



ArcNews

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Briefly Noted

Many Ways to Participate in GIS Day

On November 15, GIS users from around the world will celebrate GIS Day. Take part in the festivities by hosting an event at your organization, at a local school, or within your community. Help spread the word about how anyone can use GIS to inform decision-making; analyze information about people, places, and environments; and create a positive impact. Visit gisday.com to explore GIS Day events happening all around the world or to register one of your own.

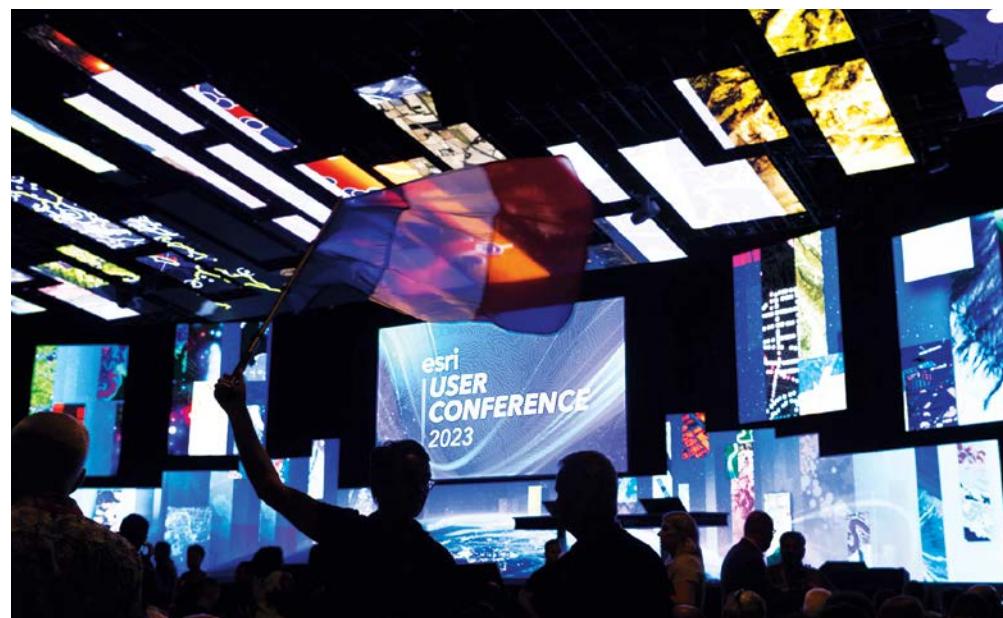
AI Makes Latest Land-Cover Map More Temporally Consistent

In partnership with Impact Observatory, an artificial intelligence (AI)-powered geospatial monitoring company, Esri has released a global land-use/land-cover map of the world based on the most up-to-date 10-meter Sentinel-2 satellite data for every year since 2017. Following the latest 2022 data released earlier this year, the AI model for classification has been improved, making the maps more temporally consistent. This enables users to work "with maps that will accurately reflect events and earth processes that are happening in reality," said Sean Breyer, Esri program manager for ArcGIS Living Atlas of the World. With planned annual releases, users can make year-over-year comparisons in global land cover. This is especially important for organizations such as national government resource agencies that use this data to define land-planning priorities and determine budget allocations. To explore this in ArcGIS Living Atlas, visit livingatlas.arcgis.com/landcoverexplorer.

Lessons in How to Create the World You Want to See

"What kind of world do you want to see?" asked Esri president Jack Dangermond to kick off the Plenary Session for the 2023 Esri User Conference (Esri UC), held in San Diego, California, July 10–14.

If people want to see relationships; patterns in land use and retail; and possibilities when it comes to conservation, job growth, and health care, GIS can give them the data-driven insight to do that.



↑ The 2023 Esri User Conference (Esri UC) hosted nearly 18,000 in-person and 10,500 virtual attendees.

The theme of the conference was GIS—Creating the World You Want to See, a concept that was woven through the user presentations, technical demonstrations, map gallery displays, and special interest group meetups that took place during the week. It was also central to the user stories, GIS demonstrations, and keynote speeches of the Plenary Session presented on day one of the conference.

"The world that we live in today is a highly interdependent ecosystem," continued Dangermond, addressing the nearly 18,000 in-person and 10,500 virtual attendees hailing from more than 130 countries. "And it's changing, it's evolving. Humans increasingly will play a major role in its future—people like you and me."

Dangermond called on the audience to consider how their GIS work shapes this future. Few people, he noted, understand the interconnectedness of the world's challenges as clearly as GIS professionals do.

Representatives from government organizations, private companies, and educational institutions inspired the Plenary Session audience by demonstrating how they use GIS to shape the world. What all the presentations had in common was a clear, powerful vision of a better future and the varied paths GIS allows people to take to create a world they want to see.

Utility Keeps People Safe with Enterprise GIS

In the last decade, Pacific Gas and Electric Company (PG&E)—which provides service to more

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For Infrastructure Megaproject in Peru, ArcGIS GeoBIM Proves Critical

In 2017, various regions of Peru experienced torrential rain, widespread flooding, and landslides due to El Niño—when unusually warm water in the Pacific Ocean causes abnormal climate conditions. The catastrophic weather affected 1 million residents along Peru's coast and destroyed nearly 22,000 homes.

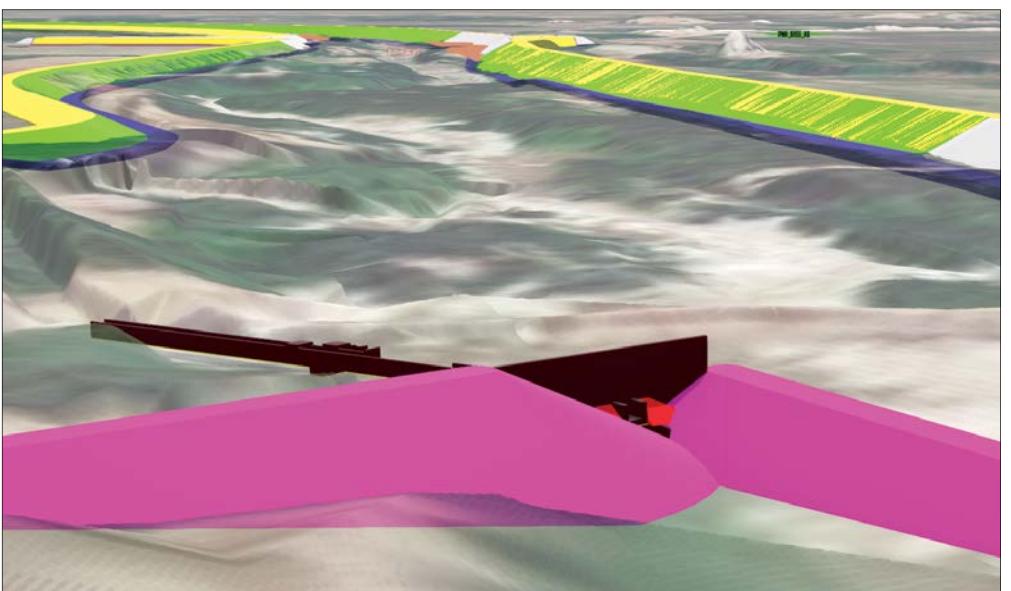
To aid with recovery, the Peruvian government established the Authority for Reconstruction with Changes (ARCC), a temporary public entity that was charged with leading the efforts to rebuild damaged public infrastructure. The ARCC's reconstruction plan consists of a series of projects in 13 regions, including one for the Olmos and Zaña river basins in northern Peru. For this project, river defenses, containment dikes, and evacuation channels are being built to reduce flooding and protect vulnerable residents in the event of other storms.

Because the design and development components involve many stakeholders and a large

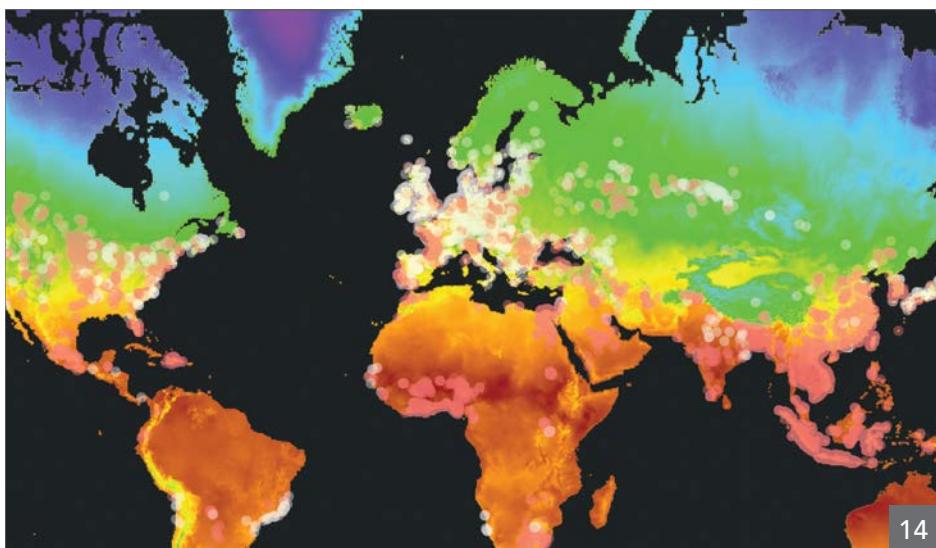
number of assets, everything needed to be organized efficiently. So the Rovella INMAC Consortium—the company charged with managing, designing, and implementing the project—deployed ArcGIS

GeoBIM. This web-based app enables team members and other stakeholders to view and collaborate on building information modeling (BIM)-based

continued on page 6



→ ArcGIS GeoBIM helps stakeholders view projects holistically and easily share feedback.



Since 2020, Highly Pathogenic Avian Influenza (HPAI) has reemerged around the world. Changes in the H5N1 subtype of the disease have expanded its reach into new regions and created devastating effects for the poultry industry and wildlife, including mammals. A new open-source dashboard, called DashFLUboard, allows users to explore the dynamics of HPAI by monitoring wild bird migrations and connecting outbreaks.



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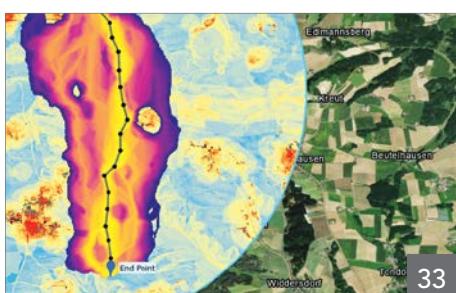
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Streamline Operations by Contextualizing Videos Using Maps

ArcGIS Video Server Allows Users to Perform Geospatial Video Analysis on the Web

In many industries—including utilities, defense, local government, and public safety—videos taken from multiple sources like drones, airplanes, and stationary cameras can help tackle issues that range from locating a rooftop leak to tracking a vehicle that's transporting contraband.

ArcGIS users who have robust video collections have long sought easier ways to incorporate this data into their GIS workflows. A new server role in ArcGIS Enterprise called ArcGIS Video Server will enable users to create video services in ArcGIS and perform geospatial video analysis on the web.

What is geospatial video analysis and how can it support analytical workflows?

Performing analysis of geospatially enabled videos involves using a video and its relationship to the earth to understand what happened and when and where the event occurred.

The key to linking a video to a map lies in the video's metadata. The video's time stamp, the position of the vehicle in relation to the ground (the camera's platform position), the camera's orientation, and the location on a map where the camera is pointed (the target location) all provide geospatial context for the video. The more metadata that's captured for a video, the better the geospatial context will be. This means that the video will more seamlessly integrate with a map and other available data sources.

In many cases, contextual details about someone or something's actions or behaviors can be seen in videos, whereas they're not as easily detected in single-frame images. For example, it might be difficult to determine if a photo of a truck with an open back and people around it depicts the truck being loaded or unloaded. Several photo frames or, better yet, a short video, could give analysts the context they need to determine that level of activity and categorize it.

Combining video with other data sources also allows analysts to monitor situations in near real time, collect observations, and compare past data to newer videos to make more informed decisions.

How do web-based services support video analysis workflows?

Imagine employees throughout an organization having the ability to easily share and collaborate on video analysis. What if instead of relying on email or cloud-based file hosting services to share large video files, employees could upload and publish videos so they stream over the web? This would enable anyone in an organization to use a portal to access the videos and analysis when they need them.

When users publish videos over the web, they are creating a video service. The addition of video

services to ArcGIS Enterprise allows videos to be hosted on a server and consumed the same way that other Esri services are consumed.

