustainable world for all.



↑ The ArcGIS StoryMaps story *The Living Land* illustrates how humans have modified about two-thirds of Earth's land.



↑ A detailed story shows how people's food choices—particularly, to eat beef—affect water, land, nature, and the climate.

About the Author

Dr. Paul C. West is an ecologist developing science-based solutions for sustaining a healthy planet for people and nature. He has led projects at local, regional, and global scales. West's research has been published in leading science journals, including *Science*, *Nature*, and *Proceedings of the National Academy of Sciences*, as well as in *National Geographic*.

To learn more about Project Drawdown, go to **drawdown.org**.

continued from cover

Streamlining Access to Biodiversity Data in North America

with interactive maps that serves as a secure, one-stop shop for clients to examine where at-risk species have been recorded and where else they might be located.

Building a Seamless, Interactive Experience

To create the database, developers first solicited feedback from members of the NatureServe Network. The members' biggest concern was protecting sensitive species data, and each organization's rules about data use were different. Based on members' feedback, NatureServe created a portal that allows data providers to set permissions on how fine-scale their data is displayed. They can also obscure data for sensitive species. As a result, database users can access location data that is as precise as possible without compromising sensitive information.

Next, developers tackled the challenge of translating disparate data about tens of thousands of species into formats that could be easily displayed on a map. To do this, NatureServe leveraged KoopJS, a JavaScript toolkit that extracts geospatial data from different sources and transforms it into various geospatial outputs. With that in place, all the data that comes in from NatureServe Network members is dynamically refreshed each night, ensuring that users of Explorer Pro have the most up-to-date information.

The developers then set out to create a seamless, interactive experience for users of Explorer Pro. A built-in interactive mapping tool, which relies heavily on ArcGIS Maps SDK for JavaScript, allows even non-GIS professionals to access detailed location data for species of interest. The map's functionality ranges from simple, such as displaying a published feature layer, to complex—including drawing, buffering, and querying multiple data layers for an area of interest. The database also points users to additional resources so they can obtain more information on species directly from the data providers.

All these features deliver unique experiences that are tailored to each user's needs. A pipeline company, for example, could upload a shapefile that outlines a potential pipeline path and create a biodiversity report for all the species that intersect with that feature. Additionally, a conservation land trust could compare possible land purchases based on a report of at-risk species on each tract of land and then select the tract that exhibits the greatest opportunities for conservation. Explorer Pro users can also gain access to curated content based on their membership in specific access groups, ensuring that they receive the most relevant and necessary information.

Filling In the Gaps with AI

A recent development in NatureServe's core offerings is species habitat modeling, which uses biodiversity data, environmental data layers, and AI-powered spatial computing to predict where imperiled species may be. These models fill in the gaps for areas where surveys haven't been completed, usually due to limited time and resources.

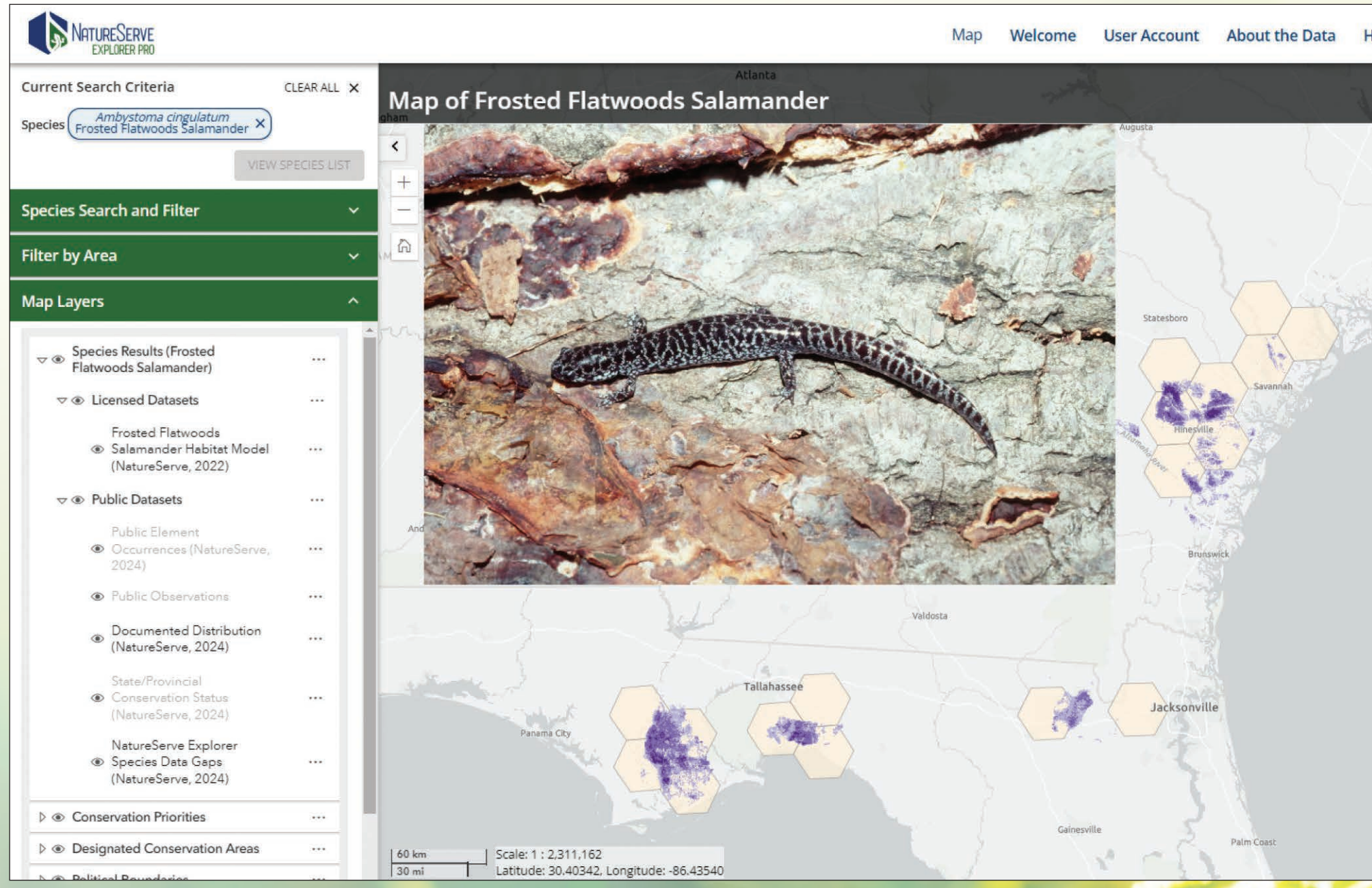
With funding and technical expertise from Esri, NatureServe has developed more than 2,000 habitat models for at-risk species, with a focus on underrepresented groups such as freshwater invertebrates and pollinators. Esri developed a library of high-resolution predictor layers, ranging from climate to geology, that were combined with NatureServe's precise species location data and machine learning outputs to create individual habitat models. NatureServe and Esri then worked together to aggregate these models into composite layers that guide large-scale conservation efforts.

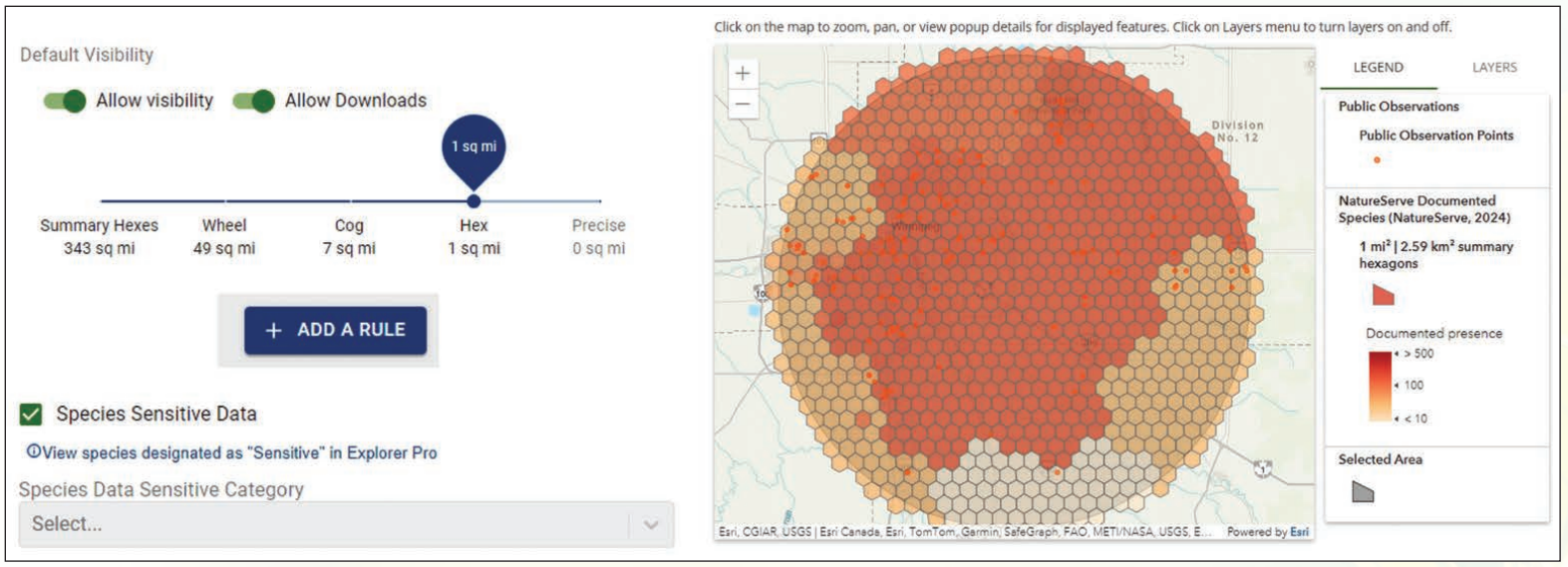
NatureServe shares this mosaic dataset of habitat models on Explorer Pro via the ArcGIS Enterprise portal, and the composite maps are available in ArcGIS Living Atlas of the World. This enables more people to access information about the species that are most in need of protection.

Improving Sustainability in Forestry

In the forestry industry, sustainable land management and procurement practices are critical for conserving biodiversity. For decades, companies certified by the Sustainable Forestry Initiative (SFI)—which range from pulp and paper companies to providers of medical supplies—have used NatureServe's biodiversity data to make informed decisions related to managing threatened and endangered species. That data, however, is not always available at the appropriate scale for procurement activities, especially on privately owned lands. This makes it challenging for companies to provide concise and actionable information to loggers and landowners about the species and ecological communities that need attention during harvesting.

The advanced mapping and reporting features in Explorer Pro present forestry companies with highly precise information about at-risk species and ecosystems in wood-sourcing areas. As a result, SFI-certified companies can communicate clearly and effectively with noncertified landowners about procurement practices that are best for preserving biodiversity. This





← Explorer Pro allows data providers to set custom permissions for each dataset to protect sensitive species data.

not only enhances sustainable forest management practices but also contributes to the broader goal of conserving biodiversity across North America's forests.

"At Weyerhaeuser, our commitment to sustainable forest management is paramount," said Chad Leatherwood, senior sustainability transformation manager at Weyerhaeuser, an SFI-certified company that makes forest products. "The radius tool feature in Explorer Pro is a more recent improvement *[that]* allows us to more efficiently gather ecological data within a wood supply area, including species' names and conservation status, empowering us to make informed decisions."

How Other Industries Use Explorer Pro

Forestry isn't the only industry that can benefit from the advanced mapping tools NatureServe created using ArcGIS Enterprise.

In the agriculture sector, pesticide companies use Explorer Pro to provide detailed endangered species proximity data to the US Environmental Protection Agency for evaluation. Agrochemical companies rely on the web app to access species habitat models and define areas where pesticide use should be limited because of threatened and endangered species.

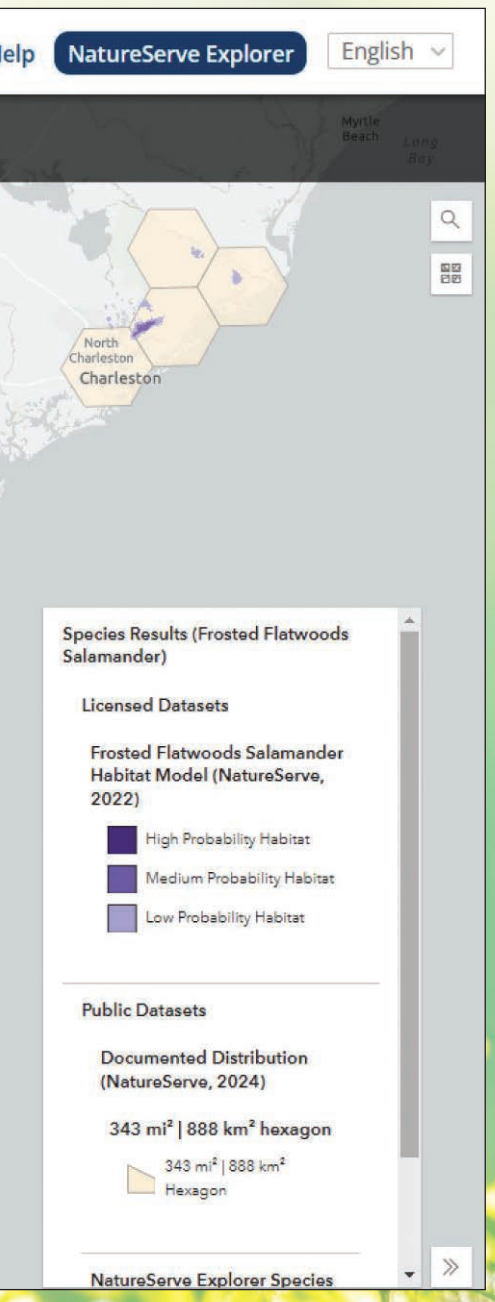
Federal land management agencies in the United States and Canada use Explorer Pro to protect natural resources. The web app's fine-scale species occurrence data and habitat models—customized with relevant boundary and planning map layers—facilitate conservation planning and reporting.

Conservation investors and land trusts use Explorer Pro to document and report on the impact of their investments by identifying species that are protected in key biodiversity areas and other critical sites. The web app helps them discover and manage species found in current or potential investment locations, enhancing their conservation efforts.

The development of Explorer Pro shows how advanced technology can transform the way that land managers and others approach biodiversity conservation. By addressing the complex challenges of data integration and accessibility, Explorer Pro exemplifies the innovative spirit required to tackle the biodiversity crisis.

About the Author

Lori Scott is the executive director of NatureServe.



← Species habitat models in Explorer Pro fill in the gaps for areas where there isn't adequate data.

New Options for Decentralized Collaboration That Protects Data Sovereignty

By Dr. Satish Sankaran, Esri

Decades of architecting the ArcGIS geospatial platform have made new patterns of work possible. GIS data flows more freely than ever before within enterprises and between trusted partners. Advancements have come in waves as new standards have been adopted. In Europe, data sovereignty concerns have fostered new approaches to data sharing.