To unlock this capability, Esri has created a server role for ArcGIS Enterprise called ArcGIS Video Server, coming out this fall. It allows users to publish their file-based videos so they stream over the web, facilitating quick and easy access. By web-enabling video, multiple users within an organization not only can work on the same archival or live footage but also can share their findings with stakeholders to foster quick decision-making about crucial operational tasks, such as tracking inventory, fixing damages, or deploying personnel on the ground.

How does Video Server work with other apps and software?

Through ArcGIS Enterprise, Video Server integrates with an organization's ArcGIS system to support searching, publishing, streaming, and analyzing geospatial video through client apps that run on users' devices. The primary client app that users can employ to interact with and publish videos is ArcGIS Excalibur, Esri's web-based imagery analysis app. With the release of Video Server, the capabilities in Excalibur will be expanded to enable users to search, access, use, and share videos in addition to imagery.

Through the Excalibur interface, users can upload videos to Video Server to view them as a service and play them alongside their telemetry on a map. Users can also plot observations on the map and capture video frames to measure or count objects seen in a video.

Excalibur provides ready-to-use tools and workflows that make interacting with videos simple and intuitive.

For users who employ the ArcGIS Imagery Analyst extension in ArcGIS Pro and/or use ArcGIS AllSource, they will be able to consume video services from Video Server with the ArcGIS Pro 3.3 release coming this spring. Support for consuming video services in web apps and dashboards will be added soon as well.

How can using video services in Excalibur streamline operational tasks?

Certain operational tasks—like monitoring a large-scale facility such as a utility network or an airport—need the kind of high-level view that only drones and other aerial cameras can provide. With Excalibur, observations that have traditionally been made on the ground can be done remotely, via video, with significantly less cost and, in some cases, reduced risk to human life. This makes large-scale operations more efficient.

For example, OC Survey, which is part of Orange County, California's public works department, used a dedicated fleet of drones to capture footage of the roof of John Wayne Airport and detect the source of a water leak.

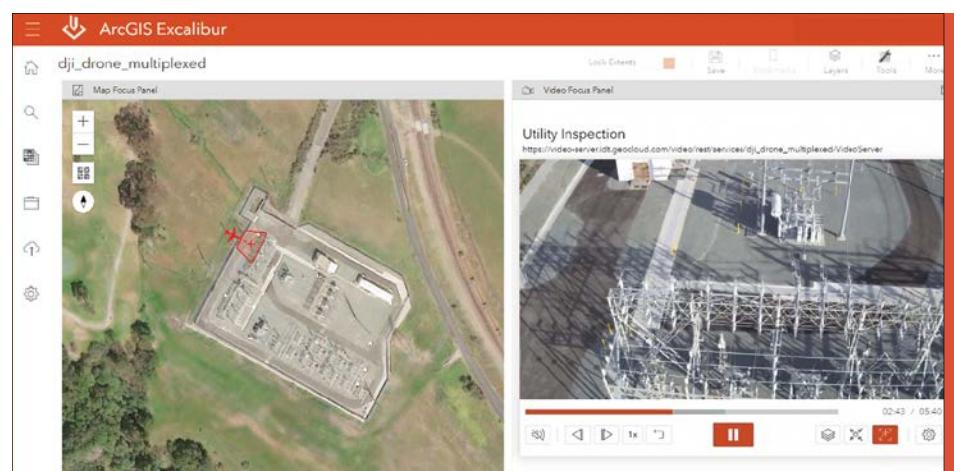
Once the footage was captured, staff from OC Survey—an early adopter of Video Server—uploaded the video to Video Server and, using Excalibur, played it alongside its map telemetry until they found the leak. Employing Excalibur's Capture Video Frame tool, staff members took a screenshot of the video frame that showed the leak and placed it on the map panel. Then, using Excalibur's built-in observation tools, the team placed an observation point on the screenshot, wrote details about the leak in the comments section, and sent the web map and the screenshot to John Wayne's service team.

The leak was repaired faster and more efficiently than if its discovery had been made in person.

How to get started

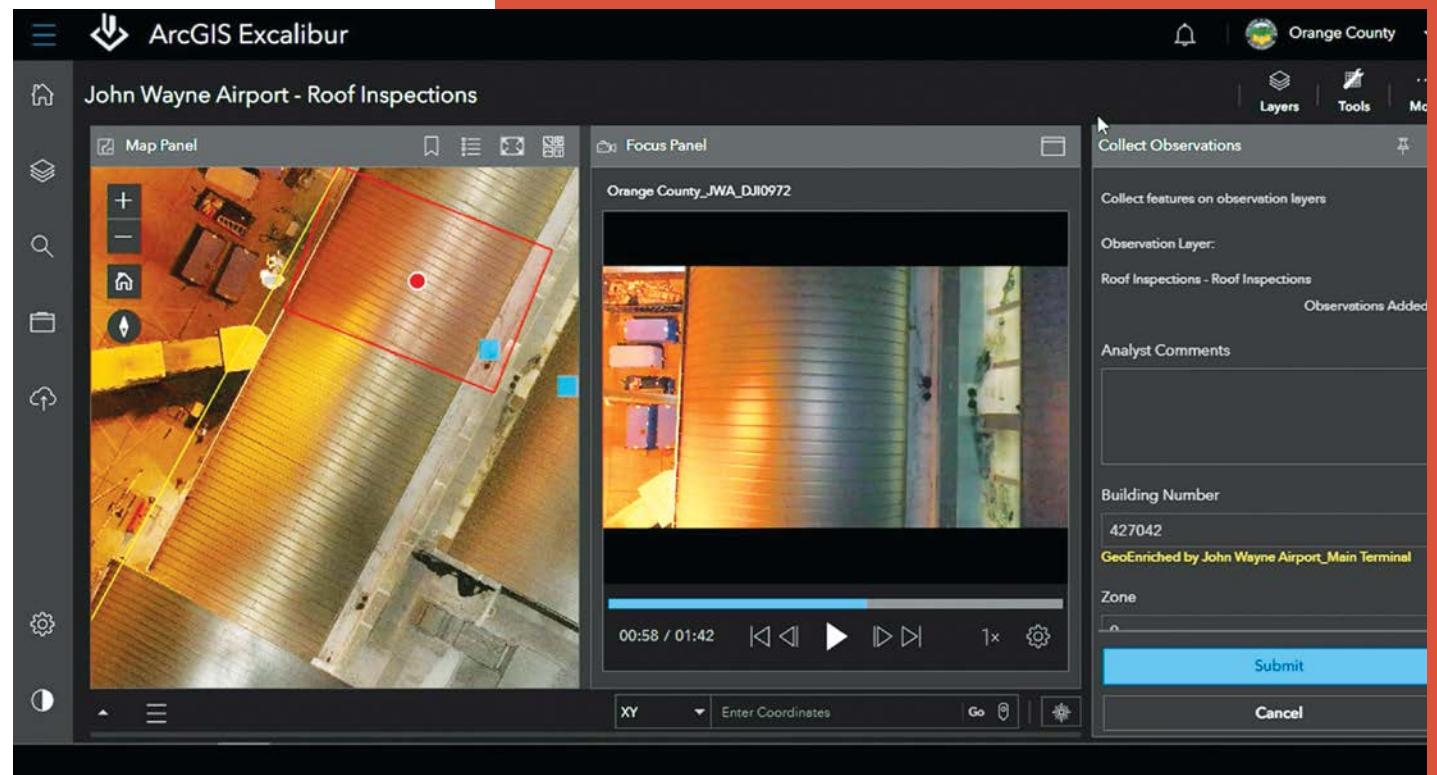
In gearing up for the fall release of Video Server, start exploring Excalibur. Get familiar with its tools and built-in workflows for imagery, and get ready to use them with video. ArcGIS Enterprise users with a Creator or GIS Professional user type extension can add Excalibur to their deployments as a premium app.

For more information about Excalibur, visit go.esri.com/excalibur. Sign up to be notified when Video Server is available at go.esri.com/videoserver.



↑ The key to linking a video to a map lies in the video's metadata, which provides geospatial context for the video.

↓ To detect a water leak in the roof at John Wayne Airport, staff at OC Survey captured drone footage of the facility, found the leak, placed an observation point on the map, and sent the web map to the airport's service team.

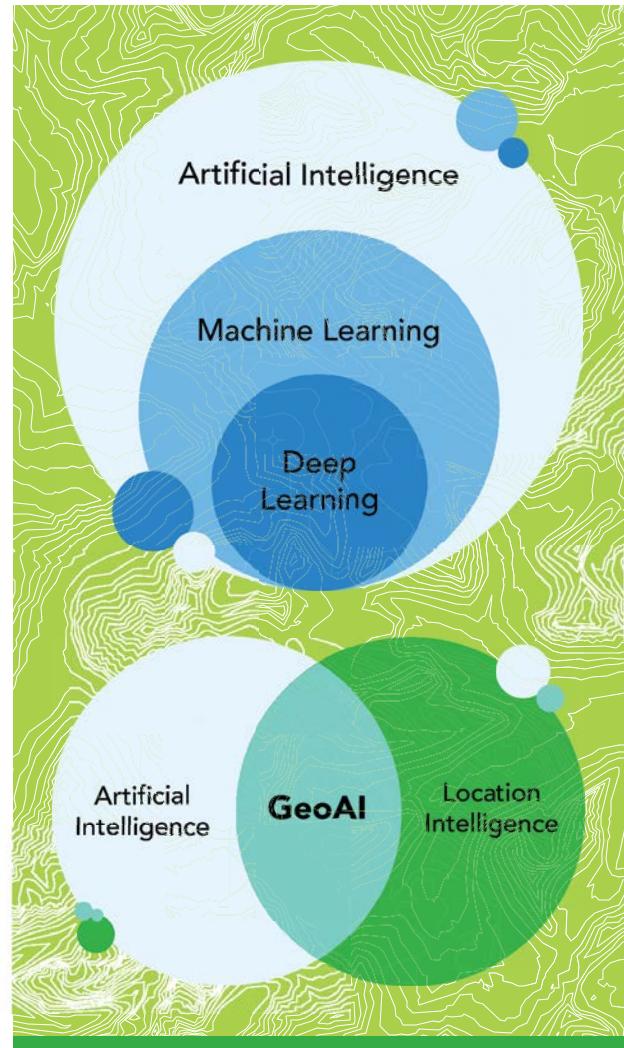


Demystifying GeoAI

In today's rapidly evolving technological landscape, the convergence of artificial intelligence (AI) and location intelligence has given rise to a revolutionary technology: geospatial artificial intelligence (GeoAI).

GeoAI fuses AI with geospatial data, science, and technology to accelerate workflows, uncover valuable insights, and solve spatial problems. With the ability to monitor and analyze events swiftly, it enables users to keep pace with the changing technological environment and make informed decisions faster than they could before. This increased situational awareness, coupled with the rich insight and predictions that GeoAI can generate from spatial patterns, generates valuable results for businesses, government agencies, and other organizations.

AI has two key components: machine learning and deep learning. Machine learning involves training a computer to learn patterns within data and predict outcomes without receiving explicit instructions to do so. Deep learning—a subset of machine learning—employs algorithmic structures called neural networks that are inspired by the way the human brain works to learn complex patterns within data by piecing together simpler concepts.



↑ Geospatial artificial intelligence (GeoAI) happens at the intersection of artificial intelligence (AI) and location intelligence.

Within the framework of GeoAI, machine learning can be used to analyze spatial data and solve spatial problems using classification, clustering, and prediction and forecasting techniques. Deep learning, on the other hand, is most often used in GeoAI to generate rich spatial data by automating the extraction, classification, and detection of geospatial information from imagery, videos, point clouds, and text. It can also be used to analyze spatial data to make predictions and forecasts.

Many organizations are modernizing their operations by leveraging GeoAI to make data-driven decisions and take proactive measures that address challenges and opportunities in the spatial domain. GeoAI supports a range of applications, such as detecting and classifying land-cover changes, predicting urban growth, and assessing environmental risks. And there is a diverse array of GeoAI solutions—including out-of-the-box pretrained models, models that can be fine-tuned to address specific issues, and custom models—that meet various organizational needs.

Read on to see how GeoAI can help organizations facing different scenarios glean meaningful insight from data and solve spatial problems with unparalleled speed, accuracy, and efficiency.

Enhancing Highway Maintenance with a Pretrained Model

Performing highway maintenance presents numerous challenges for transportation departments. Road networks are vast, and road cracks and defects need to be detected quickly. Traditional manual inspection methods are labor-intensive and can fail to identify areas that are in critical need of repairs.

There are pretrained GeoAI models that can automate road crack detection and enable transportation departments to do further analysis on key spots. With this information at hand, transportation departments can then enact efficient and proactive maintenance plans to keep highways in good condition.