The barriers of data silos are largely bygone. First, the availability of mobile devices allowed users to seamlessly access data from any device, anywhere. Then, software as a service (SaaS) offerings enabled users to share data, apps, maps, and dashboards within and outside their organizations. Cloud platforms and marketplaces have helped spread geospatial tools and workflows as components in larger systems. Now, the European concept of data spaces provides flexibility for data providers to work across clouds, aiming to streamline complex international supply chains.

It is worth revisiting these waves of interoperability—and their outcomes. Each has empowered new levels of digital transformation, making organizations more efficient and transparent. Having access to data on any device helped many organizations leave paper behind. ArcGIS Online, Esri's SaaS offering, has sped up collaboration by providing integrated tools that work together to collect data, publish web maps, and fuel in-depth analysis. Cloud marketplaces provide portability for spatial analytics tools and functions. And data spaces such as Gaia-X offer new business models in industries ranging from automotive to agriculture.

The ArcGIS geospatial platform enables each of these patterns, allowing users to provision solutions across a wide variety of technologies.

Working Anywhere, on Any Device

The ability to work from anywhere had its proof point with the COVID-19 pandemic. Organizations that held back from offering off-site data access quickly pivoted when stay-at-home mandates were declared. ArcGIS Online provided an easy pathway to expand GIS access to a distributed workforce, enabling users to sign in securely.

The device used doesn't matter. Manufacturers and software developers have adopted standards across computers, tablets, and phones to ease integration. The standards that make it possible to seamlessly exchange data on any device have made working from anywhere a reality.

This flexibility has empowered new workflows. Paper forms have largely gone away—or should. Digital workflows eliminate data redundancy and errors, and far more people have access to data that describes current conditions. New patterns of collaboration have allowed dispersed teams to resolve complex challenges with a shared awareness that showcases priorities and spurs teams to complete tasks.

SaaS Connections Help Make Decisions at the Speed of Trust

Recent disasters have tested a new level of all-of-government response, with improved outcomes thanks to the ease with which data flows among responding agencies. Multiple agencies synchronize their teams through SaaS connections and, in many instances, turnaround times have gone from days to hours.

Trust, established before events, allows each organization to offer its best data while maintaining security and control. Data exchanges that once required memorandums of understanding are being replaced by direct SaaS data connections that allow agencies to work together more closely.

Implementing ArcGIS Hub has led to more sharing of data, maps, and solutions. Data flows to shared dashboards, where everyone can visualize progress, and this creates a common operational picture.

This pattern of cross-partner collaboration is made possible by the portal component of ArcGIS Enterprise. The portal-to-portal pattern offers a new level of exchange that enhances productivity and collaboration, allowing each participant to augment other responders' experiences by giving them access to apps, tools, content, and services.

Cloud Marketplaces Expand Reach

ArcGIS Marketplace is an exchange where users can find add-ins, widgets, and partner solutions to boost their ArcGIS implementations. Other cloud providers have similar exchanges where users can employ components of GIS in larger workflows to understand enterprise data in its real-world context. For example, Esri packages an ArcGIS telecommunications management solution on AWS Marketplace for all aspects of telecommunications project life cycles.

Esri also offers spatial analytics capabilities and an extensive library of authoritative and curated spatial data to Microsoft Fabric, an AI-powered analytics platform tuned for high performance. Microsoft Fabric includes AI integration, a unified data lake, and centralized administration. Esri adds the ability to produce interactive and intuitive visualizations and maps to empower geospatial decision-making.

These marketplaces extend the reach of the geographic approach, allowing users to perform spatial analytics to explore socioeconomic, demographic, and environmental contexts.

Data Spaces Address the Wider World

In the European Union (EU), data sovereignty is paramount. To provide open data while protecting Europeans' data privacy rights, data spaces are emerging.

Data spaces create a data-sharing ecosystem with a decentralized structure that allows each participant to decide whom to share their data with while maintaining control over it. This structure provides various levels of openness in the data, with the ability to restrict some data to certain stakeholders. The aim is to boost data-driven innovations without compromising individuals' or organizations' autonomy.

Data spaces fit the broad term of *Anything as a Service*, or XaaS, which refers to solutions, products, and technologies being delivered as a service. This includes resources, apps, and infrastructure.

Gaia-X is one of several data spaces created to make data available for use while protecting the sovereignty of data in and about Europe. This federated data infrastructure has the support of the German and French governments as well as European research institutions and universities. The strategy includes plans to open publicly held datasets, invest in data processing infrastructure, and create a procurement marketplace for data processing services.

In each Gaia-X data space, a clearinghouse gives a list of available XaaS offerings that users can purchase. The clearinghouse shows each offering's name and has information about the quality of its service, usage policy, service level, and billing details. The Gaia-X Digital Clearing Houses review credentials and ensure that services comply with EU regulations. These details become verifiable credentials that are cryptographically signed and notarized. The trusted entities in the data space must have a verifiable credential in Gaia-X and must conform to rules, including inputting metadata that describes each offering. Gaia-X and other data spaces connect data providers and users without pooling data in a central store.

The concept is being driven by sectors, such as the German automotive industry, that are interested in streamlining global supply chains. In agriculture, for example, European farmers and agricultural cooperatives are adamant that they own the data about their fields and farming practices. A data space for all agrifood actors ensures that sensitive data about food production can be shared securely with others that provide related services. For instance, an AI service could help farmers detect plant stress or optimize energy and resource use.

Details and requirements for European data space exchanges are being finalized. Working with 52°North Spatial Information Research in Germany, Esri has proved that its technology integrates well with Gaia-X data spaces. A recent exercise showed that ArcGIS architecture aligns with Gaia-X requirements. For anyone wanting to participate in data spaces, Esri can help them navigate the requirements.

A Commitment to Interoperability

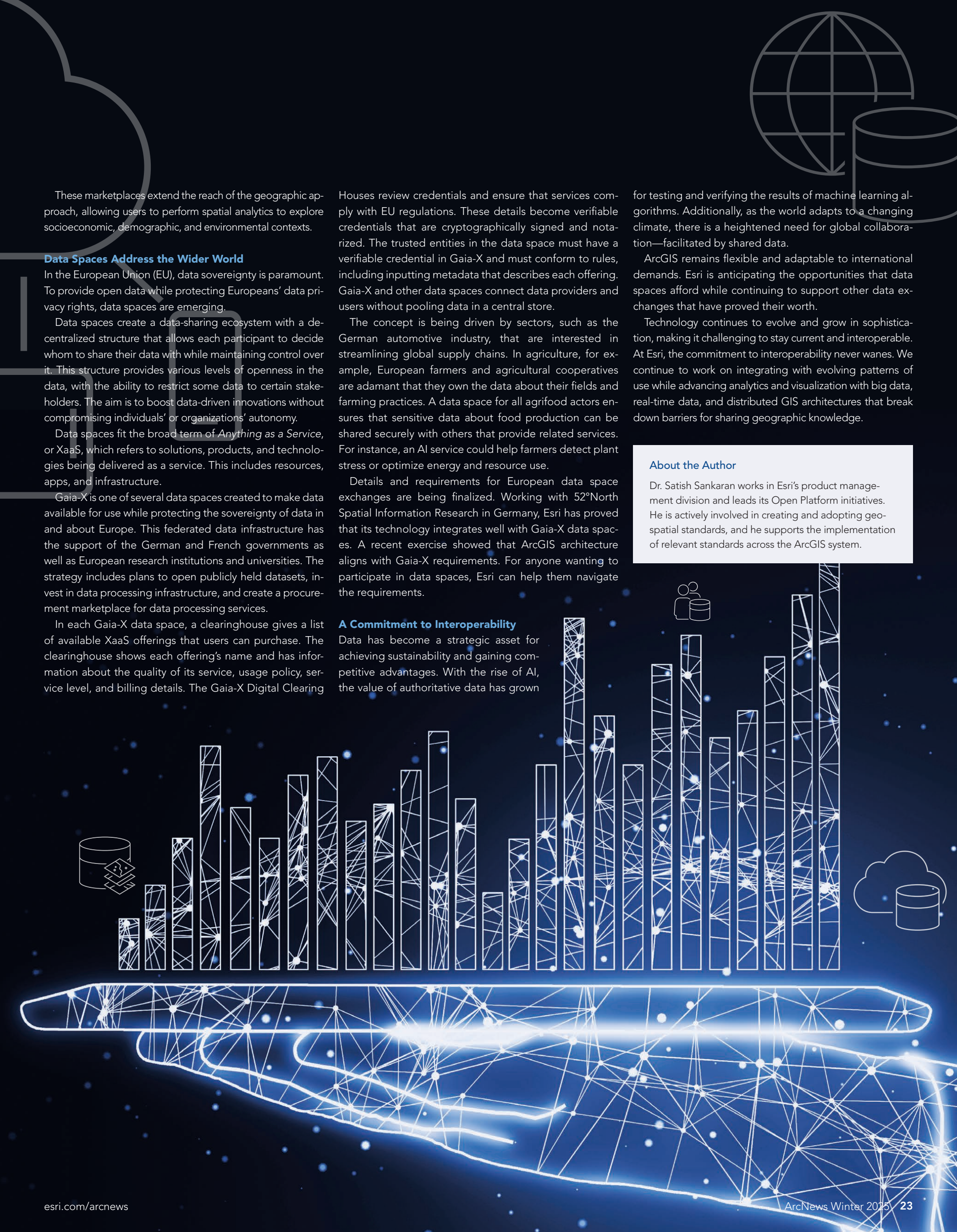
Data has become a strategic asset for achieving sustainability and gaining competitive advantages. With the rise of AI, the value of authoritative data has grown for testing and verifying the results of machine learning algorithms. Additionally, as the world adapts to a changing climate, there is a heightened need for global collaboration—facilitated by shared data.

ArcGIS remains flexible and adaptable to international demands. Esri is anticipating the opportunities that data spaces afford while continuing to support other data exchanges that have proved their worth.

Technology continues to evolve and grow in sophistication, making it challenging to stay current and interoperable. At Esri, the commitment to interoperability never wanes. We continue to work on integrating with evolving patterns of use while advancing analytics and visualization with big data, real-time data, and distributed GIS architectures that break down barriers for sharing geographic knowledge.

About the Author

Dr. Satish Sankaran works in Esri's product management division and leads its Open Platform initiatives. He is actively involved in creating and adopting geospatial standards, and he supports the implementation of relevant standards across the ArcGIS system.



Operating as One Company, Avangrid Standardizes Gas Leak Surveys

As a leading sustainable energy company composed of eight electric and natural gas utilities in the northeastern United States, Avangrid needed to standardize and streamline workflows among its operating companies. So in January 2023, Avangrid implemented ArcGIS Utility Network at two of its natural gas operating companies, Berkshire Gas Company and Southern Connecticut Gas Company—the last two Avangrid companies to apply GIS to their operations.

This was the first step in a larger initiative to standardize business systems and processes across the organization and enable Avangrid to work as one company. With all six of its natural gas operating companies now using ArcGIS technology, Avangrid has embarked on the next phase of standardizing strategic business processes: developing and implementing a common natural gas leak survey solution using ArcGIS Workforce, ArcGIS Field Maps, and ArcGIS Dashboards.

Working with Esri partner UDC, a GIS-centric systems integrator for utilities and infrastructure companies, Avangrid has built a fully digital and connected workflow solution with granular, location-based regulatory compliance reporting capabilities.

Streamlining Reporting

Previously, each of Avangrid's natural gas operating companies had its own leak survey processes and methods, making it difficult to ensure consistency and efficiency. The new digital solution aimed to eliminate paper workflows and streamline reporting. It also needed to meet increasingly rigorous regulatory reporting requirements, including requests for documented processes, digital records with time stamps, spatial records of work performed, data reporting at a more granular level, and historical recordkeeping.

When the team at Avangrid started looking for leak survey solutions, it wanted something out-of-the-box that wouldn't require customization or a lot of internal support resources. The team needed the solution to be configurable, though, so that it could handle more than 10 regulatory leak survey programs that each dealt with unique equipment and reporting requirements that vary by state. Other essentials for the solution included the ability to do the following:

- Assign work spatially
- Send work assignment notifications to mobile crews
- Use a field-based app that connects to GPS devices, incorporates breadcrumb tracking, and allows mobile crews to perform their work and collect data in ways that correspond with regulatory reporting requirements
- Notify office-based employees when fieldwork is completed and allow them to verify it
- Create accurate reports
- Generate multiple dashboards to support different users' needs

Staff at UDC documented these requirements, developed the solution architecture, and deployed Esri's out-of-the-box tools. For the initial phase of the project, the team tackled three survey types with varying compliance cycles and some state-specific requirements: main leak surveys done in vehicles, main leak surveys completed while walking, and service leak surveys carried out while walking.

Three Apps, One Solution

The three-pronged solution that resulted from this work relies on ArcGIS Workforce to manage scheduling for mobile employees; ArcGIS Field Maps for mobile employees to use to complete their field assignments; and dashboards built with ArcGIS Dashboards to track crews, work assignments, and the status of compliance requirements.

ArcGIS Workforce

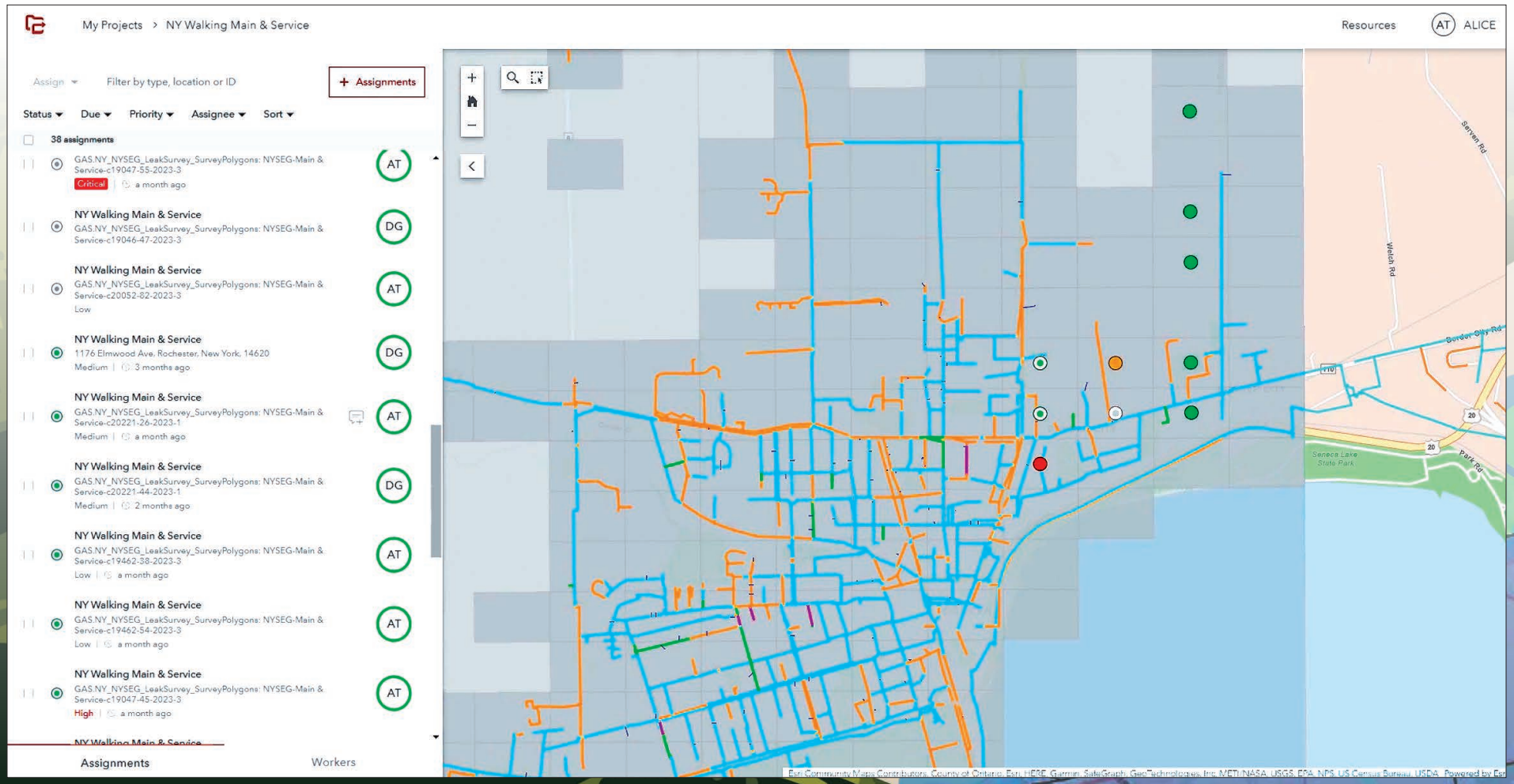
To efficiently schedule work and assign crews, Workforce shows the work that needs to be done on a map, leveraging the company's major and minor grids to create appropriately sized workloads. The app records and displays employees' locations and work progress, with real-time location and tracking enabled via Field Maps and GPS.