• How to Use a Pretrained Road Crack Detection Model

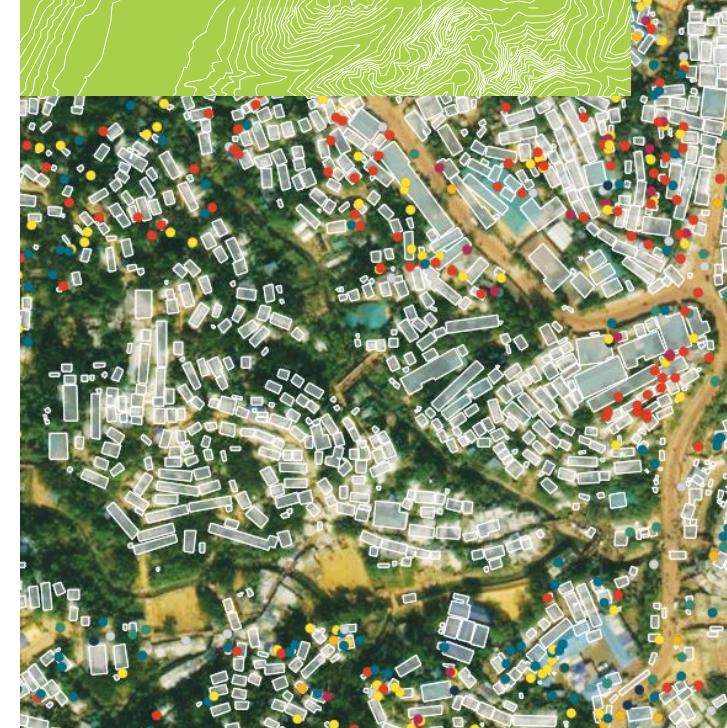
A highway maintenance department can enhance its road condition assessment procedures with GeoAI by using a pretrained deep learning model that's specifically trained to detect cracks and anomalies in roads.

The process begins by having the transportation department's GIS team use drones and vehicle-mounted cameras to capture high-resolution images of roads in its area of interest. The GIS team can then apply a ready-to-use, pretrained road crack detection model to the images. As the model processes the images, it efficiently identifies cracks and defects in roads.

The department can then use these extracted features as input for a machine learning algorithm that employs regression analysis to model road conditions based on traffic characteristics, like high truck density on certain routes; road material properties, such as the age and thickness of the pavement; and other road performance measurements. This gives the team a better understanding of the effects that these variables can have on already existing cracks and road defects.

With all this information at hand, the team can predict where road maintenance may be required. This allows the transportation department to prioritize repair efforts, perform preventive maintenance, and optimize road maintenance resources. Taking this approach significantly expedites the road inspection and repair process and enables the department to make its roads smoother and safer for drivers.

→ Pretrained GeoAI models can automatically detect cracks in roads.



↑ A building footprint deep learning model can be fine-tuned to an area's geography.

Optimizing the Allocation of City Resources by Fine-Tuning Existing Models

In many regions around the world, people live in informal settlements where a housing unit can exist today and move tomorrow. Most countries conduct population surveys via a census every decade, but since informal settlements are dynamic, local-scale population counts can be outdated by the time the census data is released.

Because local governments rely on population data to allocate critical community services, such as medical care, schools, and banking, it is imperative that they collect and maintain accurate population data at local levels—especially in areas that experience continual active migration.

Using a building footprint deep learning model that's fine-tuned to an area's geography can help local government organizations keep more consistent population counts.

• How to Employ a Fine-Tuned Building Footprint Deep Learning Model

To fine-tune an out-of-the-box building footprint deep learning model so it can detect informal settlements in a particular geography, local government staff members can begin by capturing aerial imagery of a local informal settlement. Staff can use this imagery to generate training data by, first, selecting sample areas and manually identifying informal settlements. Next, they can digitize this data and use it as input to retrain the model. Staff can then adjust the model with their desired parameters—such as the model's learning or accuracy rate—and use it to extract building footprints within the larger region.

After that, staff members can use machine learning techniques like regression analysis to model fluctuating informal settlement populations based on factors such as household demographic characteristics; geospatial covariates, including an area's elevation, proximity to roads, and nighttime lights; and specific attributes of the





• How to Build a Custom Damage Detection Model

To develop a custom deep learning model that detects the extent of damage after a hurricane, the GIS team at a disaster aid organization can begin by taking an archive of historical imagery data that shows the area after several natural disasters. A custom deep learning model can then be trained using this imagery to learn how to identify damaged buildings and other important features.

When future natural disasters occur, the team can apply this model to new postevent imagery so it automatically extracts damaged features. This makes it easier for first responders to allocate resources and for insurance companies to start processing residents' claims.

Once the model identifies and maps the structures that have been damaged by the most recent hurricane, the team can load these into machine learning workflows. From there, the team can quickly perform cluster analyses on the damaged buildings to identify priority zones for temporary housing. The team can also use a predictive model to estimate the amount of debris generated by the hurricane and figure out the storm's cumulative impact on local watersheds.

By capitalizing on deep learning models, assessors who previously conducted, say, 100 manual damage assessments per hour can now complete hundreds of thousands of automated assessments in the same amount of time. This enables federal agencies

derived building footprints themselves, like their area and density. This allows users to predict household-level population estimates across the larger region. These estimates can subsequently be aggregated to help inform local government decisions.

This technique precludes users from having to manually train a model from scratch. Instead, they can leverage a ready-to-use model and retrain it to the desired parameters. This speeds up the data gathering process and helps local governments get necessary amenities and services to their constituents to help foster community growth and prosperity.

Improving Disaster Response Outcomes by Building Custom Models

In the aftermath of a hurricane, local governments and aid organizations need to assess the damage done to building structures in hard-hit areas. Performing damage assessments quickly, right after a natural disaster, enables faster recovery and rebuilding efforts.

These organizations can take historical imagery of an area and use it to train a custom-built deep learning model that can quickly and safely identify damaged buildings and other features of interest.

→ Custom-built deep learning models can be trained to locate damaged buildings after a natural disaster.

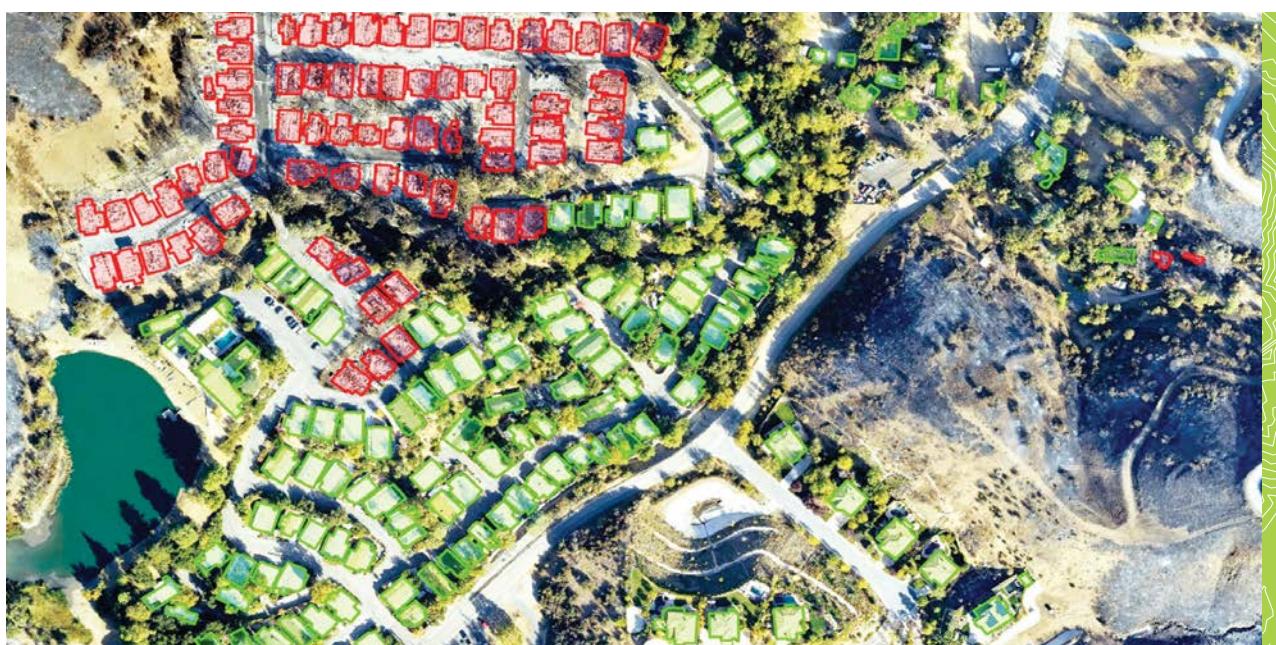
and insurance companies to take timely action in dispatching aid to those in need.

Get Started with GeoAI in ArcGIS

These are all powerful examples of how GeoAI can work in various situations, but they only scratch the surface of what's possible. There are numerous ways that users can utilize GeoAI in ArcGIS that range in complexity and levels of customization.

To get started with this groundbreaking geospatial technology, users can first explore Esri's more than 50 pretrained deep learning models at go.esri.com/geoai-DL-models and see if one works for their situation. These models provide an out-of-the-box solution, so users can begin extracting, classifying, and detecting data without taking the time and intensive resources to train a model. Users also have the ability to fine-tune these pretrained models to their specific needs. Additionally, for users who have custom workflows, they can review an extensive list of available deep learning models at go.esri.com/customize-DL-models and use these to train their models using their own data.

Learn more about GeoAI and explore the full potential of this powerful technology within the ArcGIS system by visiting the GeoAI capability page at go.esri.com/geoai-capability.



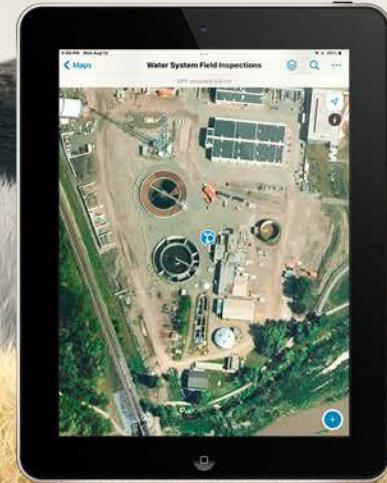


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For Infrastructure Megaproject in Peru, ArcGIS GeoBIM Proves Critical

projects, assets, and portfolios. By creating a cloud-to-cloud connection between ArcGIS and Autodesk Construction Cloud, ArcGIS GeoBIM simplifies how teams access up-to-date design and construction information that's stored across systems, including documentation, 3D digital models, and project management issues.

Integrating BIM and GIS

With the Olmos and Zaña project, a significant challenge for the Rovella INMAC Consortium—which is composed of Rovella Carranza and INMAC PERÚ, two companies based in Argentina—was getting all stakeholders to utilize the project information model (PIM) during construction. The PIM is a collection of digital information that's developed during a project's design and construction phases. A PIM assembles information from multiple disciplines, including nongraphical data and project documentation.

According to David Antonio Castillo, a BIM specialist at the Rovella INMAC Consortium, the software typically employed to create a PIM was not designed for work areas as large as the Olmos and Zaña river basins, which together comprise 1,239 square miles (3,210 square kilometers)—an area four times the size of New York City. Because the PIM is a compilation of 3D digital models, the software used for it also typically runs on high-end desktop computers, which not everyone on the team has access to.

Royer Franklin Ttito, a civil engineer and BIM manager at the Rovella INMAC Consortium, thought that integrating BIM and GIS technology to digitize relevant data and manage information could solve the PIM problem and add value to the project. It would also help the team adhere to ISO 19650, an international standard for managing information using BIM throughout the life cycle of a built asset.

"To organize and digitize the information, it was necessary to connect the GIS technology and integrate the BIM methodology into it...during the design stages," said Castillo.

The initial strategy was to federate Autodesk Construction Cloud and ArcGIS model data in Autodesk InfraWorks. However, the team encountered two very specific challenges.

Using ArcGIS GeoBIM, team members can detect clashes that may occur during the construction phase, such as between an intake and a dam, shown here.

"[Autodesk InfraWorks] could only be operated by a small team," said Ttito. "In addition, the */size/* of the entire project made it difficult to use this software to build the PIM. It was possible to visualize parts of the elephant but not the entire elephant."

That's when ArcGIS GeoBIM came into the picture.

A Way to View Designs Holistically

For Castillo, it was imperative that all members of the consortium be able to work with BIM and GIS data without needing advanced technology. As a web-based app, ArcGIS GeoBIM—which can be used on BIM projects from the design phase through construction—was able to offer this. The app also enables the team to link data across disparate systems—for example, by connecting design and construction information that's managed in Autodesk Construction Cloud with ArcGIS.