Using Workforce, dispatchers can view all work assignments, their progress, and which tasks have been completed. Dispatchers can assign work to employees based on the type of assignment it is, its priority, the date the assignment is due, its work order ID, and a description of the work. Once a task is assigned to someone, it is sent to the team member's tablet. Mobile crews then use Workforce in the field to access their projects. Their to-do list helps them track their assignments.

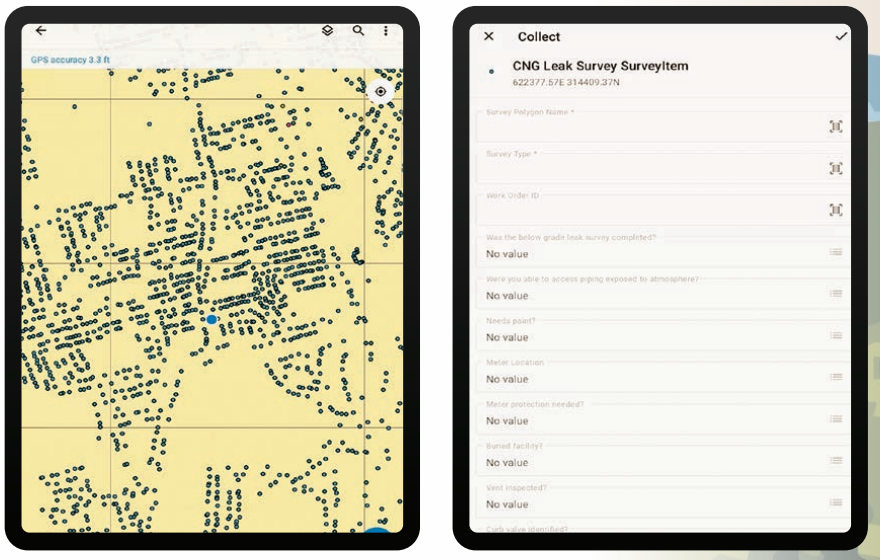
ArcGIS Field Maps

When a mobile crew member begins an assignment, the dispatcher can see that in Workforce. After choosing Start in Workforce, the crew member then selects Open in Field Maps, and Field Maps launches automatically on the person's tablet.

The crew member uses the app to complete their assignment by first entering information about each piece of equipment, including the device type, its serial number, and basic details about it. They can then start GPS tracking within Field Maps to use



↑ ArcGIS Workforce displays employees' locations and their work progress.



→ In ArcGIS Field Maps, all inspections are recorded with breadcrumb tracking (left), and mobile crews collect data using a survey (right).

breadcrumbs to document the inspection. If they come across a natural gas leak, they use the configured digital form in Field Maps to grade it and assign it a work order ID. If a mobile crew member encounters any abnormal operating conditions during the leak detection process, they can record them using another standardized form in Field Maps.

Once the mobile crew member finishes the assignment, Workforce records the project's completion and notifies the dispatcher. And if the crew member had to complete some or all of the work offline, everything they recorded in Field Maps automatically gets reported back to the dispatcher once a connection to Wi-Fi or cell service is reestablished.

ArcGIS Dashboards

The dashboards that the UDC team built using ArcGIS Dashboards enable utility employees to see historical leak analyses, daily tracking of crew members, and regulatory reporting and compliance information. An operational dashboard shows completed work assignments with real-time tracking of the completion percentage.

Compliance managers can monitor abnormal operating conditions and leaks, which is a regulatory requirement, and observe any deficiencies in equipment or use of breadcrumb tracking. This functionality and level of information reporting was difficult, if not impossible, for the utilities to achieve with their previous leak survey methods. Once a survey's reporting cycle is complete, data is moved to a historical dataset that can be reviewed in a separate dashboard view.

Unified Operations

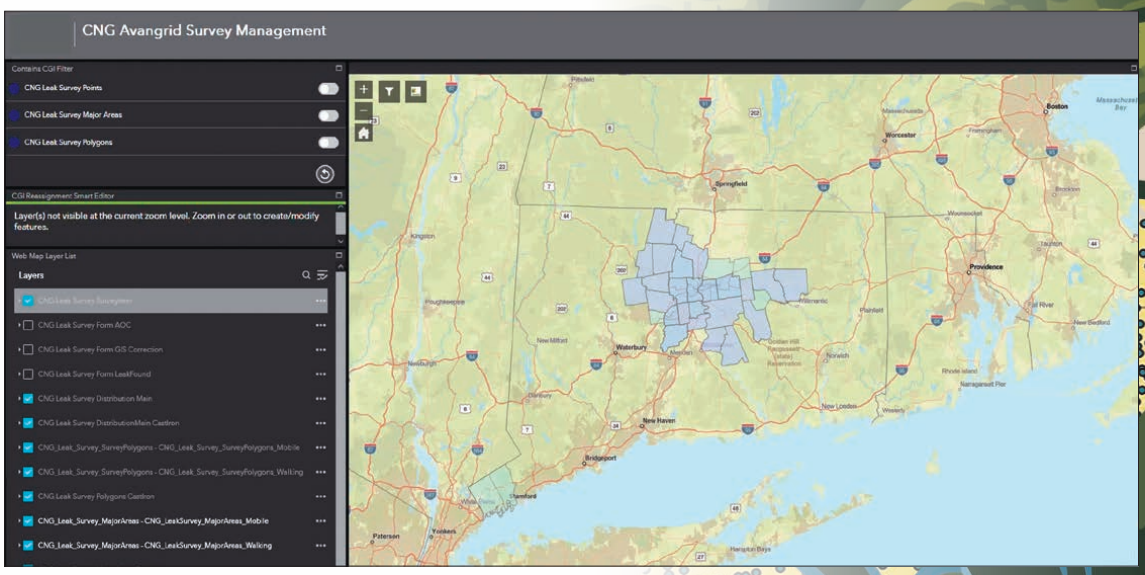
Following successful proof-of-concept implementations at Berkshire Gas Company and Southern Connecticut Gas Company, Avangrid has now rolled out the leak survey solution to Connecticut Natural Gas, New York State Electric & Gas, and Rochester Gas and Electric. At the operating companies where ArcGIS Utility Network is in use, the solution integrates the ArcGIS Utility Network model. The companies that have not yet shifted to Utility Network currently rely on the geometric network model.

The integration of ArcGIS technology into the utilities' compliance management workflows for leak surveys is helping Avangrid achieve its goal of unifying operations. The solution meets all of Avangrid's requirements and offers multiple benefits, including the following:

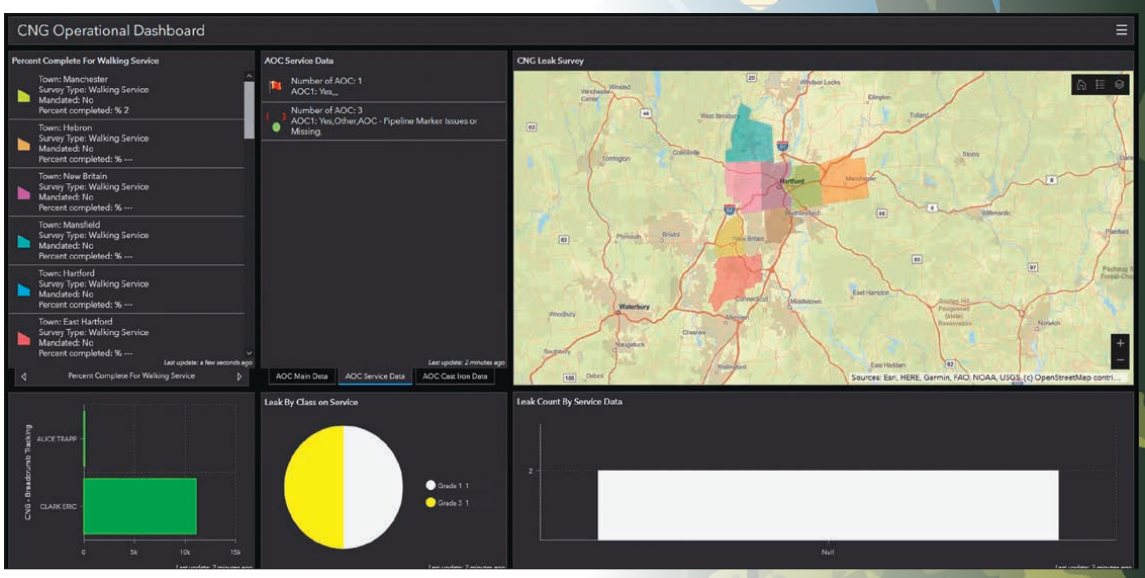
- It standardizes data collection and leak survey management methods and workflows across operating companies.
- It streamlines mobile work assignments and survey data collection.
- It improves leak survey tracking, proactive asset maintenance, data accuracy, the ability to meet compliance deadlines, and the information reported to regulators.
- It provides access to historical leak surveys, enabling operating companies to perform analyses to improve processes and support capital investment decision-making.

"Having a mobile device- and digitally enabled solution has been a big improvement for users over paper maps and forms," said Keith Anderson, GIS mapping and records supervisor for Connecticut Natural Gas. The solution, he said, boosts "the organization that is required to maintain regulatory reporting standards."

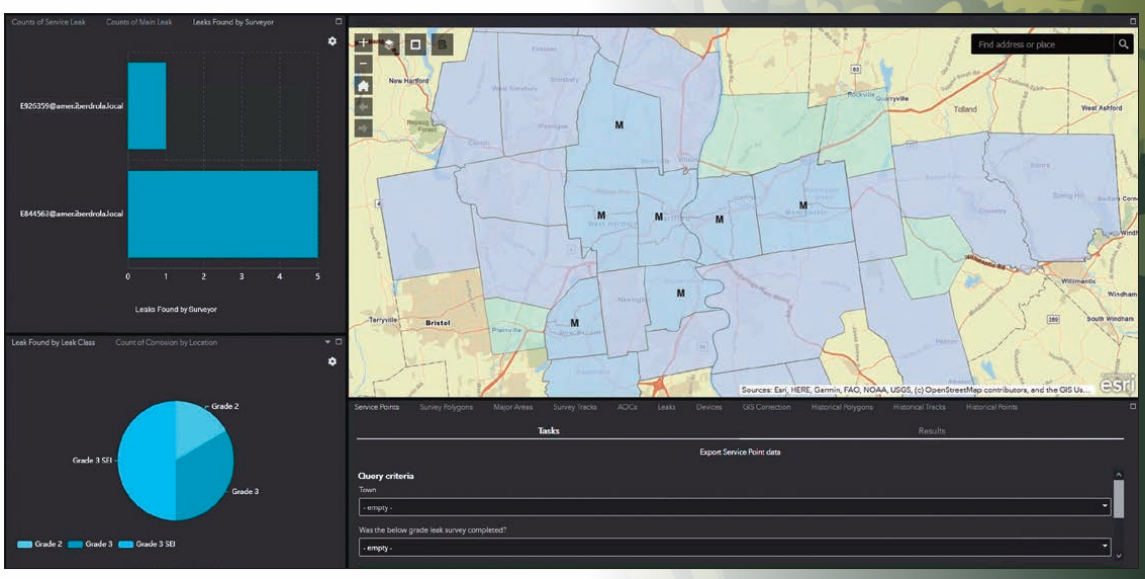
Avangrid's next steps include exploring how to integrate the solution with SAP's enterprise resource planning software, expanding it to incorporate more survey types, and introducing it to additional operating companies.



↑ Compliance managers can use a dashboard to monitor surveys and work areas.



↑ An operational dashboard shows the percentage of leak surveys that have been completed.



↑ A reporting dashboard displays compliance survey results, including leaks found and reported abnormal operating conditions.

Connecting the Dots Between GIS and Public Service

Jim Alberque

Jim Alberque remembers the moment he connected the dots. It was around 4:00 a.m. and there was a blizzard coming to Boston, Massachusetts. As an employee of the city's IT department, he was sitting in the emergency operations center behind department directors as they traded updates on the weather situation the city was facing.

At the time, Alberque was passionate about GIS work, but not equally passionate about public service—it just happened to be how he was putting his GIS acumen to good use. At the end of the blizzard-related updates, the mayor's chief of staff said something that's stuck with Alberque ever since: There's a mom who's going to wake up in 30 minutes, and she's going to need to decide whether her kid is going to school based on road conditions. And if her kid doesn't go to school, the mom might lose her job.

This human impact that public service has on an individual—and how GIS can help—is what stoked Alberque's enthusiasm for being a public servant.

"That inspires me," he said. "I feel like we're close to the levers and buttons that affect people's lives."

Now the GIS and emerging technology manager for the City of Raleigh, North Carolina's IT department, Alberque has spent 25 years in local government using GIS to help make cities better for their residents. He and his team have embraced GIS-enabled digital twin technology to generate useful data for the city, run scenarios for future planning, and tell compelling stories about the city's data. That's in addition to integrating GIS into operations citywide, including using ArcGIS Dashboards and data from ArcGIS GeoEvent Server and ArcGIS Living Atlas of the World for emergency response. Alberque and his team also use ArcGIS Indoors to manage facilities. The City of Raleigh received the Enterprise GIS Award during the 2024 Esri User Conference (Esri UC).

"There are very few things that technically you can't do," he said of GIS. Alberque added that the key is having the needed skills and curiosity to get the technology to do what you want it to do.

Passion for GIS and Public Service

Alberque grew up in central Massachusetts and moved to the Boston area in his late teens. He didn't really know what he wanted to do with the rest of his life, and he lacked "a little bit of focus," he said.

It wasn't until Alberque attended Framingham State University, west of Boston, that he discovered that the science of geography came naturally to him. He graduated with a degree in the subject. Still, it took his dad introducing him to a friend at an engineering firm who was leading a new GIS department, for Alberque to find his calling.

Once hired as an intern, Alberque said he quickly realized that GIS was something that he could be passionate about and had an aptitude for, and that it made him excited to go to work every day. Ever since, his career has been punctuated by technology releases and what he could do with them, whether it was ArcView or ARC/INFO (the first release of ArcGIS); ArcIMS; or, now, ArcGIS Enterprise.

He credits the flow of his career path, and his growing use of GIS in innovative ways, to the many teams he's worked with. First, there was the job where he learned the technical underpinnings of GIS—as a GIS analyst for Central Transportation Planning Staff in Boston's Metropolitan Planning Office. Then there were the jobs that instilled in him a passion for public service, at Boston's Redevelopment Authority (now the Boston Planning Agency) and the city's IT department.

"They had a real appetite to innovate and leverage technology in new ways," he said.

It was also during that time that he began to build a relationship with Esri as an organization, specifically with employees working on 3D modeling, to seek out help with how the city could use the tools.

"Each one of the stops in my career, I've been super lucky to be surrounded by smart, caring, passionate people," he said.

He's since brought both the aptitude and advocacy for GIS and public service to Raleigh.

Innovating in Raleigh

Alberque's reasons for moving were not unlike those of many others moving from bigger cities to fast-growing Raleigh: He knew people who had moved there—in his case, his sister and her family. Visiting, he saw firsthand how a dollar went further for square footage compared to the cramped and historic quarters in Boston. His sister's home was brand-new, everything worked, and "it seemed like a mansion to me," he said. Plus, there were the good schools and the good weather.

There was also the professional challenge. Between 2010 and 2019, Raleigh gained 260,292 new residents, growing by 23 percent, according to a Carolina Demography report from the University of North Carolina at Chapel Hill.

Alberque, his wife, and their three children were among those new residents when they moved to Raleigh in 2013.

The city's growth has continued, and Alberque believes GIS can help mitigate some growing pains.

When he arrived, he quickly realized that "Raleigh was so far ahead…from a GIS perspective," he said. Raleigh fostered close collaboration between the city and Wake County, and the city invests heavily in data and technology. Alberque said he wouldn't necessarily be building something new but, rather, would be trying not to break what was already there.

"We are definitely doing a lot. The key there is 'we,'" he said. "They're curious, they're interested in what's next and what's happening," he said of his team members, adding that they share his passion for public service.

Alberque said he also brings some competitiveness to the team. "I read *ArcNews*, and when I read it, I think to myself, 'Why are they writing about them and not us?'" he mused.

His team has set a high standard, recently garnering attention in publications such as *Axios* and *GovTech* about its work to analyze urban heat islands in Raleigh by building a digital twin. The team has been working to create a micro-scale climate model that could show wind patterns in the city related to what's been built, exhibiting where there may be still, trapped air behind buildings that influences ground temperatures.

Alberque's team has also been employing computer vision, using data gathered from about 200 traffic cameras and applying machine learning to detect activity that might otherwise go unnoticed. The information can help inform signal timing and design roadways.

He said he feels lucky when meeting with someone in the city who starts to ask, "'Can you…' And I'll just stop them: 'The answer is yes.'"

A World Built on Spatial Analysis

When Alberque thinks of a future driven by advancements in generative AI, he's keen to note that much of the foundation for large language models is built on the distance and angles between related types of data. "The whole world is about to be built on spatial analysis," he said.

He's not about to cede his passion for public service to AI, though. He regularly parks about a half mile from the office so he can walk through Raleigh neighborhoods to get to work. He marvels at the mechanics of cities—things like arranging seamless trash pickup for hundreds of thousands of people, for example—every few days.

"That stuff is fascinating to me," he said.

And it's on those walks that he's frequently thankful to work for the people of Raleigh and be part of the city's mechanics.

"That public service thing? I take it pretty seriously," he said.

↓ The team is creating a microscale climate model to show wind patterns in relation to the built environment.

UNIVERSITY OF REDLANDS ANNOUNCES THE INSTITUTE FOR GEOSPATIAL IMPACT

A hub for geographic discovery, innovation, applied research, service, and community, the Institute for Geospatial Impact (IGI) fosters the use of geographic information systems (GIS) to empower people to positively impact society through thoughtful and intentional analysis of the world around them.

In continued partnership with geospatial industry leader Esri,® IGI is driven through cutting-edge application of Esri's contemporary technologies for higher education. Our students are guided by expert faculty in GIS who provide one-on-one mentoring and collaborative hands-on, real-life learning opportunities that prepare them to make meaningful impact in their organizations and communities.

Through interdisciplinary instruction and community-based internship projects, students are equipped for diverse careers that employ geospatial insights to improve organizational strategy, streamline government services, optimize non-profit operations, and more. The IGI at University of Redlands is eager to continue mentoring current and aspiring GIS professionals for this innovative and competitive field.

Graduate Degrees

- Master of Science in GIS (MSGIS)
- Master of GIS (MGIS)
- Executive Master of GIS (EMGIS)
- MBA with Location Analytics Concentration
- Master of Science in Business Analytics (MSBA)

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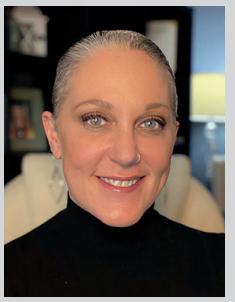


As a graduate student working full-time, Liz not only excelled in her MBA coursework at Redlands, but she also worked alongside faculty members James Pick and Avijit Sarkar on research projects studying digital divides in Latin America and the U.S. She has co-authored peer-reviewed publications and has returned to Redlands as an adjunct professor, keynote speaker, and mentor to students.

At H-E-B, Liz leads strategic implementation of the enterprise geospatial technology and development of a multi-year roadmap of technology solutions & business intelligence.

Liz's personal motto is "Impact the Outcome." She is passionate about helping organizations and individuals achieve success through well-curated geospatial strategies that harness the power of location, data science, and technology to drive business results.

"My U of R experience was life-changing. Learning from professors with executive leadership and business experience has been a priceless addition to my life."

— Liz Parrish '17 MBA
Manager of Geospatial Analytics and Insights at H-E-B, the largest grocery chain in Texas (Forbes, 2023)

The Relevance of Cartography

A Cartographer's Perspective

By Dr. Georg Gartner
International Cartographic Association

Why AI and Large Language Models Benefit from Cartography

The integration of cartography with AI—especially geospatial artificial intelligence (GeoAI) and large language models—is a transformative development in the fields of data analysis, natural language understanding, and spatial analysis. Cartography acts as a critical enabler for GeoAI and large language models because it provides a way for users to visualize complex data, extract meaningful insight from it, and communicate their findings effectively.

The synergy between cartography and AI is crucial, as it allows for more advanced analysis and better decision-making by enhancing people's capacity to interpret, visualize, and predict spatial patterns. In a world where humans are trying to tackle a changing climate, address the spread of urbanization, and manage ever more destructive natural disasters, the fusion of cartography and AI is increasingly vital, since all these issues require understanding spatial patterns and relationships.

Cartography's role in GeoAI and large language models is extensive and revolves around the following four concepts:

Enabling the Visual Representation and Interpretation of Spatial Data

Cartography enables GeoAI-based models to present spatial relationships visually, making data more accessible and comprehensible. Maps can display the geographic distribution of data points, trends, and patterns that would otherwise be difficult to discern as raw, numerical data. This is especially important in GeoAI, where the data often comes from various sources, such as satellite images, sensor data, and social media geotags.

By integrating cartographic principles, GeoAI-based models can be used to create thematic maps that make it easier for decision-makers to understand complex geospatial data, facilitating data-driven planning and resource allocation. In fact, in this context, perhaps a new term can be coined: MapAI.

Enhancing Spatial Analysis Through Machine Learning

Cartography enhances GeoAI-based models by providing spatial context, which is essential for making accurate predictions and analyses. Cartography helps encode spatial features such as proximity, elevation, and land-use patterns, which can be critical for understanding the dynamics of geographic phenomena. For instance, GeoAI-based models can predict patterns such as deforestation, urban sprawl, and disaster risk by incorporating spatial relationships into analysis.

For large language models, cartography contributes by enabling a better understanding of spatial references in texts. When large language models are trained on text that includes geospatial information—including place-names, regions, and spatial relationships—cartographic data can help these models ground their language comprehension in real-world locations. This improves their ability to perform tasks such as generating travel recommendations, summarizing regional cultural differences, and analyzing location-specific phenomena within their historical and sociopolitical contexts.

Integrating Textual Data with Geospatial Data

Cartography provides a bridge for integrating textual data processed by large language models with geospatial data handled by GeoAI. Large language models can analyze a large corpus of text—such as news articles, social media posts, and historical documents—to extract geospatially relevant information. This information can then be geocoded and visualized through maps.

A practical example of this is disaster response operations. Large language models can process social media data to extract information about the location and severity of an event like an earthquake or a flood. By employing cartographic tools, GeoAI can map these reports to provide real-time situational awareness. This allows emergency responders to identify affected areas and allocate resources more effectively. The integration of large language models, GeoAI, and cartography thus facilitates a more comprehensive analysis, providing a nuanced understanding of events as they unfold.

Improving Decision-Making and Policies

The combination of cartography, GeoAI, and large language models can significantly enhance decision-making processes. Maps have always been critical tools for policymaking, as they help policymakers understand complex geographic relationships and patterns. With GeoAI, the predictive capabilities of AI models can be layered onto maps to show future trends, risks, and opportunities in various regions. This is important, since geographically contextualized information is key for effective communication and, ultimately, underpins decision-making.

In a sea of data, maps offer a good way to recognize patterns and detect anomalies—including clusters of disease outbreaks, trends in migration, and changes in the environment—and cartography is vital to how this data gets visually represented. For example, GeoAI can process remote sensing data to detect changes in forest cover over time. But it is the way in which this data is cartographically represented that enables map viewers to clearly understand these changes within their spatial contexts and forecast change by, for instance, identifying areas that are most at-risk of deforestation.

Furthermore, cartographic methods significantly improve the scalability of GeoAI. GeoAI often deals with vast datasets, and cartography allows these large datasets to be appropriately scaled and efficiently visualized through multilayered maps that show different aspects of the data at different scales. This allows map viewers to analyze both micro (local) and macro (global) spatial patterns, making it possible to compare trends across disparate regions while maintaining a high level of detail.

For large language models, cartographic knowledge improves their understanding of natural-language text that contains geographic references. These include mentions of locations, spatial relationships, and geographic features that are not always easy to interpret without spatial context. Cartography can inform large language models about spatial hierarchies—including relationships among cities, states, and countries—which refines tasks such as named-entity recognition and sentiment analysis as it relates to places.

Additionally, large language models often interpret and respond to location-based queries, such as when users ask about historical events, inquire about cultural norms, and request travel advice for specific regions. To answer these questions accurately and comprehensively, it is crucial for these models to have a deep understanding of geography. Cartography gives large language models foundational knowledge of spatial data, which helps them generate factual and contextually relevant responses.

As the use of AI continues to evolve, the role of cartography in refining and providing context to AI-based models will only grow. Thus, cartography is a fundamental part of the future of geospatial intelligence and AI-powered insights.

That is why the International Cartographic Association (ICA) is actively fostering the development of cartography's role in AI by promoting research, collaboration, and the integration of geospatial technologies with artificial intelligence. Additionally, through initiatives such as the Commission on GeoAI (chaired by Dr. Samantha Arundel, director of the Center of Excellence for Geospatial Information Science at the US Geological Survey), the Commission on Geospatial Analysis and Modeling (chaired by Dr. Xintao Liu, associate professor in the Department of Land Surveying and Geo-Informatics at Hong Kong Polytechnic University), workshops, publications, and conference sessions, the ICA supports the development of new cartographic techniques that leverage AI.

Understanding spatial phenomena in a digitally connected world is an interdisciplinary undertaking, and the ICA seeks to bring together cartographic and geospatial professionals to ensure that spatial concepts and techniques continue to underpin reasoning in any spatial context.

About the Author

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

Georeferencing Augmented Reality Brings a Proposed Transit Project to Life

↓ With georeferenced augmented reality (AR), bus tour participants were able to see themselves walking around proposed new infrastructure.

West Broad Street in Columbus, Ohio, bears one of the longest and richest histories of any street in the state. Stretching for 9.3 miles through busy downtown Columbus, West Broad Street presents challenges to pedestrians and cyclists—but not for much longer.

As part of Columbus's LinkUS project, the Central Ohio Transit Authority (COTA) is planning to turn West Broad Street into a rapid-transit bus corridor that will include bike lanes and paths to improve connectivity and walkability. Esri startup partner inCitu (incitu.us) is using augmented reality (AR) and ArcGIS technology to help COTA bring its vision to life.

A New Vision for Public Transit

Started in 2020 by founder and CEO Dana Chermesh-Reshef, inCitu leverages AR technology to help city planners collaborate with residents and others impacted by urban development to visualize and plan new projects.

"We take open data from cities and generate augmented reality experiences," said Chermesh-Reshef. "We create a map but also an experience on the ground where you can walk block by block and see the projects."

By redesigning West Broad Street, COTA plans to foster a more equitable and sustainable community. The goal is to provide better access to jobs, businesses, schools, and health care for residents of one of the fastest-growing metropolitan areas in the United States.

To gain public support for this far-reaching vision, COTA needed to help residents understand not just how the infrastructure would impact streets, but also how it might transform neighborhoods and the commuting experience between historic areas such as Hilltop and Downtown Columbus.

"That's where we come in," said Chermesh-Reshef. "Through InCitu's pipeline, planning data is turned into georeferenced mobile AR experiences using multiple ArcGIS products."

The LinkUS team collaborated with InCitu to bring to life a new vision of public transit in central Ohio.

Seeing New Infrastructure in Context

Working with COTA's communication partner Murphy Epson, the team designed an immersive bus tour experience for stakeholders and members of the public. The tour shares the narrative of several hypothetical future bus riders as they navigate from the Westland Mall area toward Downtown Columbus.

COTA used inCitu's platform to visualize three parts of the proposed project in their real-world contexts: a bus rapid transit (BRT) station, micromobility hubs (places where commuters can transfer to other modes of transportation), and the projected mixed-use developments that will spring up along the West Broad Street route.

Leveraging InCitu's already existing ArcGIS integration, the project was set up for fast and accurate testing and iteration. ArcGIS Maps SDK for JavaScript was used to host 3D models on a web map. InCitu's technology then converted the models into georeferenced AR experiences that were accessible via QR codes. In addition, InCitu's pipeline generated 3D feature layers and scene layers that were stored in ArcGIS Online and could then be used in other ArcGIS products.

Once the AR visualization was ready, COTA ran bus tours along West Broad Street twice a week. Participants were let off the bus at three stops, where they scanned a QR code with their smartphones and, using the devices' cameras, experienced the area in its future state via AR.

"This approach allowed people to see the proposed infrastructure and its impact on the area from their own perspective and let them share screenshots and videos with friends and family," said Chermesh-Reshef. "It helped the public understand and get excited about the improved regional connectivity and accessibility, sustainable development, and how—even with expected population growth—*[that]* might lead to thriving, transit-connected neighborhoods instead of congestion."