"ArcGIS GeoBIM is a digital solution that satisfies our strategy of integrating information within a digital model. We can connect the construction of digital assets with */this/* environment and promote collaboration with the other */stakeholders/* involved," said Ttito. "This allows us to avoid rework and reduce the latency of information response time."

Castillo added that with ArcGIS GeoBIM, the team "can incorporate and link endless information in terms of models converted to feature layers and models in their native software that are stored in Autodesk Construction Cloud."

To learn how to use ArcGIS GeoBIM, Castillo and Ttito watched instructional videos and practiced working with the app. Ttito in particular liked how ArcGIS GeoBIM allows specialists to easily view final design information during construction, since data visualizations are available in the cloud.

"The way of working in order to visualize the alphanumeric information of the BIM models and the GIS information is much friendlier for the specialists involved," Ttito said. "ArcGIS GeoBIM is intuitive, and it is as simple as opening a web page without having to install desktop software."

Team members now use Autodesk Construction Cloud to design and store the data needed to make digital models and

for documentation, such as metrics and budgets. The team also employs Autodesk Docs, a cloud-based document management environment on the Autodesk Construction Cloud platform, to manage formal information submissions from design and construction subcontractors. Project management software Autodesk Build helps the team organize documents, connect BIM data with GIS data, and enhance collaboration among stakeholders.

With ArcGIS GeoBIM apps—which connect web maps, web scenes, and georeferenced Autodesk project data—team members can leverage linked data to support project delivery goals and operational workflows. And the apps can be shared with various stakeholders within the consortium so that they can view projects holistically and easily share feedback.

For Castillo, the most appealing aspect of using ArcGIS GeoBIM is that it has the capacity to tackle a project as large as the one being done in the Olmos and Zaña river basins.

"I like the fact that ArcGIS GeoBIM has been thought of as a solution for megaprojects, where the amount of information that is handled is not a limitation," he said.

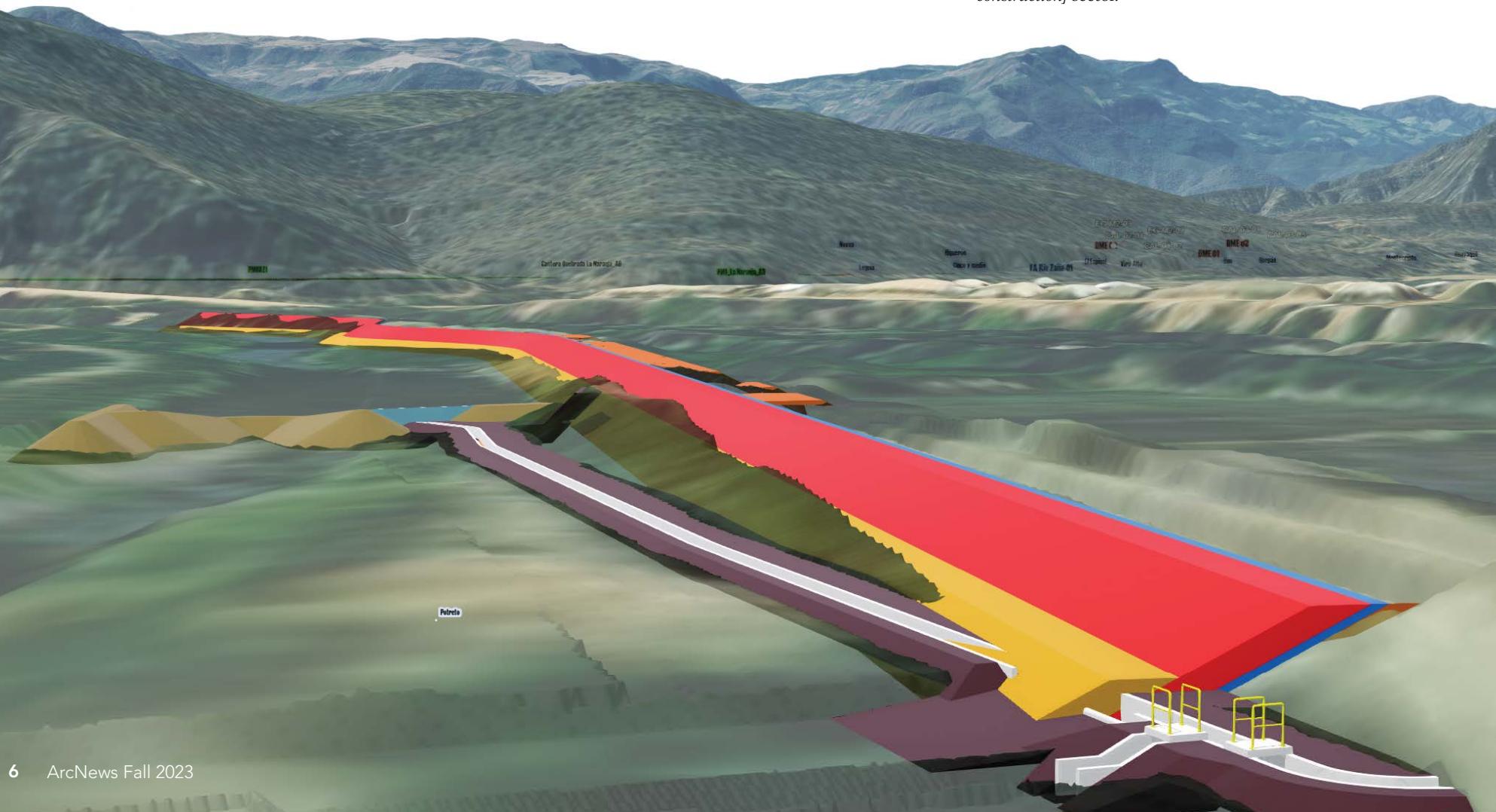
The Project's "Greatest Achievement"

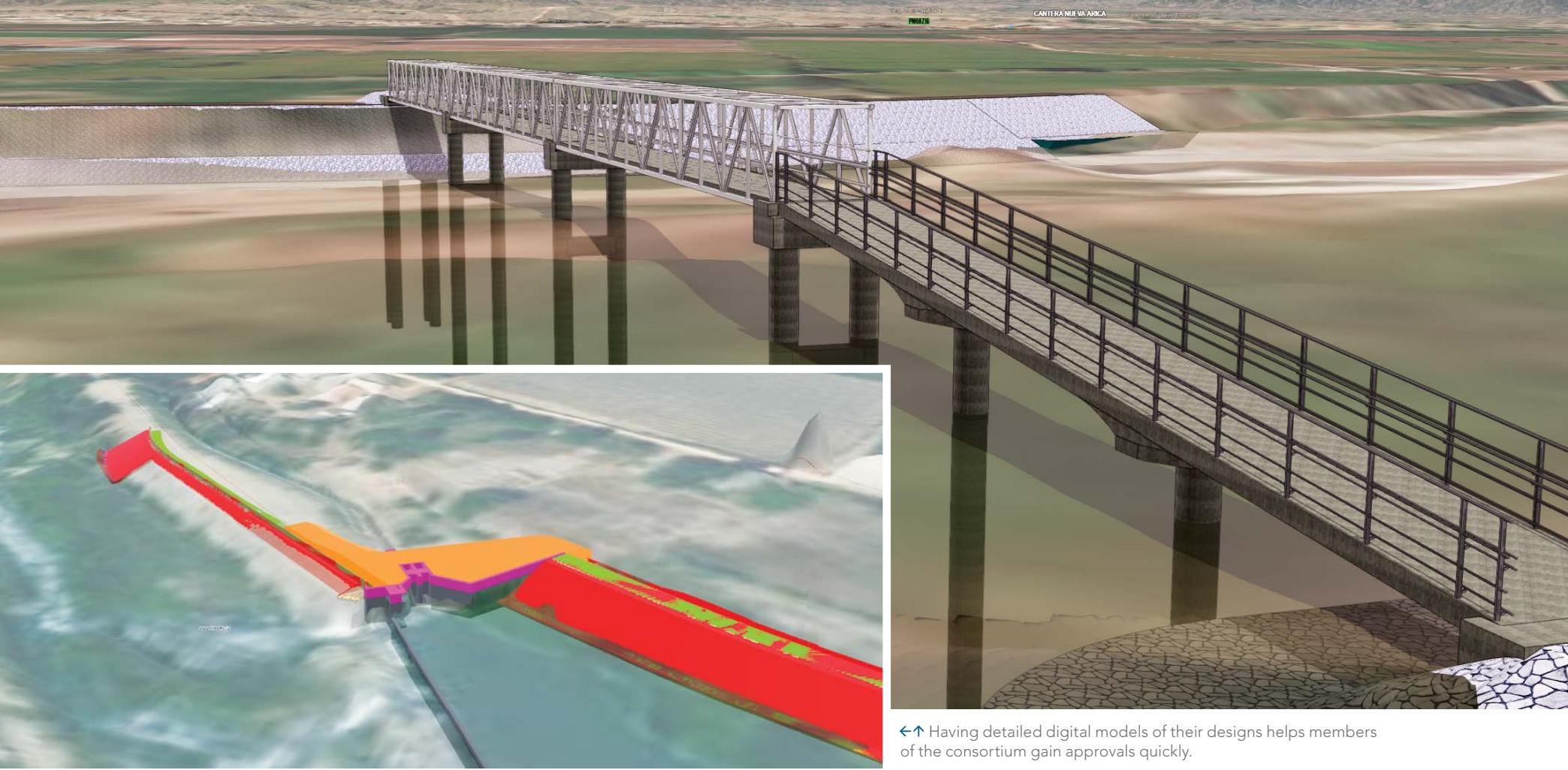
The Olmos and Zaña project is still in the design phase, but the consortium's use of ArcGIS GeoBIM has already yielded positive results for planning and cost calculation. The digitized, organized, and linked GIS and BIM data has made the project more agile because stakeholders are able to easily access the information they need to make decisions quickly and effectively.

Members of the consortium team, as well as subcontractors on the project, can work on BIM documents and digital models and communicate in Autodesk Construction Cloud. This data is also shared in Microsoft SharePoint, which fosters additional cooperation.

Having a web-based space to store and link project assets has been the consortium's "greatest achievement," according to Castillo.

"We could say that ArcGIS GeoBIM is the icing on the cake in the entire project," he said. "The collaboration that exists between Esri and Autodesk has been a great contribution to the GIS and BIM/CAD integration, which was necessary for the development of projects in the AEC *[architecture, engineering, and construction]* sector."





"The information collaboration is making it possible to discover deficiencies in spatial coordination that would not have been possible if we worked in a conventional way," Ttito added.

Using ArcGIS GeoBIM, the team can produce a coordinated digital model of a piece of infrastructure prior to building it. The web-based experience delivered by ArcGIS GeoBIM that connects to Autodesk Construction Cloud allows the team to gauge environmental impacts and potential damage to archaeological remains before construction begins.

"Autodesk and Esri solutions have definitely become a necessity for specialists, making their work more efficient compared to traditional workflows," said Ttito. "Our client has more confidence in the designs, and it is possible for *[the designs]* to be accepted faster so they can be built."

When construction does start, stakeholders will still be able to access the information they need in a single digital model—and that digital model will even be useful when the infrastructure ultimately goes into operation. This reduces duplicate work and makes it possible to more efficiently provision resources and figure out where surplus materials could be used, according to Ttito.

"Building a coordinated model...makes it possible to have a complete, holistic vision of the project," he said. "We have clearer access routes to the works, and also the freight calculation estimation for the budget is more realistic and effective."

A Pillar for Success

Although the Rovella INMAC Consortium is still in the process of implementing ArcGIS GeoBIM, Ttito confirmed that

the organization is planning to use it, along with Autodesk and other Esri offerings such as ArcGIS Field Maps and ArcGIS Survey123, to manage construction and perform data collection. Consortium personnel who will be participating in construction are being trained on the solutions now, with construction subcontractors to follow.

The team is also using ArcGIS GeoBIM to put together presentations for residents in the Olmos and Zaña river basins to keep them informed of project updates. Ttito said the team will continue this throughout the project's life cycle.

"The Rovella INMAC Consortium is convinced...that digital solutions from Esri and Autodesk are a fundamental pillar for the success of the project," Ttito concluded.



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Three Ways to Use ArcGIS Arcade to Enhance Web Maps

ArcGIS Arcade is an expression language created by Esri that gives users the ability to define and save custom content in their web maps. Through Arcade, users set rules that determine how dynamic content, such as text and pop-ups, displays within the context of a map. When an Arcade expression gets saved, any app that an organization creates using ArcGIS technology—whether it's on the desktop, a mobile device, or the web—honors that logic to maintain consistency wherever the map is viewed.

Although Arcade was initially created for ArcGIS Pro, it also works in ArcGIS Online and ArcGIS Enterprise. Here are three ways that users can employ Arcade in Map Viewer to enhance the look, feel, and interactive elements of web maps.