The AR tour engaged more than 2,500 viewers directly over six months, catching the attention of various stakeholders, including local government officials. Columbus mayor Andrew Ginther participated in the AR experience and even took a photo in front of the future Belle Street Station, sharing it on Instagram. This further expanded the reach of the AR visualization.

Interacting with Proposed Changes

For people who couldn't participate in the bus tour, the LinkUS website features a map, powered by ArcGIS Online and available at app.incitu.us/map/linkus, where users can take a self-guided version of the AR tour showing key locations along West Broad Street. Highlighted areas include the South Westgate Avenue and Belle Street BRT stops and the Westland Mall.

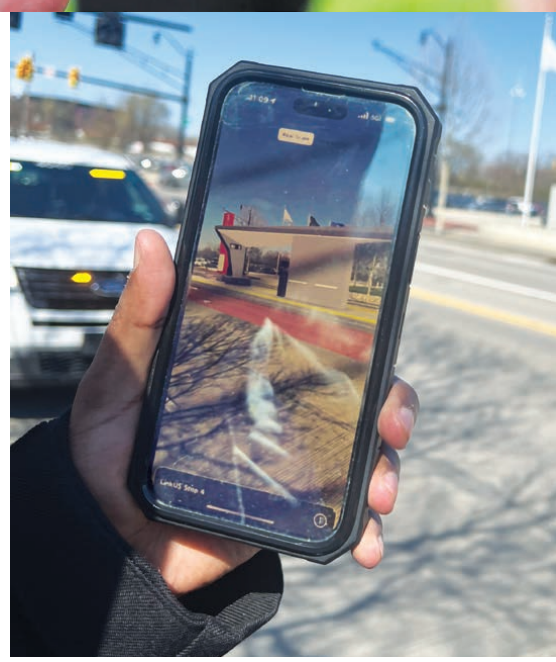
The map allows users to explore and experience these future developments interactively. By overlaying AR visualizations onto real-world locations, the map lets people picture themselves next to the new infrastructure being proposed in the area so they can visualize how these projects will benefit the community. It also makes the concept of future changes to transit more understandable and engaging.

"The goal is to provide an accessible platform for residents to see and interact with the proposed changes, as well as build an enduring sense of ownership and participation among community members," said Chermesh-Reshef.

A Broader Vision for Regional Connectivity

The West Broad Street BRT corridor is just one part of a larger LinkUS plan that includes five more rapid-transit bus corridors. These corridors are part of a comprehensive strategy to enhance regional connectivity, reduce traffic congestion, and promote sustainable growth.

By using ArcGIS Online and inCitu AR technology within a larger experiential storytelling campaign, the LinkUS team helped make a complex project more tangible. Now, members of the public can see that by incorporating various modes of transportation into their main transit corridors, the LinkUS plan is supporting a more livable and sustainable urban environment.



↑ The Central Ohio Transit Authority (COTA) used inCitu's platform to help people visualize sections of the proposed rapid-transit bus corridor project in context.

For more information on the Esri Startup program, go to **links.esri.com/startup**.

↑ A map on the LinkUS website lets visitors experience three key locations along West Broad Street, including the bus rapid transit (BRT) stop at South Westgate Avenue.

Esri Partners Bring Technology and Data Up-to-Date

When organizations find themselves saddled with outmoded technology and inaccurate data, Esri partners can help. With expertise in developing innovative GIS-based solutions, as well as in guiding users through implementations and new workflows, Esri partners are seasoned collaborators that take an active part in helping their clients realize their goals.

See how three partners assisted a gas utility and two counties in enhancing their GIS-based workflows to streamline operations and fix data inaccuracies.

Geoenabled Workflows Foster Better Connections to Pipeline Projects

The pipeline acquisition process was tedious for Georgia-based energy services firm Southern Company Gas (SCG), a Fortune 500 company that serves 4.4 million customers in Georgia, Illinois, Tennessee, and Virginia. Historically, SCG's land management team used a spreadsheet with 53 columns and more than 100 rows to manage and track new and existing gas pipeline easement acquisitions.

To improve project efficiency, **Dawood Engineering** (dawood.net) geoenabled SCG's spreadsheet-based workflows by implementing the new SCG Land Management GIS portal. This project data hub and transparent central repository empowers SCG's pipeline design project team to better detect patterns, anticipate challenges with property owners, and identify areas of concern.

Natural gas transmission pipelines in the United States cross public and private land, where easement restrictions, environmental issues, and current and future land use complicate regulatory compliance during construction. Geoenabled workflows help SCG employees overcome these challenges by making it easier for them to stay connected not only to the overall status of a project but also with each parcel in a pipeline's path.

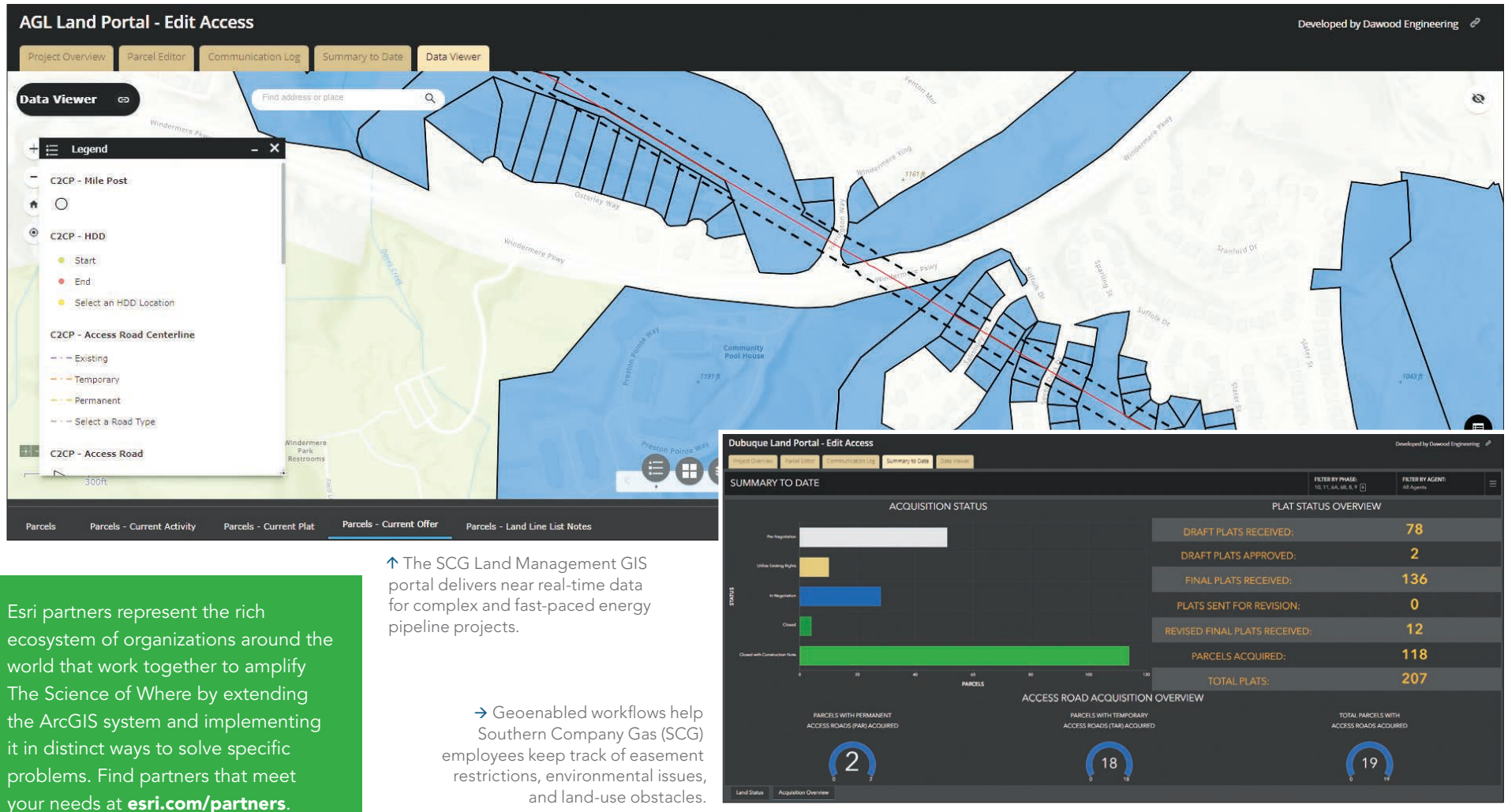
Dawood staff members created SCG's geospatial portal using ArcGIS Dashboards, ArcGIS Survey123, ArcGIS StoryMaps, ArcGIS Web AppBuilder, and ArcGIS Experience Builder. They employed an eight-step Agile-based methodology to develop the GIS workflow—a process that engaged users and enabled continual feedback and testing.

Development included beta and "sandbox" testing—a security practice that relies on an isolated environment to test code, files, and programs without affecting the underlying app, platform, or system. This was a key factor in the project's success. Dawood staff also employed Esri's AEC Project Delivery subscription service to host the portal, making maintenance easier.

Since developing the portal, Dawood has added functionality to allow users to load design information—such as location data for access roads, reroutes, workspaces, and boreholes—into the system. If any changes are made to pipeline designs, designers have 24 hours to provide new computer-aided design (CAD) files directly in the portal, which also tracks the progress of environmental surveys.

Encapsulating the idea of a one-stop shop, the portal delivers near real-time data for complex and fast-paced energy pipeline projects.

"Dawood's GIS land portal increases efficiency, tracking, communication, and reporting while reducing past issues SCG faced in these areas," said Dave Surina, SCG's systemwide manager of land management. "We're confident it will more than pay for our initial investment and apply to additional infrastructure and asset improvements."



↑ The SCG Land Management GIS portal delivers near real-time data for complex and fast-paced energy pipeline projects.

→ Geoenabled workflows help Southern Company Gas (SCG) employees keep track of easement restrictions, environmental issues, and land-use obstacles.

GIS-Based Asset Management System Improves Road Inspections

In Woodford County, Illinois—home to more than 35,000 residents—the county's highway department conducted regular asset inventories, but the data wasn't well organized and was often outdated. The department, which maintains 159 miles of roads, had limited funding and resources. Inspection records were documented on paper and stored in binders, which prevented staff members from making full use of this infrastructure data. Referencing the records was time-consuming, and using them introduced the potential for human-caused errors.

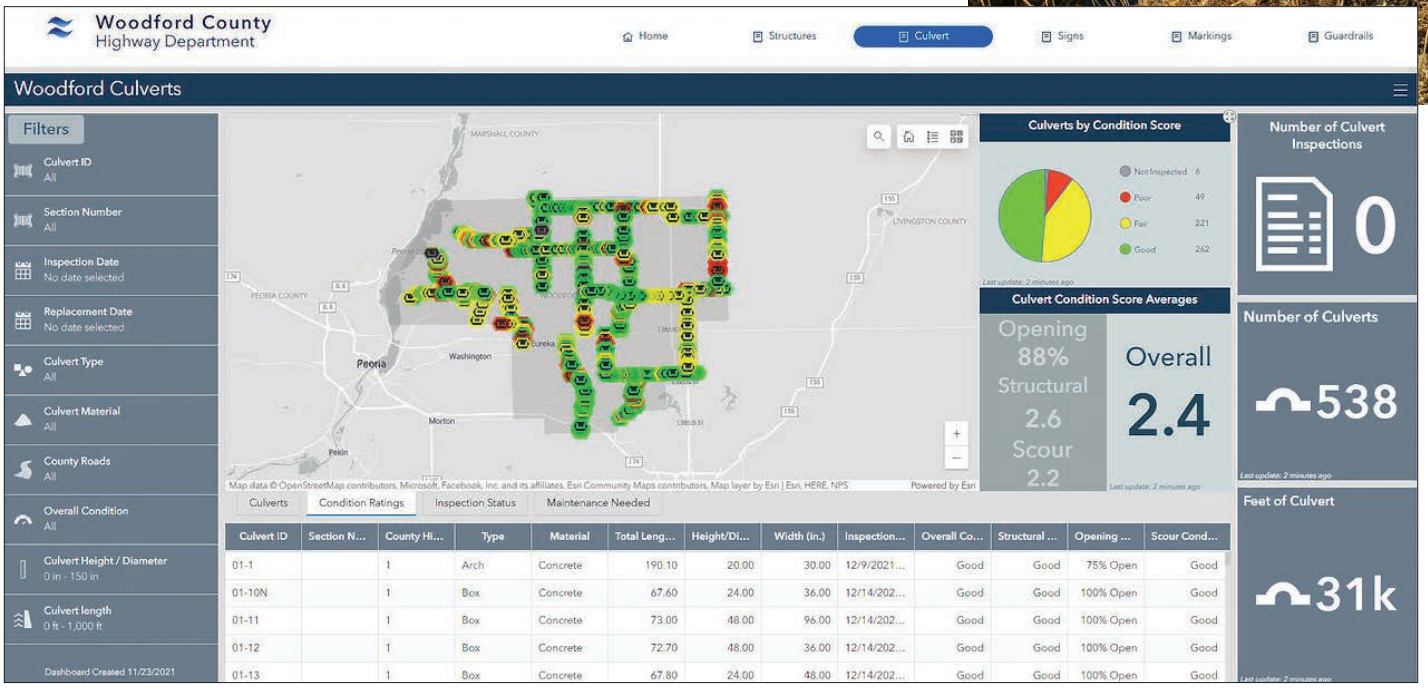
To address these issues, the Woodford County Highway Department partnered with **Cloudpoint Geospatial** (cloudpointgeo.com) to create a GIS-based asset management system using ArcGIS Online. The Cloudpoint team employed ArcGIS Experience Builder to consolidate the highway department's existing asset inventories into one centralized system and integrated ArcGIS Field Maps into the department's field-based workflows. Now, mobile crews can digitally collect and update asset data in real time, eliminating manual data entry, improving accuracy, and enhancing communication between mobile staff and office employees.

Cloudpoint team members conducted initial inspections on 75 percent of the county's 538 culverts and 36,000 feet of guardrails, with staff members from the highway department completing the rest. This thorough data collection process laid the foundation for more effective infrastructure management.

The results have been transformative. The new GIS-based asset management system—with its easy-to-interpret visualizations of spatial data—has empowered department staff to monitor asset conditions more closely, schedule proactive maintenance, gain a comprehensive overview of infrastructure assets, and make more informed decisions. The new system saves time and resources by streamlining workflows, optimizing maintenance scheduling, and reducing redundancies.

Woodford County now benefits from taking a more proactive approach to infrastructure management, fostering long-term sustainability, improved resource allocation, and significant cost savings. The highway department's adoption of the new asset management system serves as a model for how GIS technology can enhance public works operations.

→ Mobile crews use ArcGIS Field Maps to collect and update asset data in real time.



↑ A dashboard built with ArcGIS Dashboards shows the results of the Woodford County Highway Department's culvert inspections.

Parcel Fabric Implementation Transforms Tax Mapping and Enriches Collaboration

Jefferson County is the largest county in Alabama, serving more than 600,000 residents. Recently, staff at the Jefferson County Assessor's Office found themselves grappling with a nearly 20-year-old tax system that relied on obsolete technology and outdated scripting languages. The county's 320,000 parcels had significant issues with data accuracy, including problems with tile corners and edges, along with data gaps and overlaps. Additionally, some cities within the county, including Birmingham and Bessemer, operated independently, further complicating things.

To increase data accuracy and consistency among collaborative departments, the Jefferson County Assessor's Office turned to **Sidwell** (www.sidwellco.com) for the company's expertise in developing cost-effective GIS solutions. Working together, the two organizations used ArcGIS Enterprise to deploy ArcGIS Parcel Fabric, a comprehensive framework for managing, editing, and sharing parcel data. The assessor's office needed a solution that could be edited and maintained in a multiuser environment using a services-based architecture. The team implemented attribute rules and workflows to ensure continuity in editing and reduce errors among mapping staff.

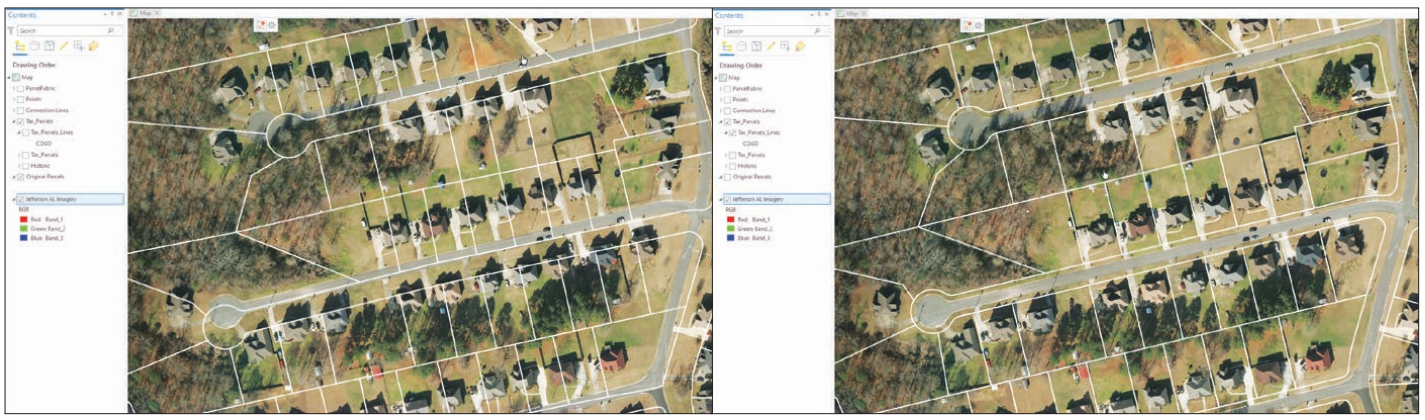
Sidwell and the assessor's office initiated a countywide project to remap all parcels from the source plats and other land records. Now, the countywide parcel layer is updated each night to reflect changes made that day, keeping the data accurate. Staff across the county felt the effects of these endeavors almost immediately: There was a remarkable reduction in constituents reaching out to report data inaccuracies or request clarifications.

By adopting Esri's parcel fabric data model, Jefferson County shifted from outdated processes to cutting-edge technology. The county has since extended this to optimizing its emergency services network boundaries. Additionally, the City of Birmingham—one of Jefferson County's largest partners—has used the parcel data to update and refine its existing city boundary data.

"Tax assessor Gaynell Hendricks's goal was to bring the county into the 21st century, *[and]* this project is a great example of that," said John Powe, chief deputy tax assessor for Jefferson County.

With its ongoing partnership with Sidwell, Jefferson County is continuing to keep its technology up-to-date and its data accurate.

↑ The City of Birmingham has used Jefferson County's parcel data to update and refine its existing city boundary data.



↑ Jefferson County, Alabama, used Esri's parcel fabric in ArcGIS Enterprise to remap all parcels from the source plats and other land records.

GIS Helps Youth Make Their Voices Heard

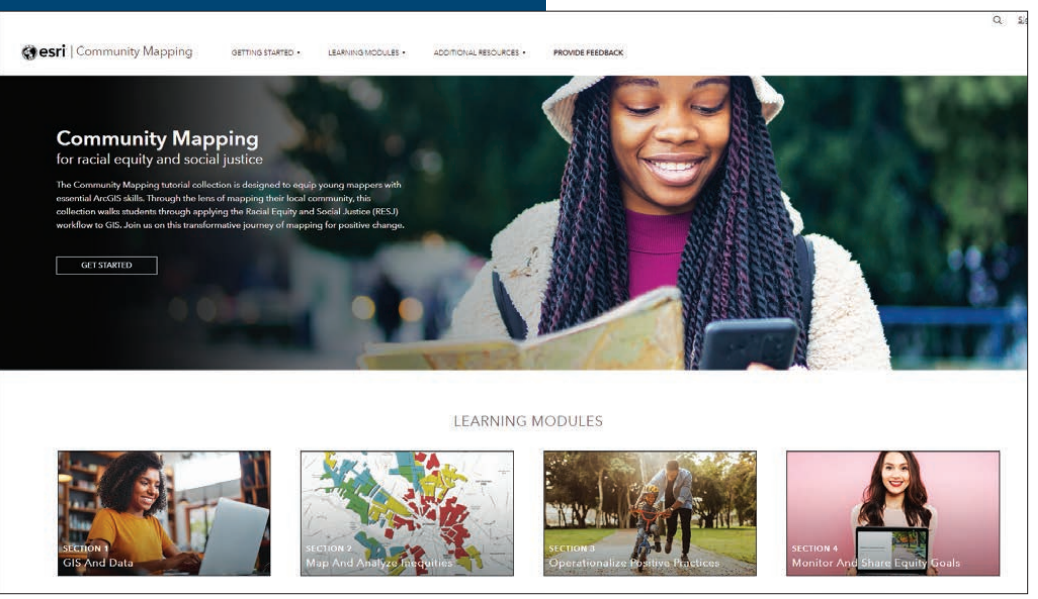
There are 2,892 miles separating the two farthest points in the continental United States, and exploring each of those miles presents an opportunity to reexamine history and issues concerning equity, justice, and race. This is according to an educational endeavor supported by the National Geographic Society—2892 Miles to Go. As the creators of the project's storytelling platform assert, "It is long past time to walk these miles together."

The program cultivates intergenerational collaboration to illuminate unacknowledged stories that center on the environmental, social, and cultural issues impacting local communities across the country. Recognized with the Special Achievement in GIS (SAG) Award at the 2024 Esri User Conference, 2892 Miles to Go leverages geospatial storytelling and analysis tools such as Esri's ArcGIS StoryMaps and National Geographic's MapMaker—an interactive mapping tool for students—to amplify youth voices.

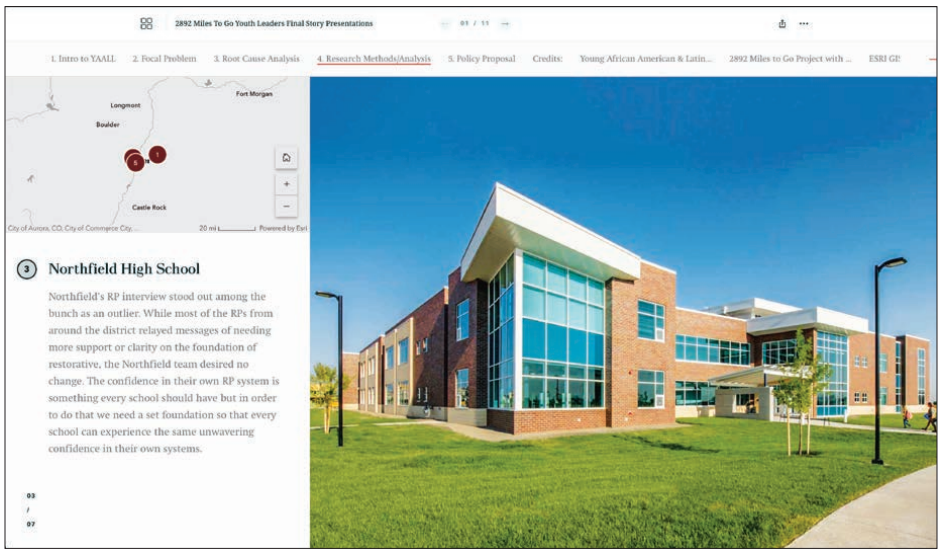
In 2024, 2892 Miles to Go partnered with Esri's education and tutorials team to integrate the Community Mapping for Racial Equity and Social Justice (RESJ) tutorial collection into the organization's programs. Not only has this collaboration taught young people how to use a variety of GIS tools, but it has also helped them advance the work they do to improve their communities.

Hear from four students who participated in the 2892 Miles to Go program—all of whom completed the tutorials and then employed GIS to engage with their neighbors, explore issues within their communities, and propose solutions to underemphasized problems. Some of their ArcGIS StoryMaps stories are available at links.esri.com/2892stories.

Explore Esri's Community Mapping for Racial Equity and Social Justice tutorial collection at links.esri.com/communityRESJ. Other racial equity and social justice tutorials are available at learn.arcgis.com.



↑ Esri's Community Mapping for Racial Equity and Social Justice (RESJ) tutorial collection is designed to equip young mappers with essential GIS skills.



↑ Using GIS, members of the Young African American and Latinx Leaders (YAALL) program recommended that the local school district have baseline restorative justice requirements for all schools.

Sara Marquez
High School Senior, Denver, Colorado

Young leaders often find themselves overshadowed by adults. But 2892 Miles to Go gives young people a platform to voice their concerns effectively. By integrating GIS into our learning, we can break through systemic and societal barriers to drive impactful change in our communities.

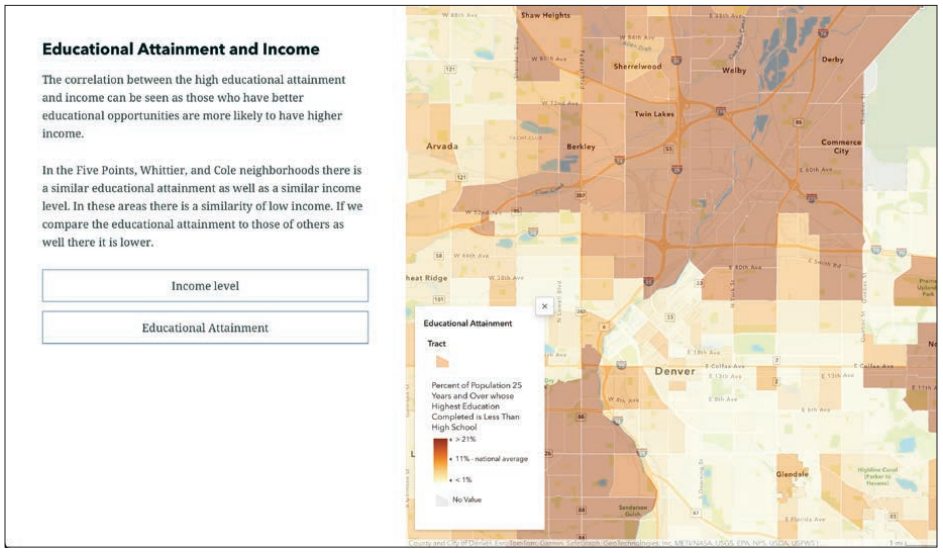
In partnership with 2892 Miles to Go, youth from the Young African American and Latinx Leaders (YAALL) program in Denver, Colorado, investigated inconsistencies in restorative justice programs at Denver public schools. Restorative justice focuses on repairing the harm a crime causes beyond punishing the offender.

YAALL members, like me, first did the Community Mapping for RESJ tutorials, which cover the basics of GIS and data as well as how to map and analyze inequities, use GIS to engage with the community and develop solutions, and monitor and share equity goals. The group then used ArcGIS Survey123 to create surveys to give to the community; and ArcGIS StoryMaps to illustrate correlations among school locations, how many restorative practice coordinators there are per school, and each area's socioeconomic status. The results showed that there are fewer restorative practice coordinators at schools in historically marginalized, lower-income areas.

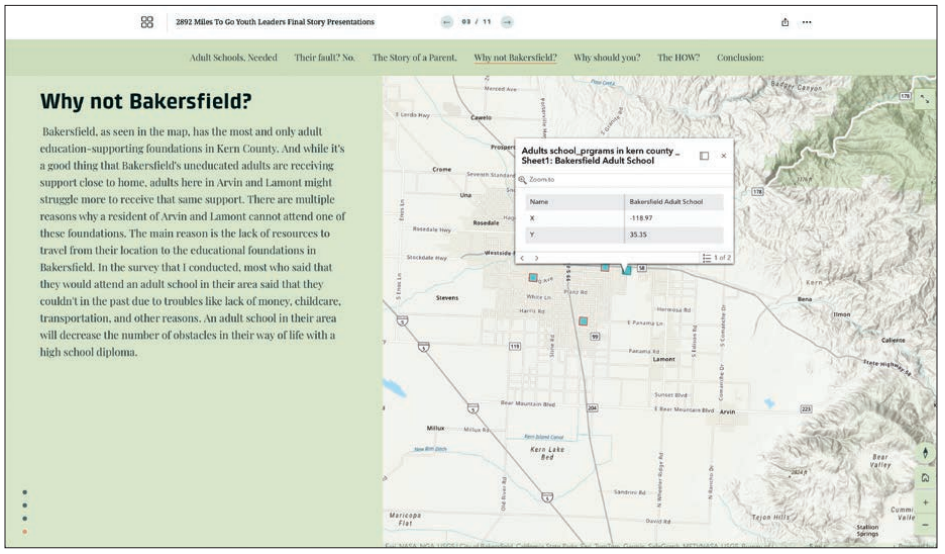
The Community Mapping GIS tutorials gave YAALL members the tools and confidence they needed to recommend a district-wide policy change to establish baseline requirements for restorative justice practices. Project participants also learned that effective leadership requires understanding historical context.

By harnessing the power of GIS, YAALL members gained a deeper connection to the past, identified systemic oppression patterns, and acquired technical skills that they can use to forge a bright future. Empowered with these tools and knowledge, young people can advocate for change while also becoming the drivers of that change.

For more information on incorporating ArcGIS technology, MapMaker, and Esri tutorials into youth-led projects that seek to generate positive change, email 2892 Miles to Go founding partner Ashley Lamb-Sinclair at ashleylambsinclair@gmail.com. To learn more about 2892 Miles to Go, go to 2892Walk.org.



↑ Students at Manual High School in Denver, Colorado, examined the relationship between income and education.



↑ Jilhary Cuellar explored the socioeconomic reasons why many adults in her area lack high school diplomas and don't pursue higher education.

Abraham Muñoz
High School Senior, Denver, Colorado

Programs like 2892 Miles to Go help young people find their voices and recognize that they are not alone in wanting—and working—to make their communities better. I wouldn't have been able to achieve a deeper understanding of my community of Denver without it.

After going through the Community Mapping for RESJ tutorials, members of the Manual High School Student Voice and Leadership team, which I am a part of, employed GIS to create charts and maps that used critical data relevant to investigating curriculum disparities within our school and across the district. Using Survey123, we gathered input from educators and students on curricular content and youth mental health. We then took data from ArcGIS Living Atlas of the World—including data on demographics and economic inequities—and created a community asset map that showed not only where there are disparities in curriculum but also how educators and students aspire to change the curriculum and incorporate historical insight into it. This gave us the ability to address issues in our community that we otherwise would not have been able to see.