1. Format Data Values

It's no secret that GIS professionals are often required to work with messy data. To make this data more presentable, Arcade provides built-in functions that let users format data values in pop-ups and labels.

Change Case

Consider a text attribute in a layer representing parks that stores the name of each park in all caps or even inconsistently, with some park names in all lowercase letters and others in mixed case. Arcade's Proper function allows users to transform any text value to the proper case.

For example, if some data sources list "LASSEN VOLCANIC NATIONAL PARK" while others show "lassen volcanic national park," employing the following Arcade expression will format both so they display as "Lassen Volcanic National Park."

```
1 Proper($feature.NAME)
```

Calculate Formulas

Using Arcade, Map Viewer users can calculate both simple and complex formulas, such as the percentage change in an area's population from one year to another. In the 2020 Census, for example, the town of Poultney, Vermont, recorded a population of 3,020 people, whereas in the 2010 Census, the town's population was recorded as 3,432 people. To calculate this difference, a user can employ the following Arcade expression:

```
1 var previous = $feature.pop2020; // previous = 3020
2 var current = $feature.pop2010; // current = 3432
3 var change = (current - previous) / previous;
```

In many cases, dividing two numbers returns a number with many decimal places, such as 0.12004662004662005—the difference in Poultney's population between 2010 and 2020. This level of precision, however, is often too high or not required by the end user. That's why Arcade also enables users to format values so they are more readable. (Learn more about this in the next section.)

Format Numeric Values

Users can employ the Text function to create an Arcade expression that formats numeric values. So a number with 17 decimal places, as in the example above, is automatically cut to two places, or a four-digit year (2023) is displayed as a two-digit year (23).

This function also respects the locale of the map. As people view the map from different locations—say, the United States versus Spain—the number formatting conventions for where the end user is located are honored.

Adding the following line to the previous example in the Arcade expression for labeling would display -12.0 percent in the United States and -12,0 percent in Spain.

```
1 Text(change, "+#.##;-#.##");
2 // displays "-12.0%" if locale is English
3 // displays "-12,0%" if locale is Spanish
```

Synthesize Data into Meaningful Categories

Some numeric values need to be classified into categories that help a general audience better understand them. For instance, the average person likely doesn't know whether a value of 30 parts per thousand is a high or low salinity value for the ocean. Arcade's When function helps give context to raw data values by classifying them in meaningful categories. Here's how to do this for ocean salinity:

```
1 When(
2   $feature.SALINITY > 37, "high",
3   $feature.SALINITY > 33, "normal",
4   "low"
5 );
6 // returns "low" if the value of SALINITY in the selected feature is 30
```

When to Apply Arcade to Format Data Values

These examples demonstrate how users can employ Arcade to transform raw or even messy data values into meaningful information for end users. This can be useful in the following situations:

- When the user doesn't own the data—Arcade only transforms data in a browser. It doesn't change the underlying data values in a database or web service.
- When the data is updated frequently—Each time a map gets refreshed, any new data values that appear in the underlying database are taken into account and properly input into the Arcade expressions, returning up-to-date information.



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2. Visualize Data Layers That the Organization Doesn't Own

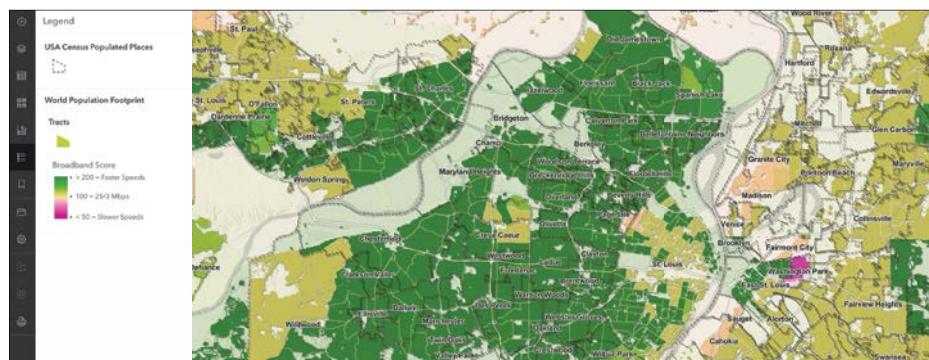
Arcade gives users the flexibility to transform data to create unique visualizations. And users don't even need to own the data to take advantage of this.

Previously, map authors had to contact the owner of a layer and ask for updates that had been made to the dataset. With Arcade, users can customize and calculate new data values themselves, without editing the underlying data. Since Arcade expressions perform evaluations on the fly, as data is loaded into the map, expressions always use the most current data from the layer, ensuring that maps stay up-to-date.

In the example below, Arcade is used to calculate and visualize a broadband score for performance based on data from the Federal Communications Commission (FCC). Arcade calculates the score by using the median download and upload speeds of each census block compared to the FCC's minimum standard for broadband of 25 megabits per second (Mbps) for downloading and 3 Mbps for uploading, as shown in the expression below. To access this Arcade expression editor in Map Viewer, click the Styles pane, then select the + Expression tab.

```
1  /* This score gives 100 points to the median download speed
2   if it is 25 Mbps or higher. If the census geography has a median
3   download speed of 50 Mbps, it awards 200 points. If the census
4   geography has a speed of 20 Mbps, it awards 80 points.*/
5   var downMedianScore = $feature.MedianConsumerDown98 / 25 * 100;
6
7  /* This score gives 100 points to the median upload speed
8   if it is 3 Mbps or higher. If the census geography has a median
9   upload speed of 6 Mbps, it awards 200 points. If the census
10  geography has a speed of 1 Mbps, it awards 33 points.*/
11  var upMedianScore = $feature.MedianConsumerUp98 / 3 * 100;
12
13 /* Use when() to evaluate conditional expressions and return result.
14 The average of the two scores is used if BOTH scores
15 are 100 or higher. If not, the lower of the two scores is used.*/
16 var medianScore = when(
17   downMedianScore >= 100 && upMedianScore >= 100, (downMedianScore + upMedianScore) / 2,
18   downMedianScore < 100 && upMedianScore >= 100, downMedianScore,
19   downMedianScore >= 100 && upMedianScore < 100, upMedianScore,
20   downMedianScore < 100 && upMedianScore < 100 && downMedianScore <= upMedianScore, downMedianScore,
21   downMedianScore < 100 && upMedianScore < 100 && upMedianScore <= downMedianScore, upMedianScore,
22   100);
23
24 return Round(medianScore, 0);
```

Here's what this looks like on a map:



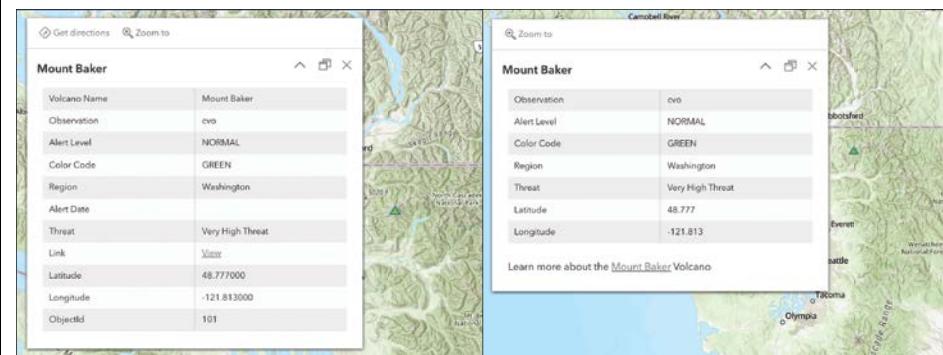
3. Conditionally Set Pop-Up Field Values

Pop-ups are essential tools for map authors. They convey information to readers effectively about select features on a map. Within Map Viewer, pop-ups can be enriched with various types of content, including field lists, charts, images, text, hyperlinks, related records, and Arcade expressions.

Typically, the data for pop-up content is sourced from the underlying feature layer or related records that are part of other layers within the map. When authoring Arcade expressions for pop-ups, users are provided with this sourced data. Additionally, users have the option to import FeatureSet data from outside their current map by utilizing the FeatureSetByPortalItem() function.

To illustrate this, look at the web map version of Volcano Status from ArcGIS Living Atlas of the World at links.esri.com/VolcanoStatus. This dataset takes data from the US Geological Survey's Volcano Hazards Program to show the status of active volcanoes in the United States. When users select a volcano on the map, a pop-up with a field list displays relevant information about that volcano, such as its name, threat level, and latitude and longitude.

When building pop-ups like these, users don't need to manually select which fields to display; they can instead use an Arcade expression to craft their own field lists that filter out unnecessary or unknown fields and even show default values for specific fields. For instance, if a field is empty, it is considered uncertain and can be excluded from the field list. Here's what this looks like before (left) and after (right):



Using Arcade to build a field list also ensures that if this dataset introduces a new field, pop-ups will be updated dynamically. In the final map product, empty fields, duplicate volcano names, and volcano object IDs are excluded from the field list, and the URL is manually moved outside the field list for better visibility.

To try these expressions, copy code snippets, interact with sample maps, and learn more about ArcGIS Arcade, visit arcg.is/1iOOfD0 or use the QR Code.



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than 16 million people across 70,000 square miles in California—has transformed its operations from a paper-based system to a mission-critical, enterprise-wide GIS.

The company has deployed enterprise GIS on reliable and scalable hardware; integrated its geospatial software with non-GIS enterprise systems; and made GIS accessible to PG&E's 26,000-person workforce via an internal website, created using ArcGIS Hub, called GeoHub. Elizabeth Proctor, principal GIS data program manager at PG&E, demonstrated the hub site.

"From here, all of our coworkers can get access to our enterprise applications, discover content specific to our functional areas, and access an authoritative GIS catalog of data," Proctor said.

PG&E also developed its Electric Distribution GIS (EDGIS), which integrates GIS-based asset data with other critical business systems. It allows electrical engineers, for example, to see work orders from the company's SAP system and plan projects that minimize customer inconvenience. It also enables field crews to see the layout of the electric network they're working in.

"*[This]* not only helps us with regular maintenance, but it also is critical to helping us respond to real-time events that impact the safety of our communities," said Dave Lewis, PG&E's senior manager for GIS products and solutions.

PG&E has the Hazard Awareness and Warning Center as well that works 24/7 to bring together feeds such as weather warnings, outages, live camera footage, and real-time PG&E truck locations to help analysts monitor and manage critical events. PG&E also developed two portals to keep the public and partner agencies informed of power shutoffs during dangerous weather conditions.

The company has created a central repository as well for all its images, lidar, and videos to help employees remotely inspect substation assets.

"This was a total game changer," said Hamilton Erridge, principal remote sensing data platform program manager at PG&E. "This year, we used the tool to inspect over 125 substations. We had expected to achieve about a 30 percent increase in productivity, but what we actually achieved was 150 percent."

A County Showcases Three Decades of GIS Work

Orange County, California, has been working with GIS for a long time. After establishing its GIS Control Network in 1991, the county became an early leader in mapping technology and has continued in that vein since.

"The integration of surveying and GIS has led to our unique success," said Kevin Hills, county surveyor for OC Public Works, who highlighted accomplishments such as a capital project portfolio dashboard and a registrar of voters dashboard.

With these tools, the county has consistently prioritized innovation in surveying and mapping. OC Survey, which is part of OC Public Works, has embraced new techniques and technologies—including automation and artificial intelligence—to streamline workflows.

With 114,000 new parcels added to Orange County since the inception of its GIS department, the county has developed tools such as a self-service mapping review app that allows property maps to be uploaded, corrected, and sent to the GIS team.

"Surveyors are provided with real-time validation on their map submission to automate and expedite the map review," said Cameron Smith, GIS manager for OC Public Works, "which leads to cost savings."

OC Survey's geospatial expertise came in handy when heavy rain led to a leak at John Wayne Airport. Having created a 3D digital twin of its terminals, OC Survey staff used ArcGIS Indoors to determine which assets would be impacted and to formulate a plan to temporarily relocate them for repairs.

"We used Indoors to check out the floor plan," said Marie Aquino, GIS specialist for OC Public Works. "Our floor plan was derived from BIM [*building information modeling*] and migrated into ArcGIS Indoors."

With an aerial drone searching the roof for the source of the leak, the team was able to find and flag it for repair using drone imagery and ArcGIS Excalibur.

"In Orange County, we are constantly innovating," said Smith.

Siting Locations for Electric Vehicle Charging Infrastructure

Electrify America has built the largest open, ultrafast charging network in North America, with over 800 operating stations. Brandy Mathie, director of site acquisition and portfolio management at Electrify America, and Julie Wagner, Electrify America's location strategy manager, gave the Plenary Session audience a look at how the company uses GIS to determine where to install new EV charging stations.

"We use data to understand where to focus our strategic efforts," said Wagner. "Once we've identified our strategic metro areas, we want to look for where people live; where people buy EVs; where disadvantaged communities are, to ensure equitable access; and the National Electric Vehicle Infrastructure—or NEVI—highways that states have identified as part of the program, which [*provides*] federal funding to build EV charging infrastructure."

Wagner showed how she takes those layers and enriches them in ArcGIS Business Analyst with additional data on traffic and retail businesses to perform suitability analyses. She can also use a program to automatically generate reports that indicate whether a site is appropriate based on strategic, financial, and real estate requirements.

She brought up a map of Palm Springs, California, that contained a few potential sites for EV charging stations. One was near two shopping centers, indicating great amenities, but finances were problematic. Wagner explained, however, that the area was split into two utility districts. By simply moving the site from a shopping center in one utility district to a shopping center across the street in another utility district, she was able to bring the finance requirements down to an acceptable level. GIS also enables Electrify America to work with utility companies to ensure appropriate power availability.

"Building North America's largest open, ultrafast charging network can't be done alone," Mathie concluded.

A Medical Facility Constructed with GIS

Every step of PCL Construction's \$1.7 billion project to build St. Paul's Hospital in Vancouver, Canada, has been underpinned by GIS. A team from PCL walked the audience through the planning, construction, and operation of the site from a geospatial perspective.

As demonstrated by Lina Stinnett, senior integrated construction technology manager for PCL, one of the most significant aspects of the project has been employing Site Scan for ArcGIS to make decisions about site logistics.

"We're able to push the envelope of construction and elevate it through accuracy and precision," said Stinnett.

Drones are used to map the project site every week, allowing PCL to monitor progress with heat maps and excavation analysis.

"As drone imagery is changing constantly, it serves as a living canvas we can literally draw on," said Bilal Yasir, a PCL integrated construction technology specialist.

This picture of the site enabled the PCL team to avoid a conflict between an access ramp and the crane foundation, plan for the 550 cement trucks needed to pour the site's foundation, and save costs on the removal of several large boulders found during the excavation phase.

"Everything fit like a jigsaw puzzle, with precision and accuracy," said Yasir. "There was no hassle, no frustration, and no on-site coordination."

Geospatial tools have also been central to preparing for the hospital's operation. Providence Health, PCL's client, requires specific BIM data to hit the ground running, explained Aaron Akehurst, senior integrated construction technology manager for PCL. Fortunately, the team can link the design and construction models to provide accurate asset locations, collecting this data as they build.

"The construction industry wants to be part of the digital future," he said.

Inside Cambridge's 3D Digital Twin

With more than 18,000 people per square mile, Cambridge, Massachusetts, is one of the most densely populated cities in the United States. With space at a premium, the city created a detailed 3D basemap, with many formerly 2D web maps—such as a neighborhood viewer—now available as 3D web scenes in ArcGIS Online.

Jeff Amero, GIS manager for the City of Cambridge, demonstrated the capabilities of this basemap with his colleague Katie Grillo, a GIS web technology specialist.

The basemap leverages Cambridge's open data policy to make this information freely available for download. The goal is to engage the community by fielding public comments—about where to add crosswalks or stop signs, for example—that can be reviewed in a 3D mesh created with ArcGIS Reality. This enables city planners to prioritize areas that need urgent response.

Cambridge also uses its 3D basemap to analyze climate factors such as roof reflectivity and the health of the city's tree canopy. The department of public works, for instance, leverages its urban forestry point layer to help maintain and preserve vegetation and plant new trees.



↑ Brandy Mathie and Julie Wagner from Electrify America.



← Bilal Yasir of PCL Construction.

"We're trying to mitigate urban heat and improve the quality of life in our city," said Grillo. "[This requires] all members of our community to understand the importance of our collective urban forest."

Another place this digital twin has been particularly useful is at the Massachusetts Institute of Technology (MIT). With 20 separate renovation projects and four ongoing capital projects, digital modeling is critical to maximizing the use of campus space, explained William P. Witts, Jr., manager of facility information systems at MIT.

"Being able to explore BIM models directly within our web scene allows us to answer questions about ongoing and future projects," said Witts.

MIT also supplies these models to the city so they can be maintained as part of a comprehensive 3D basemap of Cambridge.

GIS Facilitates Proactive Threat Management

Aerospace and defense company Lockheed Martin has more than 120,000 employees located in 350 facilities in 40 different countries.

"Our greatest asset is our people, and we have a massive responsibility to ensure their safety and security," said Amanda Haas, security systems senior manager at Lockheed Martin.

Nearly 10 years ago, Lockheed Martin began to evolve how its teams address hazards caused by severe weather, earthquakes, civil unrest, and more. The company developed the Global Emergency Operations Center (GEOC) to help analysts acquire information, share knowledge, and assist employees.

"Knowing where and when events are occurring across the globe can be overwhelming," Haas pointed out.

The system takes risk events from multiple providers, including the National Weather Service and crisis-focused consulting firms, and joins those with company assets such as facilities, corporate travel data, and employee locations. If a risk event occurs near an asset, a threat report is generated, and Lockheed Martin's watch officers assess the alert.

"This system is...a robust situational awareness tool that provides users with the resources needed to take action," said Haas.

In April, the company ensured that 65 of its employees in the Netherlands were safe after a train derailment. And last year, watch officers used an app called Global Command Center—just two days after it launched—to bring in data from state and local government GIS departments and the National Hurricane Center to visualize the potential impact of Hurricane Ian to Lockheed Martin's employees, facilities, and business operations.

"By using a geospatial tool integrated with company assets and near real-time risk data, we can be prepared to respond and act," Haas said.

Building a Desert City from the Ground Up

Planning a city from scratch is no small task. That's exactly what Foster + Partners (F+P) set out to do in Kuwait with South Sabah Al-Ahmed, a planned 24-square-mile development with a projected population of 280,000.

The priority is mobility and sustainability, according to Bruno Moser, F+P's head of urban design.

"We build geography into our design process," he said. "We need to understand the forces that shape our cities so we can make informed decisions when we design new projects."

To start, the team at F+P used an algorithm for spatial hierarchy to analyze the benefits and drawbacks of city street layouts around the world and applied these principles to its design.

Using ArcGIS CityEngine, F+P was able to plan and map out the street network and land use, as well as export the 3D model to a web scene. The scene could then be embedded in an ArcGIS StoryMaps story to flesh out the plan for the client or exported to the Unreal game engine to model a real-time, photo-realistic environment.

Planning the site in a virtual environment allowed the F+P team to consider and visualize every part of the future city, from the average height of buildings in its business district to the native vegetation planted in parks. Connectivity analysis even allowed the team to ensure that all residents could live within 400 meters of a green space.

"The design process is a collaboration between multiple design professionals," said Dr. Mateo Neira, associate data scientist at F+P. "[We're] bringing together all the elements needed to create a city that will respond to the needs of the people that will live here in the future."

Documenting War Crimes Remotely

As Russia's military forces built up along Ukraine's border—just before Russia's full-scale invasion on February 24, 2022—the US Department of State's Bureau of Conflict and Stabilization Operations (CSO) convened conflict analysts and Ukraine experts.

"CSO's mission is to anticipate what might occur and devise strategies to rapidly respond to crisis situations," said Dr. Susan Wolfinbarger, CSO's bureau chief geospatial information officer. "We knew that Russia's brutal, full-scale invasion would lead to the unfortunate need for atrocity documentation."

Wolfinbarger immediately put her brainchild—the Conflict Observatory—into operation. The program is composed of nearly 70 subject matter and technical experts, including Yale University's Humanitarian Research Lab, the Smithsonian Cultural Rescue Initiative, and Esri. The Conflict Observatory relies on spatial data sources and open-source investigation techniques to document war crimes in a way that is admissible as evidence in justice and accountability procedures.

Wolfinbarger showed the audience a dashboard that displays war crimes and other abuses across Ukraine. When the Organization for Security and Co-operation in Europe called for documentation support shortly after the invasion began, Yale responded rapidly with a report that focused on atrocities committed at medical facilities, which are almost never legitimate targets of war. One point on the dashboard showed a hospital in Mariupol that had evidence of artillery shelling and other damage.

The Conflict Observatory is also monitoring potential damage to Ukraine's 28,000 cultural heritage sites, as well as Russia's abuses against Ukrainian civilians. The team's documentation of Russia's illegal relocation of thousands of Ukrainian children led to the International Criminal Court issuing arrest warrants for Russian president Vladimir Putin and his children's rights commissioner, Maria Lvova-Belova.

While the Conflict Observatory was created in response to the invasion of Ukraine, COS can deploy it anywhere. When fighting broke out in Sudan this past April, Wolfinbarger and her team put it to service there to document threats to human security and critical supplies.

"With the Conflict Observatory...we can tackle problems from multiple angles," Wolfinbarger said.

→ Dr. Mimi D'Iorio of the National Oceanic and Atmospheric Administration's (NOAA) National Marine Protected Areas Center.

← Dr. Susan Wolfinbarger from the US Department of State's Bureau of Conflict and Stabilization Operations (CSO).

Keynote Speakers Urge Audience Participation

The keynote speeches at the Plenary Session focused on the future.

National Geographic Explorer Dr. Steven Boyes spoke about his extensive use of GIS, including ArcGIS Survey123, to help conserve the Okavango River delta. And the National Geographic Society's chief education officer, Dr. Deborah R. Grayson, lauded the benefits of National Geographic MapMaker, an app designed to facilitate geographic curiosity in the classroom. Grayson was even joined onstage by three sixth-grade students from Foulks Ranch Elementary School in Northern California who demonstrated what they liked most about using MapMaker.

"I invite each of you to [promote] these resources in your own programs, communities, and classrooms," Grayson encouraged the audience. "Together we can make a real impact and help inspire the explorer in everyone."

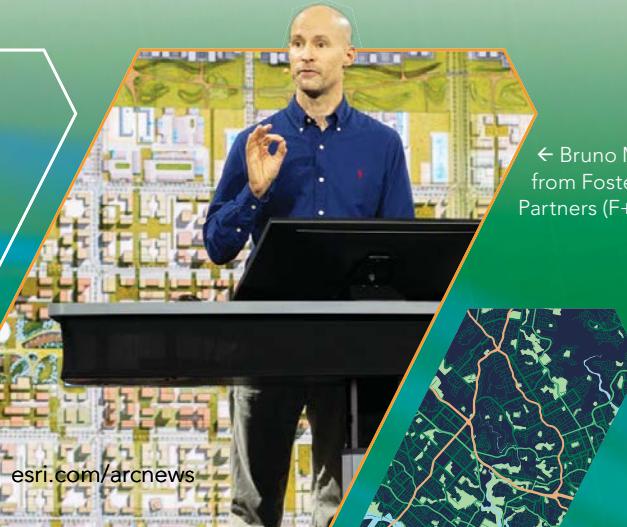
The third keynote speaker was Dr. Richard W. Spinrad, undersecretary of commerce for oceans and atmosphere and the 11th administrator of the National Oceanic and Atmospheric Administration (NOAA). He educated the audience about what he calls the New Blue Economy, a knowledge-based economy that looks to the sea to find the information needed to address global challenges.

Thanks to technology like GIS, there's so much data and so many ways in which scientists can collect data that Spinrad believes humans can now use the ocean to build a more sustainable world based on predictability.

Spinrad's colleague Dr. Mimi D'Iorio, a geoscientist for NOAA's National Marine Protected Areas Center, demonstrated how GIS is already being used to transform data gleaned from the ocean into actionable information. For example, investigating variables such as temperatures at the bottom of the ocean, salinity, and sea ice concentration and then applying machine learning models in ArcGIS Pro can show, with precision, not only where snow crab habitats currently are but also where they will likely shift by the end of the century.

Additionally, data from buoys, satellites, and other sensors feeds global models for building hourly forecasts that inform optimal shipping routes and fishing areas and can even predict when harmful algal blooms are likely to occur. But none of this is enough to build the New Blue Economy, both Spinrad and D'Iorio stressed.

"All this rich data only gets us so far," D'Iorio said. "We need you, the global GIS community, to work your magic. Apply your local knowledge, your passion, your perspective, your talent, and your expertise. Help us transform this data into action."



A Legacy of GIS Innovation in Portland, Oregon

Metro, the metropolitan planning organization for the Portland, Oregon, area, has been a GIS pioneer since 1990, when it began its GIS journey using Esri's then-recently released ARC/INFO. Today, Metro—which manages Oregon's land-use law in the area—and Portland's regional government are nationally recognized leaders in government use of GIS.