As the Manual High School Student Voice and Leadership team embarks on a second year in the 2892 Miles to Go program, we plan to apply GIS to explore and address other youth-identified issues in the community, such as how to achieve climate sustainability, deal with homelessness and hunger, handle discrimination, and improve teacher-student connections in schools.

Indigo Smith
High School Senior, Denver, Colorado

Too often, young people are underestimated and underrepresented, and their voices go unheard. But young leaders crave respect—and 2892 Miles to Go gives youth a platform to use to garner that appreciation.

My experience in the 2892 Miles to Go program enabled me to advocate for my school, Manual High School, in Denver. Using a host of ArcGIS Online tools, my classmates and I explored why education is so important for communities of color.

Through the Community Mapping for RESJ tutorials, we learned how to display demographics and income data for specific neighborhoods in our community. We explored issues such as redlining and the kinds of resources each neighborhood has access to—or doesn't. The maps we made illustrated how people located in the same area can live in different realities. While learning from the tutorials, I was taken aback by carbon emissions maps that revealed how people of color are more likely to live in areas with heavy air pollution, especially if they have lower incomes. These examples helped me visualize racial inequities and the parallels with my community.

The tutorials taught us how to create surveys using Survey123. After people in our community filled out our surveys, we widened the scope of our project to explore issues that we weren't aware of, including a lack of historical context in the school curriculum and a dearth of representation of historically marginalized and low-income communities in that curriculum. We then worked with leaders to address these issues by creating a new curriculum, leading professional development workshops for educators on how to incorporate this curriculum into their classrooms, and presenting our research at the American Educational Research Association's annual meeting. Our team used ArcGIS StoryMaps to present the results of our project. The story also emphasizes our determination to ensure the success and sustainability of our community.

As a teenager who is experiencing a taste of adult life for the first time, I often lose hope, momentum, and faith in myself. Going through this program reminded me how important it is to continue to be my best self so I can make my community better.

Jilhary Cuellar
High School Junior, Arvin, California

My classmates and I collaborated with 2892 Miles to Go to explore Kern County, California's rich history and existing issues. In making my way through the Community Mapping for RESJ tutorials, I learned how to use ArcGIS to connect with the people I want to learn from, work with, and support.

The tutorials taught me how to use a variety of data to create detailed maps, apply Survey123 to ask people questions, and employ ArcGIS StoryMaps to develop an interactive story that explores my community. The issue I focused on was education shortfall among adults in Kern County.

Survey123 was an especially valuable tool to use to connect with people. It helped me ask members of my community questions and record their answers. And the summarized views in Survey123 made it easy to understand and draw conclusions from people's responses.

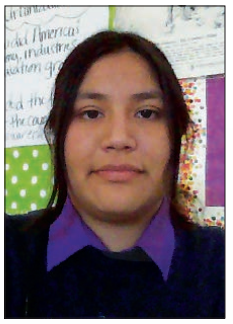
I also used layers from ArcGIS Living Atlas to explore why most of the adults in my community lack a high school diploma and have not pursued higher education. I explored layers that showed the percentage of children whose parents are immigrants, lack housing, and work in agriculture.

The place-based learning I experienced by using GIS and ArcGIS Living Atlas gave me a clearer illustration of both the historical and present-day issues that affect the people around me. This perspective is important for youth to learn because they are the future leaders of their communities.


Sara Marquez


Abraham Muñoz


Indigo Smith


Jilhary Cuellar

→ An educator works with Cuellar on her community improvement presentation. (Photo by Tailyr Irvine/National Geographic.)

From the Meridian

By Dr. Risha RaQuelle
American Association of Geographers

Creating a Culture of Care in Geography

Whether pinpointing the impacts of global events or mapping various conditions that affect societies and ecosystems, geographers, like other researchers, strive to be accurate, objective, and credible. Yet there are other crucial and complementary values that can be elevated as well to strengthen research, such as committing to fairness, mentorship, and connection and striving to support the whole person. These values are the backbone of a care-focused approach to supporting geographers of all backgrounds so they can flourish in long and fruitful careers.

How is it possible to balance rigor and care in research while also staying attuned to and addressing geographers' less visible needs, particularly those of people who have been—and still are—underrepresented? The American Association of Geographers (AAG) took on this challenge when it piloted a toolkit called TLC GRAM, which stands for *training*, *listening*, *communications*, *governance*, *reports*, *advocacy*, and *membership*. It is as set of inventory- and listening-based tools for assessing and addressing care work within a department or institution.

When I first designed this toolkit with the AAG committee that's focused on fostering inclusion and promoting fairness, the intent was to guide AAG's own efforts to fulfill its strategic plan, which recognizes inclusion and fairness as essential to strengthening the geography discipline. Now, the toolkit is contributing to the creation of a framework for building a culture of care across the field of geography. It addresses the value of listening; exchanging diverse perspectives; and building on existing practices to advance institutional support for employees, faculty, and students.

What Is a Culture of Care?

A culture of care, as defined by the Othering and Belonging Institute at the University of California, Berkeley, involves intentionally engaging in practices that foster connection and growth. This includes "bridging"—creating an ongoing feedback loop between idealistic policies and their real-world application in communities, as shaped by people's lived experiences.

A culture of care exists within, despite, and often because of uncaring conditions that might otherwise prevail. The institute encourages people to proactively examine and address how systems either embody or fall short of care. In this sense, a culture of care is viewed as a positive, generative type of resistance and adaptation.

Bringing Care to the Forefront

The TLC GRAM toolkit helps leaders elevate the act of caring for colleagues by conducting focused listening sessions with collaborators—such as employees, faculty, students, or community members—and then analyzing the care strategies identified during those listening sessions to carefully measure outcomes. Anyone filling out the toolkit worksheet is encouraged to list the caring strategies or practices they have already planned or implemented and assess which of the following domains they may show up in:

Caring Domains (TLC)

- **Training**, including professional development, programming, and resources
- (Focused) **Listening** to promote optimal and actionable dialogue
- **Communications**, both promotional and interpersonal

Measuring Domains (GRAM)

- **Governance** that works to identify and address systemic and structural barriers
- **Reports** that assess policies, practices, and progress
- **Advocacy** that advances inclusionary aims and applies collective expertise and skills to support policy
- **Membership** strategies that encourage participation and improved representation

TLC GRAM helps leaders collaboratively inventory their planned activities, policies, practices, and procedures to assess how they show up in each of the care (TLC) or measurement (GRAM) domains. Through practicing active listening and paying attention, the inventory pinpoints opportunities for alignment, areas that overlap, and gaps in planning. The toolkit helps leaders refine their brainstorming into shared goals and clear next steps.

An Enduring Commitment to Care

The work that goes into creating more equitable, caring departments and organizations is deeply systemic and sometimes unpredictable. The TLC GRAM framework creates a call to action to begin—or start over—with the understanding that fragmentary or faulty efforts can be expected.

A robust plan, despite any stumbling blocks, can inspire people to stay the course and rededicate themselves to nurturing and embedding caring practices into institutional systems. As geographer Ruth Wilson Gilmore said, "What the world will become already exists in fragments and pieces, experiments and possibilities."

Let's bring the pieces together and bravely pursue the possibilities for geographers.

From the Meridian is a regular column from AAG, a nonprofit scientific and educational society whose members, from nearly 100 countries, share interests in the theory, methods, and practice of geography. Find out more about AAG's programs and membership at aag.org.

About the Author

Dr. Risha RaQuelle is the chief strategic officer at AAG. She has 30 years of research and leadership experience in addressing structural inequalities and racism and their collective impact on people's educational attainment and opportunities for economic mobility.

Download your copy of the TLC GRAM Toolkit at **links.esri.com/TLC-GRAM**.

How Tallahassee-Leon County Is Retaining Its GIS Employees

By Scott Weisman, Tallahassee-Leon County GIS

Managing GIS
A column from members of the Urban and Regional Information Systems Association
URISA Fostering Excellence in GIS
www.URISA.org

Workforce retention is a hot topic. I encounter this concern often in conversation, and I find myself telling people that at Tallahassee-Leon County GIS in Florida, we don't have a retention issue. In fact, most employees don't leave until they retire! One person even came back after they retired and didn't miss a beat.

Retention builds continuity and reduces the need to retrain. It also produces a flywheel effect, wherein employees' capabilities build on one another, producing a highly productive and skilled team.

Tallahassee-Leon County GIS has a long history of providing mission-critical, professional GIS solutions and services across the enterprise. The program was created in 1990 through an interlocal agreement among the City of Tallahassee, Leon County Government, and the Leon County Property Appraiser's office. The idea was to share an enterprise GIS platform that enables the creation and maintenance of data and apps for the many departments each entity serves.

I began my career in an entry-level GIS position and had six titles before reaching the role of coordinator of the interlocal program in 2013. After 31 years of service, I now find myself asking, What are we doing at the Tallahassee-Leon County GIS program that allows us to retain team members through the years?

I'm reminded of something that happened when I had been in the coordinator role for just three months. A team member approached me and said, "I want you to know, I really enjoy coming to work here. Thank you for what you are doing." This has stuck with me.

Thinking about that interaction helps me step out of my role and look inward at my organization to discern what my team members want. It's more than just money to pay the bills. They want the work they do to have value, and they want to know that they are valued. We all want what we do to make a difference. We want our work to be seen and utilized. And when we do a good job, we want to be told thanks or even garner broader recognition.

Managers need to be on the lookout for their employees' milestones and accomplishments, and they need to say thank you. It is also important to make a work environment a fun and productive place. I like hosting breakfasts, usually when someone is celebrating a birthday or there has been a big team accomplishment. I love looking around the room and seeing the conversations and the comradery.

Managers should take interest in their team. If they want their staff to grow and learn, managers need to create those learning opportunities. There are many ways to do that.

Sending team members to conferences is a good start. Even if the whole GIS team can't make it to the Esri User Conference in San Diego, California, for example, video recordings are made available online so anyone can watch. They cover hundreds of topics that can serve as research and development (R&D) and other learning opportunities. Managers should also try to establish or expand their budget for attending conferences—and encourage team members to present at them. It's easier to get approval to travel if someone presents at a conference.

R&D is ingrained in my team. I ask staff members to take time during the week and research a GIS topic. This gives them a break from their everyday work to explore something new. It builds research skills, and people have fun with it. R&D has yielded savings as well at Tallahassee-Leon County GIS. Team members have learned skills that they then used to create products and services that the team previously paid for.

Another way to show team members how important they are is to make it standard for the organization to pay for professional memberships and certifications. This demonstrates that managers care about their team members and are willing to invest in them.

One big motivator for employees is knowing that they can achieve upward mobility in the organization they work for. At Tallahassee-Leon County GIS, we have worked hard with human resources and our chief information officer to formulate policies and documented growth paths that allow employees to achieve that mobility. We call this a progression plan, and it helps team members advance to the next level of their position without having to go through the budget process, which can take a long time. Progression plans offer employees long career paths that keep them dedicated—and this comes back to the organization in the form of long-term retention. At Tallahassee-Leon County GIS, there are six separate positions that employees can move to in the progression.

I hold the bar high for my team members, but I also ensure that I've provided them with the necessary tools to do the job. I make sure that they have high-end workstations, and I even let them choose their own mouse and keyboard. Little things like this go a long way.

I subscribe to leadership author John Maxwell's notion that people can lead from wherever they are. To me, that means giving every team member the opportunity to do that—whether they're leading a team, leading a workgroup, or supervising and assisting interns. In these scenarios, growth happens in all directions—for example, the intern gets hands-on learning, and the team member gets supervisory experience.

Creating an environment for retention is a multifaceted process. These are just some of the things we think about at Tallahassee-Leon County GIS. It takes time to develop a program that employees don't want to leave. But at the heart of it is caring for your team.

About the Author

Scott Weisman is the GIS program coordinator for Tallahassee-Leon County GIS. He has a master's degree in GIS from Florida State University and is an adjunct instructor in the university's GIS master's program. Weisman is also president of the grassroots organization Seven Hills Regional User Group for GIS (SHRUG), which holds GIS conferences in Tallahassee.

Spatial Foundations

By Dr. Trisalyn Nelson and Dr. Peter Kedron,
University of California, Santa Barbara

A New Guide for Teaching the Geographic Approach

Over the last three decades, GIS and geographic information science (GIScience) have advanced rapidly. Computing environments have become more powerful, software has become easier to use, datasets have become more accessible and diverse, and analytical techniques have evolved to flexibly handle a wider range of problems.

Spatial technology has also become part of daily life, and society has changed. As all this has happened, GIS researchers and practitioners have helped people sharpen their focus on how to respond to climate change and social and racial inequities. They have also accentuated the need to take a geographic approach when developing solutions to the world's problems.

Given all this change, now is an opportune time to revisit what is taught in GIScience courses. Faculty from the University of California, Santa Barbara's (UCSB) Center for Spatial Studies and Data Science have partnered with Esri to do just that. With support from a global advisory group of GIS experts, the team has initiated a discipline-wide conversation about how to transform GIScience education to incorporate recent technological advances and meet societal needs. New ideas—and a new curriculum—are already emerging from these conversations.

A Lighthouse That Guides

Participants in this endeavor are working together to identify the skills and competencies needed to solve problems using evolving GIS technologies and spatial data. The goal is to create an updated GIS curriculum that can be adapted to meet different educational needs and evolve with a constantly changing world.

Most GIScience programs in the United States—and, indeed, around the globe—are guided by a core curriculum that was developed in the 1990s. Led by the National Center for Geographic Information and Analysis, this core curriculum has been incredibly beneficial to GIS instruction because it aligned learning outcomes and minimized duplication efforts when refreshing curricula.

Modernizing this curriculum gives GIScience educators an opportunity to step back and think broadly about what essential concepts, pedagogical models, and learning outcomes students need to experience given shifts in technology, data, and society. An updated curriculum can be a lighthouse that guides instructors, researchers, and practitioners as they work to solve the world's problems and educate the next generation of GIS developers and users.