Metro serves approximately 1.7 million people in the Portland area. With a jurisdiction that spans 24 cities and three counties, Metro brings together policymakers, planners, and the public to collaborate on projects that impact the entire region. One of Metro's key goals is to democratize access to authoritative data, which the organization is now doing via ArcGIS Hub.

Need for Regional Map Data Kick-Starts GIS

In 1990, Metro was in the process of developing a regional growth strategy that would become known as the 2040 Growth Concept. This 50-year plan would promote a healthy economy, environmental sustainability, improved transportation systems, thriving neighborhoods, and secure housing for all.

The staff at Metro realized that mapping data would be a crucial tool for planning and launching the 50-year strategy for growth. But up until then, detailed regional map data coverage didn't exist. Metro turned to ARC/INFO, the first commercial GIS product of its kind.

"Metro saw this as more than just a way to create an internal data product," said Julie Stringham, senior geospatial developer at Metro. "This was a way to kick-start GIS in the region."

And kick-start GIS it did. Metro fully embraced the new tools offered by ARC/INFO, investing thousands of staff hours over a two-year period to create the initial 10 layers of map data. The result was that Metro boasted one of the first GIS programs in the country: the Regional Land Information System (RLIS).

Two Unique Ways of Collaborating

RLIS comprised more than just the data produced by Metro itself. The staff at Metro's Data Resource Center reached out to regional partners and contributors to share data from a variety of local sources, creating a unique interjurisdictional collaboration with regularly updated regional coverage.

The agreement was simple. Contributing jurisdictions and organizations would have continuous free access to this collaborative regional data, and in return, they would each maintain their own features, lightening the load for Metro's team.

This arrangement gave numerous partnering organizations access to high-quality data. But Metro didn't stop there. In the late 1990s, Metro began making RLIS data available for purchase by users everywhere. Before the common availability of high-speed internet, this early arrangement required mailing quarterly data updates on discs to subscribers.

Today, RLIS is a collection of nearly 200 spatial data layers spanning the entire Portland metropolitan region. It has information ranging from aerial imagery and up-to-date street mapping to data on canopy cover and tax lots.

"Data drives everything we do. We collect, manage, and distribute the data we need," said Christine Rutan, RLIS enterprise data lead at Metro. "But we're not just publishing data; we're delivering it in a way that lets people gain insight into our region and plan wisely for its future."

One Place to Access Data

By 2010, Metro was ready to transition from delivering data by mail to distributing it online. Staff at the Data Resource Center developed a custom website, built using Adobe ColdFusion, that allowed RLIS subscribers to download shapefiles from any layer in Metro's catalog, as well as access documentation and metadata—all in one place.

Soon, Metro was also using ArcGIS Server to publish data to web services. This enabled staff to provide updates and corrections to data as needed and allowed users to access data anytime, without having to download new data each quarter.

These improvements enabled Metro to discontinue producing physical data in the form of CDs or DVDs, saving the organization thousands of dollars in resources. They also made it possible over the following decade for Metro to provide an increasing amount of information as open data.

"Other jurisdictions started telling people to get their data from us," said Rutan. "Through the website and the open data, people were engaging with a local government agency that they might not have known about before. RLIS became another tool for Metro to connect with residents."

After a decade, Metro discovered that its data had been downloaded 45,000 times during 2021 alone. Everyone—from government agencies and nonprofit organizations to private companies and even students—was using Metro's RLIS data to apply GIS to everyday problems.

→ When Metro began using GIS in the early 1990s, colleagues would huddle around a workstation.



Reinventing GIS Once Again, Online

By late 2021, the GIS team at Metro realized that it was time for another upgrade. Users needed the spatial data to be easier to access online, and the server that Metro was using had become outdated, presenting the organization with a security risk.

After researching its options, Metro reinvented its GIS once again, publishing all its mapping data to ArcGIS Online and transitioning RLIS to a new website, known as RLIS Discovery, that was built using ArcGIS Hub.

"We chose ArcGIS Hub because we had this new array of demands, but we didn't necessarily have the staff time to spin up a custom website again," said Stringham. "We were looking for something that could do the heavy lifting for us. And out of the box, ArcGIS Hub met most of our needs."

Deploying ArcGIS Hub gave Metro a way to easily host RLIS data online and store documentation. It also simplified the process of updating data and metadata, since this doesn't require expertise in coding. By using ArcGIS API for Python as well, staff at Metro standardized the way RLIS data is displayed without having to retrain staff members or rewrite metadata.

The agency has been able to apply its versatile and easy-to-use data in many innovative ways. Recently, in partnership with the Portland area's Regional Disaster Preparedness Organization, Metro secured funding from the Department of Homeland Security to design a way for emergency planners to identify which communities lack adequate access to emergency services. A GIS analyst at Metro created a regional index for social vulnerability using 25 separate indicators drawn from the RLIS catalog.

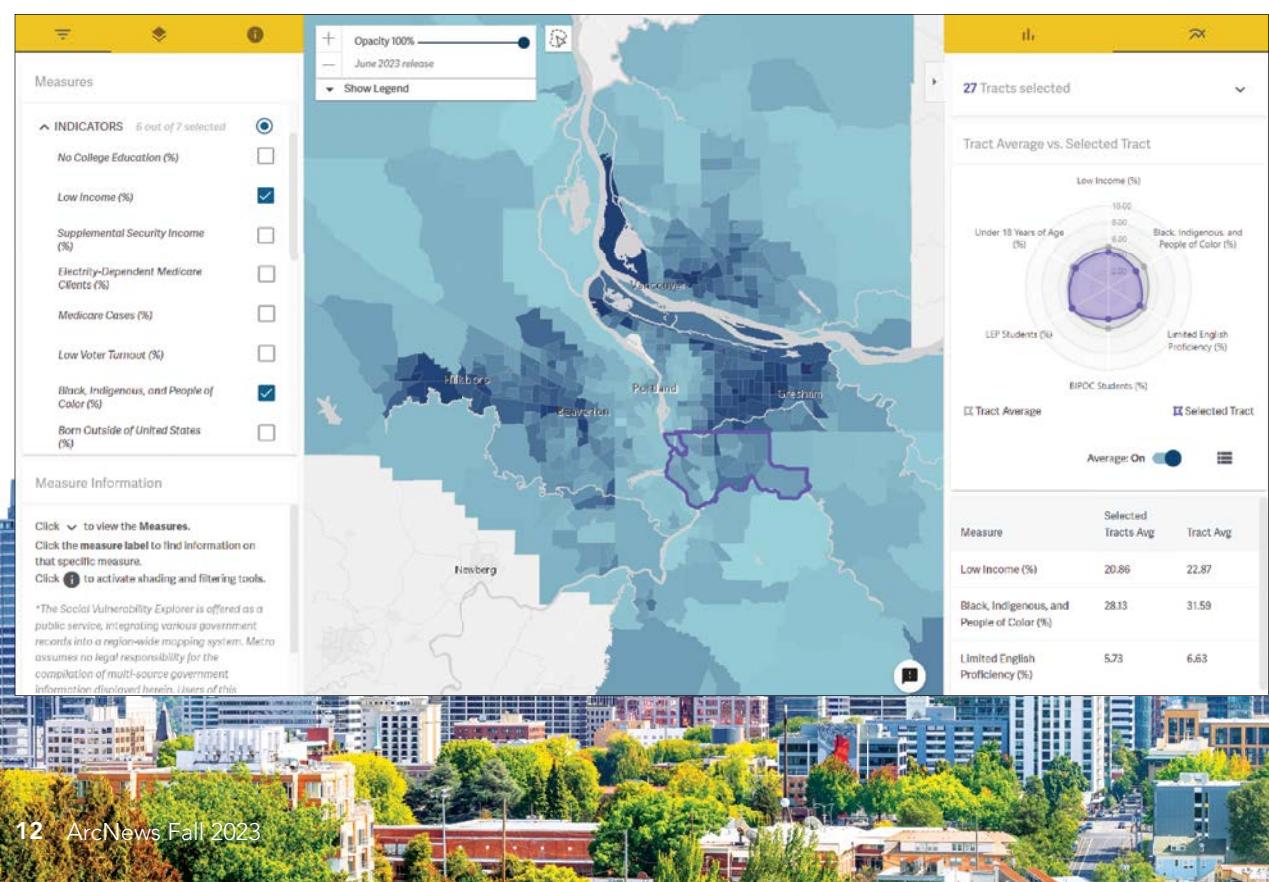
"Our developers got to work building a web application," said Stringham. "It uses *[ArcGIS Maps SDK for JavaScript]* and D3 *[an open-source JavaScript library]* to create a tool for emergency planners to go online and do exploratory data analysis. It helps us plan for emergencies, and it helps us reframe those efforts in a more equitable way."

A Commitment to Democratizing Data Access

Metro is continuing its efforts to democratize access to information. It recently eliminated the annual RLIS subscription fee so that organizations of every kind can use comprehensive spatial data, regardless of their budget. This decision was made possible by Metro's automated data processes and online data access.

"When we evolve alongside the rest of the GIS community, our success compounds," said Stringham. "Data is really powerful, but it's maps and dashboards that show us what the data has to say. By modernizing the way that we present our data, we're making it easier for developers to give that data a voice."

← The Social Vulnerability Explorer app employs 25 separate indicators drawn from the Regional Land Information System (RLIS) catalog.



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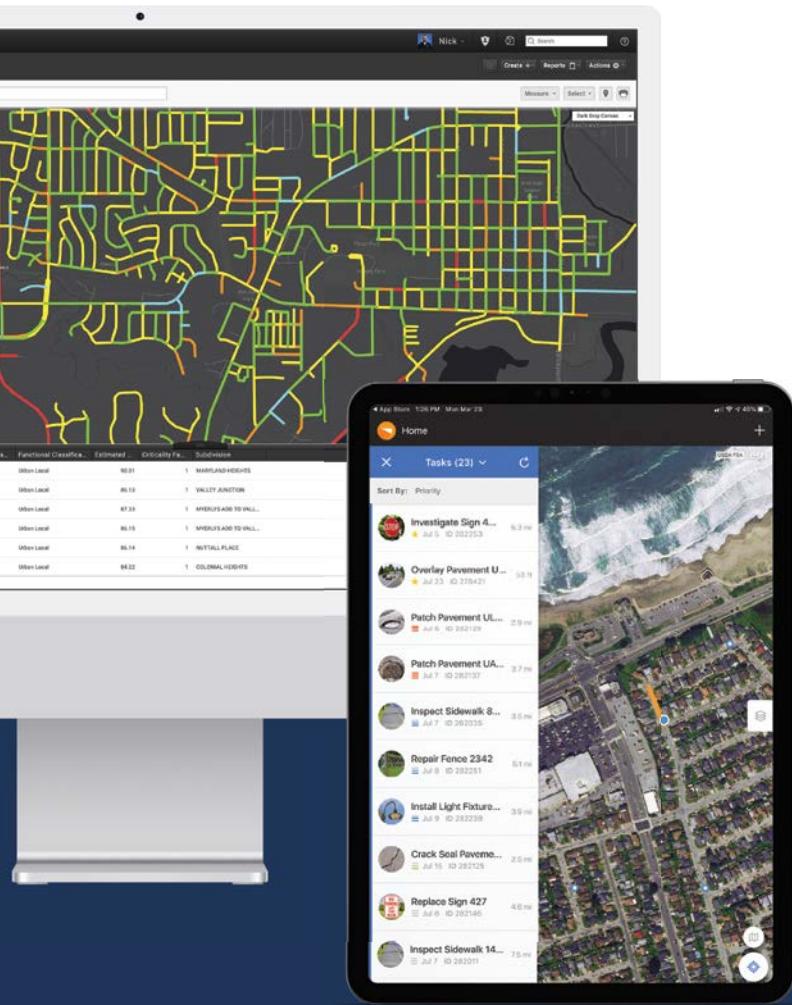
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Dashboard Helps Analyze and Predict Spread of Bird Flu

By Dr. Irene Iglesias Martín, Dr. Ana de la Torre, Pablo Ibañez, and Carlos E. Blanco, Spanish National Institute for Agricultural and Food Research and Technology; and Dr. Lim Seunghyun, Dr. Kaushi Kanankege, Kathryn Fillman, and Dr. Andres M. Perez, University of Minnesota

Highly Pathogenic Avian Influenza (HPAI) is a viral disease caused by the type A avian influenza virus that affects poultry farming. Since late 2020, outbreaks have reemerged around the world, creating unprecedented challenges for controlling the disease.

The H5N1 subtype of HPAI has undergone changes since its last appearance that have led to increased incidence, year-round presence, and heightened susceptibility in wild birds. These changes have expanded the disease's reach into new regions, such as Central America and South America, and created devastating effects for the poultry industry and wildlife, including mammals.