Integrating the Community's Voice

Reenvisioning core GIScience curricula is something that should involve the entire GIS community. The team working on this held several listening sessions and workshops with GIS professionals and academics over the past year. Many of these events happened at key GIS conferences, including meetings convened by the University Consortium for Geographic Information Science, the 2024 Esri User Conference, and the Association of American Geographers' annual meeting. Here are some ideas that came out of those meetings:

- **GIS training needs to be focused on solutions.** Experts in the field have indicated that what separates a GIScientist from a data scientist who works with geographic data is the ability to ask and answer geographic questions. An impactful GIScience curriculum needs to train students to implement a geographic approach, which includes asking spatial questions, leveraging the most advanced spatial data technology, and deploying outputs as solutions that can support decision-making. Geographers have long been leaders in taking an interdisciplinary approach to understanding the world. Advancing GIScience curricula means leaning into systems thinking, problem-solving, and other interdisciplinary methods of learning and doing.
- **Ethics must be central.** The GIS community has clearly indicated that ethics cannot be an afterthought or even an add-on component to courses. An evolved GIScience curriculum must put ethics, equity, and empathy at the center of its teachings. Lessons should show students how to ethically employ data and analysis, ensure equity among data and teams, and recognize that the use of GIS can both challenge and reinforce biases. Additionally, lessons in ethics need to be developed with input from groups that have typically been excluded.
- **GIS users need to learn to design workflows to solve problems.** Fundamental GIScience concepts remain important, and students will need to continue learning about raster and vector data models. But deep knowledge of GIS fundamentals is no longer required to use the software, so educators should rethink the order in which courses introduce GIS concepts and skills. Workflow design should move up in GIScience education. Students can now first learn how to develop GIS workflows that answer questions or solve problems, and this can be used to deepen students' understanding of GIS tools and concepts. Teaching students how to design a workflow early in their GIS education also opens the door for them to learn programming skills, enabling them to automate data processing, conduct advanced analysis, and use new visualization techniques to communicate their findings. These skills are transferable across domains and allow GIS students to build expertise and effectively apply their knowledge and creativity.
- **Emerging technologies need to be integrated into the curriculum.** Wider availability of geographic data, advances in computing, and the proliferation of AI mean that the spatial analysis techniques available to those working in GIScience are expanding. These technological advances need to be integrated in GIScience curricula and introduced early. The rapid development of technology is also shortening the refresh cycle for course materials, so there is a growing need for open-source materials that instructors can adapt and share. Not only will having open educational resources benefit students by making GIS education more accessible, it will also allow instructors to integrate new knowledge into their courses at a faster pace.

Ten New Teaching Modules

This spring, the team will release an initial set of 10 teaching modules that will be open and available for use by all. These modules will include the theoretical, practical, and ethical lessons for a broadly applicable course in GIS. The audience for this first set of modules is an introductory college or university course, although the material can be leveraged for diverse learners at many levels.

The modules will be delivered in multiple formats. Compiled materials, which can be used in plug-and-play mode for lectures and hands-on learning events, will be available as ArcGIS StoryMaps stories. All parts of the curriculum—including lecture scripts, lecture videos, hands-on labs, and ethical exercises—will also be available via a website, so instructors can pick and choose which elements of the lessons best fit their own courses and modify the materials to meet their needs. The website will have a community function that will enable instructors to interact with user groups and provide feedback.

Since this project to evolve GIS curricula is just getting started, the team anticipates developing future modules that will focus on imagery and more specific application areas such as health, business, and the social sciences. But the success of this work relies on feedback from GIS and GIScience instructors, researchers, and practitioners. Please reach out to the Center for Spatial Studies and Data Science at admin@spatial.ucsb.edu with ideas about what else should be included in today's GIS curriculum.

About the Authors

Dr. Trisalyn Nelson is a professor and holder of the Jack and Laura Dangermond Chair of Geography at UCSB. She is also a Public Voices fellow of the OpEd Project, which seeks to elevate underrepresented expert voices. Dr. Peter Kedron is an associate professor of geography at UCSB and the associate director of the Center for Spatial Studies and Data Science.

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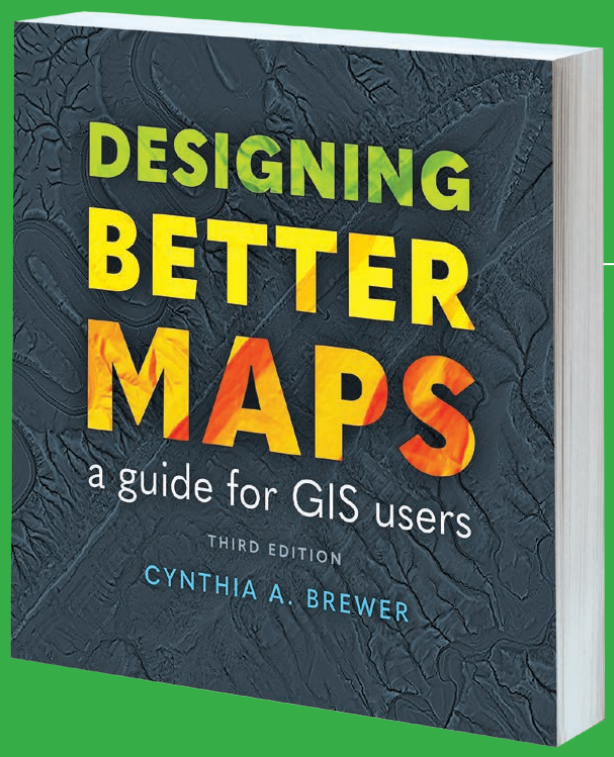
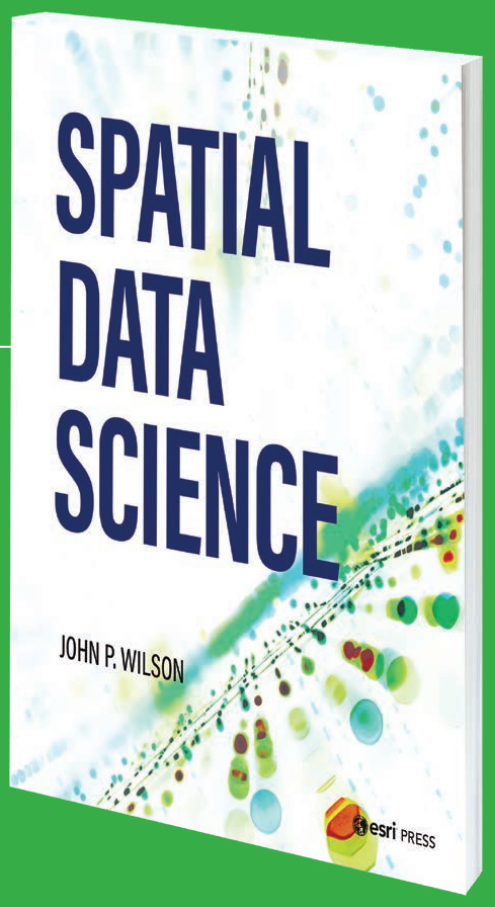


Designing Better Maps: A Guide for GIS Users, Third Edition

By Cynthia A. Brewer

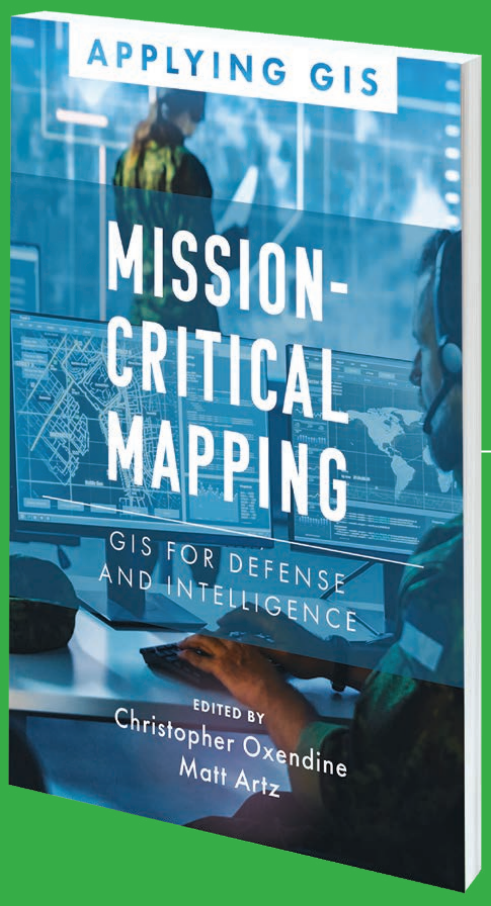
For more than 18 years, *Designing Better Maps: A Guide for GIS Users* has been essential reading for all mapmakers who use GIS. The third edition—updated with new and revamped design practices—continues that legacy. With more than 400 full-color illustrations, this book applies map design best practices to both reference and statistical mapping. Readers learn how to plan maps, use basemaps, employ scale and time, share maps, apply type and labels, understand and use color, and customize symbols. October 2024, 272 pp. Ebook ISBN: 9781589487833 and paperback ISBN: 9781589487826.



Spatial Data Science

By John P. Wilson

In *Spatial Data Science*, author John P. Wilson reveals how spatial data scientists and GIS practitioners can add big data to their workflows and use ArcGIS technology to support new spatial data science methods. Over six chapters, the book explains the growth of spatial data through the past few decades, cloud computing, data science, big data, and the Esri geospatial cloud. Anyone studying GIS or who works in computer science, engineering, statistics, and information and library science would benefit from reading this book. November 2024, 220 pp. Ebook ISBN: 9781589486119 and paperback ISBN: 9781589486102.



Mission-Critical Mapping: GIS for Defense and Intelligence

Edited by Christopher Oxendine and Matt Artz

Mission-Critical Mapping: GIS for Defense and Intelligence is a collection of real-life stories that demonstrate how defense and intelligence organizations use GIS to improve operations and readiness, collect intelligence, collaborate, and provide humanitarian assistance. By using ArcGIS technology, these organizations can integrate data, perform analytics, and create a decision-support framework that encompasses all defense functions, improving decision-making in dynamic environments. The book includes a section that provides ideas, strategies, and tools to help readers jump-start the use of GIS in their own defense and intelligence operations. October 2024, 160 pp. Ebook ISBN: 9781589488007 and paperback ISBN: 9781589487994.

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New Training and Certification Offerings

Training

Preparing for ArcGIS Pro Migration with Instructor-Led Courses

With the retirement of ArcMap coming in 2026, teams need to be well-prepared to transition their GIS workflows to ArcGIS Pro. The following instructor-led courses are ideal for GIS professionals and others who need to learn how to do their work in ArcGIS Pro:

- **Migrating from ArcMap to ArcGIS Pro—**In this two-day course, experienced ArcMap users learn essential ArcGIS Pro terminology and concepts and complete a variety of tasks related to mapping, editing, analyzing, and sharing geospatial data and resources. Head to go.esri.com/migration-course to learn more.
- **ArcGIS Pro: Essential Workflows—**Over three days, new GIS users learn techniques and general best practices to map, manage, analyze, and share data and other GIS resources in ArcGIS Pro. Visit go.esri.com/workflows-course to explore course details.

All instructor-led courses are developed in-house and are beneficial for anyone who uses ArcGIS software to support their daily workflows and enhance projects with geographic context. These courses can be delivered online, in person, or as private training events for groups. Adding instructor coaching days to private training events increases participants' knowledge retention and helps them more quickly apply what they've learned to their organization's workflows. View all instructor-led courses at esri.com/il.

Learn the Systems Approach to ArcGIS

New from Esri Academy is a collection of no-cost web courses that support organizations that want to align their enterprise GIS implementations with best practices for ArcGIS.

- **The Systems Approach to ArcGIS: An Introduction** teaches participants about ArcGIS system patterns and how to take a business-first approach to aligning these patterns with an organization's needs. Go to go.esri.com/intro to start the course.
- **The Systems Approach to ArcGIS: Architecture of ArcGIS** covers how ArcGIS is structured and how the technology enables end users to connect with content and capabilities through mobile, desktop, and web apps. Visit go.esri.com/architecture-arcgis to start the course.

A Quick and Easy Way to Learn

Live training seminars have become a top option for learners looking to explore new technical topics in a short amount of time. In one hour, Esri experts cover key concepts, demonstrate software workflows, and share their favorite tips and tricks. Each live seminar is recorded and available via Esri Academy for future viewing. Recent recordings include the following:

- Python 101 for ArcGIS
- Introducing ArcGIS StoryMaps
- Understanding GeoAI in ArcGIS

View all recorded training seminars at go.esri.com/recordings, and see upcoming live training seminars at esri.com/lts.

Learn How to Make Beautiful Maps and Geo Apps

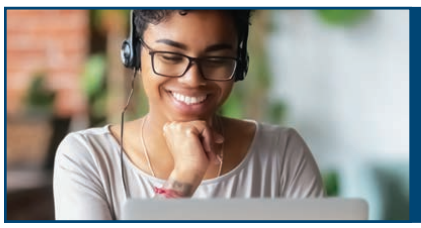
Esri's massive open online courses (MOOCs) are back in session with six offerings available in 2025. These courses are free and include videos, guided exercises, discussion forums, and a certificate upon course completion. Esri provides all the ArcGIS software needed to participate. Registration is now open for the following upcoming courses:

- **Make an Impact with Modern Geo Apps—**Running April 9–May 7, this course teaches participants how to create and share engaging apps that feature geospatial content and capabilities, all without coding. Each week focuses on a different app, including ArcGIS Instant Apps, ArcGIS Experience Builder, ArcGIS Dashboards, and ArcGIS StoryMaps. Sign up at go.esri.com/geo-apps-2025.
- **Cartography.—**Running August 27–October 8, this fan favorite covers the art and science of cartography, brought to life by an enthralling panel of experts. Participants explore ArcGIS Pro mapping tools and learn how to avoid common cartographic pitfalls—all while creating beautiful maps of their own. Sign up at go.esri.com/carto-2025.

Certification

The Esri Technical Certification program enables ArcGIS software users and developers to validate their knowledge and skills. The new certification exams below are available now. Visit go.esri.com/certs for detailed exam information.

- **ArcGIS Pro Associate 2025—**This exam tests candidates' experience in applying ArcGIS concepts and processes to workflows. Qualified candidates should have two or more years of applied experience using ArcGIS. Learn more at go.esri.com/eapa2025.
- **ArcGIS Pro Professional 2025—**This exam tests candidates' experience in using a range of tools and functionality across ArcGIS. Candidates are also tested on how well they apply advanced GIS concepts to a project. Find out more at go.esri.com/eapp2025.



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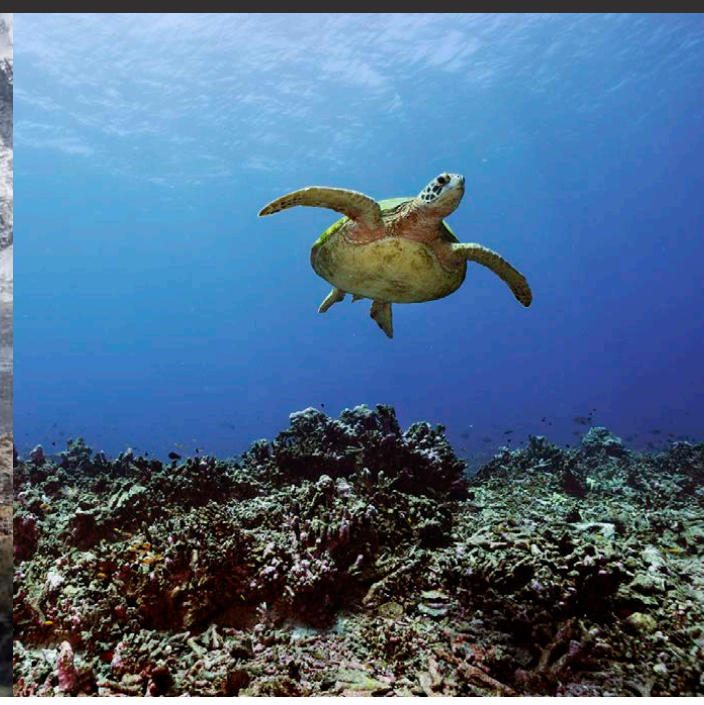

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