Due to HPAI's current high rate of occurrence and its presence in different species, including mammals, the disease poses a relevant threat to public health. To address this, it is essential to develop surveillance systems that can monitor and predict the spread of the disease to inform effective prevention and control measures.

DashFLUboard, an open-source dashboard app developed using several ArcGIS products, allows users to explore the dynamics of HPAI by monitoring wild bird movements (the primary—and unavoidable—way the disease gets introduced to new areas) and connecting outbreaks. The dashboard enables users to perform near real-time risk assessments, strengthen surveillance of the disease, anticipate the spread of HPAI, and implement control measures within the poultry industry.

When Highly Pathogenic Avian Influenza (HPAI) appeared in Newfoundland, Canada, in late 2021, DashFLUboard traced the outbreak's origins to infected wild birds migrating from Europe.

Dashboard Integrates Key Data Sources for Easy Visualization

DashFLUboard's user-friendly and accessible interface caters to a wide range of GIS users across public health, academia, farming, veterinary services, and geospatial technology fields. This furthers the objectives of the global One Health initiative, which recognizes the health-related connections among people, animals, plants, and their environments.

A joint, interdisciplinary team from Spain's National Institute for Agriculture and Food Research and Technology and the University of Minnesota built the dashboard using ArcGIS Web AppBuilder and ArcGIS Dashboards. Its analytical tools are implemented through ArcGIS API for Python and ArcGIS API for JavaScript. The dashboard integrates data from the following sources:

- Details about HPAI outbreaks come from the Food and Agriculture Organization of the United Nations' EMPRES-i database of animal diseases.
- Movement information for wild birds is based on the Bird Banding Laboratory's recovery data for 118 at-risk wild bird species that are outfitted with research rings. The laboratory has accumulated nearly 2 million records over the last 20 years and developed a network movement matrix that summarizes connections between the birds' departure and destination points at the regional and US state levels. The project team categorized the 118 species into 9 taxonomic groups for ease of exploration.
- The Temperatures tab contains an interactive map of the world that displays historical and real-time data on monthly mean temperatures, wind metrics, and HPAI outbreaks. Temperature is an important factor in monitoring HPAI, as the virus has a better chance of surviving in colder temperatures.
- The Wildbirds movements tab allows users to explore HPAI outbreaks alongside the movements of wild birds, first in the United States and

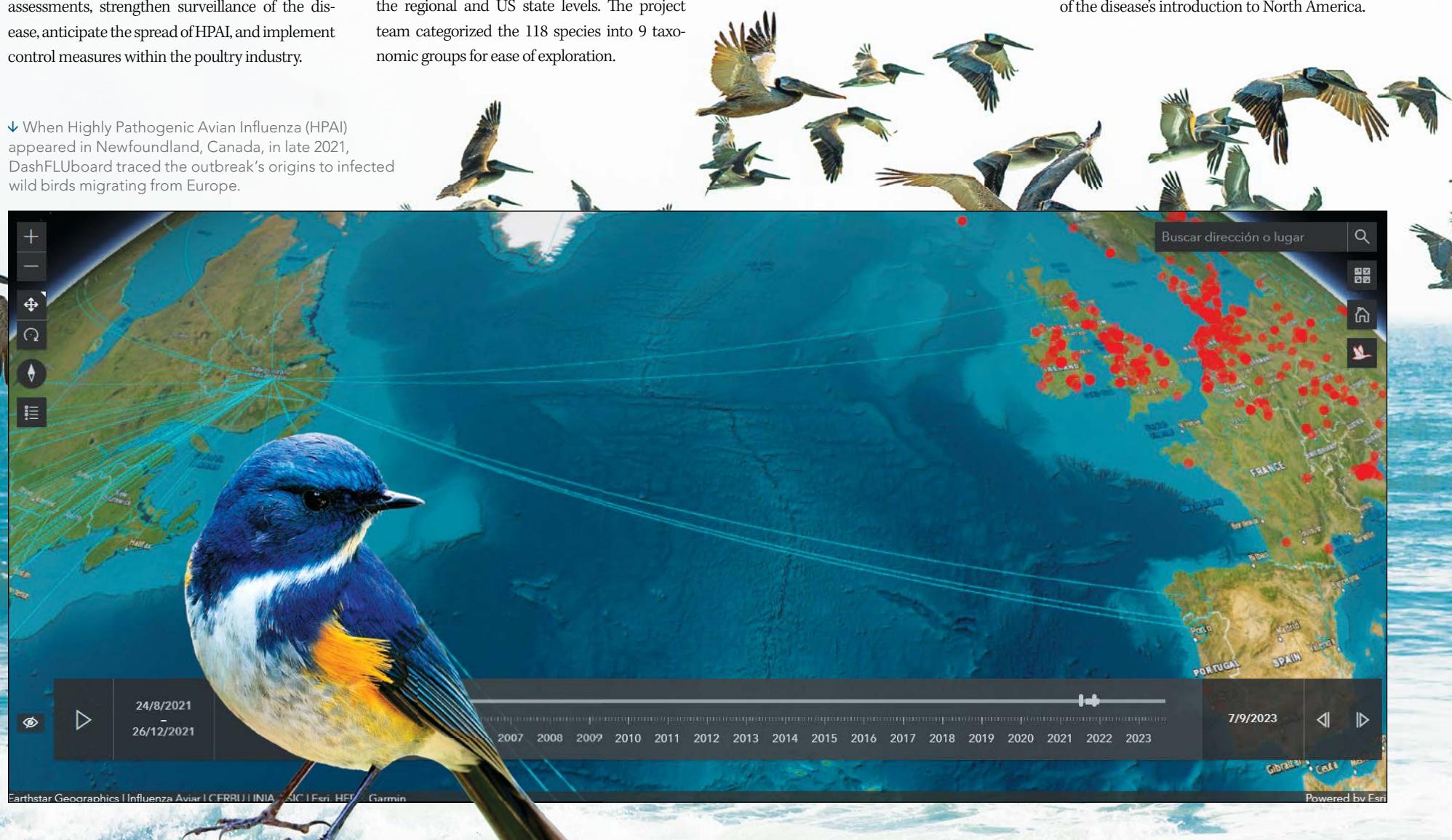
then around the entire globe at the regional level. The time slider along the bottom of the screen enables users to adjust the period in which they are seeing outbreaks and bird movements.

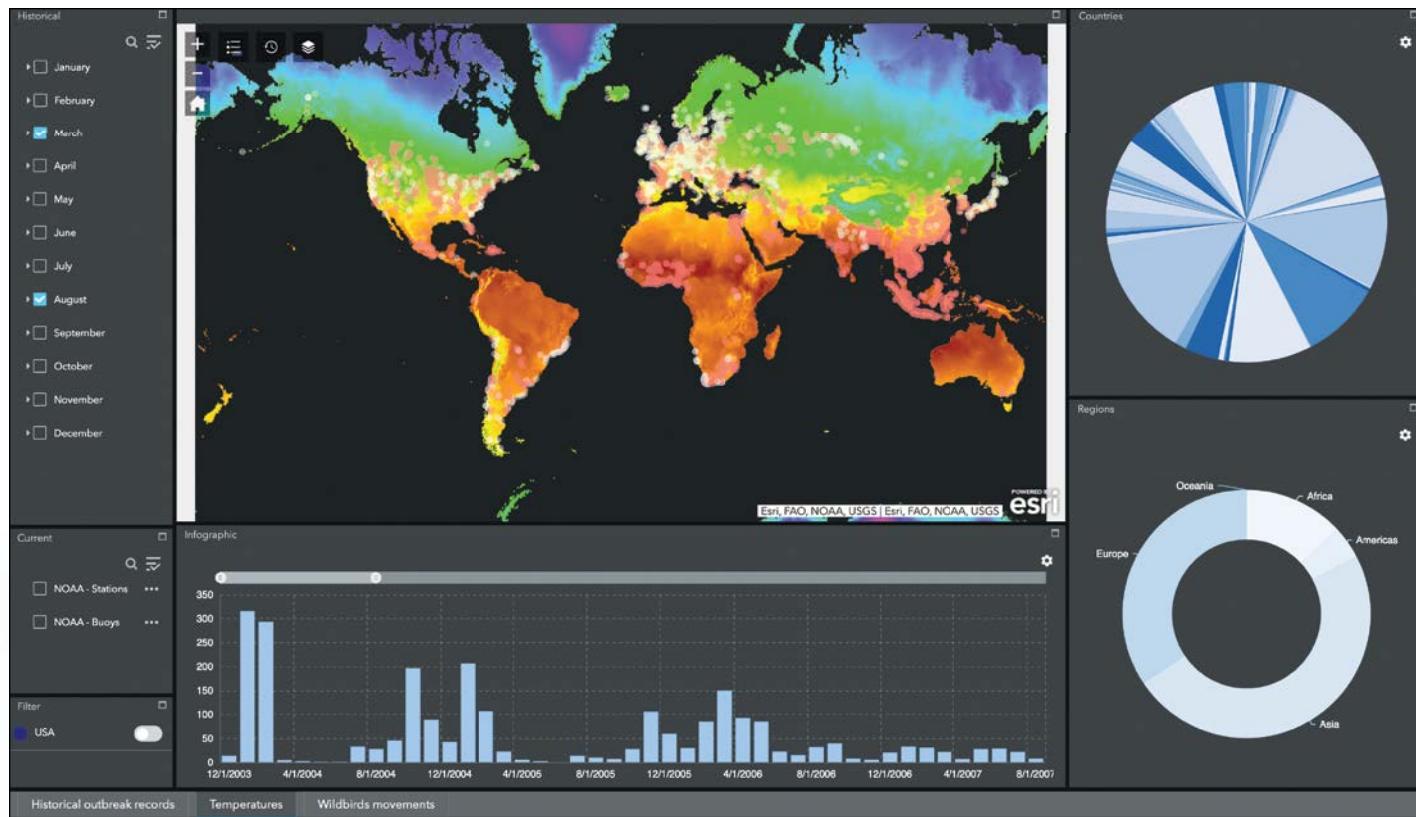
Conducting Retrospective and Predictive Analysis with DashFLUboard

Since the dashboard was developed, researchers have been able to use it to explore the origins of HPAI outbreaks, forecast the disease's spread, and predict its introduction to new areas.

In late 2021, for example, HPAI was introduced in Newfoundland, Canada, marking the first outbreaks of HPAI in North America that season. By employing the time slider to analyze bird movements, DashFLUboard users were able to investigate the possible origins of the outbreaks, which looked like they came from infected wild birds that traveled to Newfoundland from heavily affected regions in Europe in the two months prior.

While the dashboard cannot provide conclusive evidence of causation, it serves as a valuable tool for hypothesizing how HPAI gets introduced to new areas based on the movements of wild birds. Subsequent phylogenetic studies, which look at evolutionary relationships among organisms, demonstrated that these connections between Canada and Europe were indeed the source of the disease's introduction to North America.





↑ With DashFLUboard, users can visualize data about HPAI outbreaks from 2005 to today.

Additionally, in May 2022, researchers collaborated with the International Regional Organization for Agricultural Health to use DashFLUboard to explore the risk of HPAI spreading into Central America, since the disease was persisting in North America. In particular, the team assessed the connection of wild birds moving from affected areas in the United States to each province in Panama.

As anticipated based on these observations, wild birds brought HPAI to Panama a few months later, from September to December 2022. While

there wasn't enough time to generate a full, government-supported effort to improve bio-security in higher-risk areas, veterinary service providers and farmers in Panama were notified of the disease's impending arrival, and outbreaks were limited to five domestic poultry farms.

A New Way to Enhance Disease Surveillance and Control

As an openly available and easy-to-use tool based on Esri technology, DashFLUboard

offers an effective way for researchers and decision-makers to monitor the spread of HPAI and predict how the disease will extend throughout the world. By integrating various data sources and providing interactive maps and tools, DashFLUboard supports efforts in government and within the poultry industry to monitor the spread of HPAI and enhance disease surveillance and control strategies.

For more information about DashFLUboard, email Dr. Irene Iglesias Martín, a veterinary epidemiologist at Spain's National Institute for Agricultural and Food Research and Technology, at iglesias@inia.csic.es or Dr. Andres Perez, professor of veterinary population medicine at the University of Minnesota, at aperez@umn.edu.

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About the Authors

Dr. Irene Iglesias Martín is a researcher and veterinary epidemiologist in the Epidemiology and Environmental Health Group at the Center for Animal Health Research, a department of Spain's National Institute for Agricultural and Food Research and Technology, which is part of the Spanish National Research Council (known by the Spanish acronyms CISA, INIA-CSIC). Dr. Ana de la Torre is a researcher and head of the Epidemiology and Environmental Health Group at CISA, INIA-CSIC. Pablo Ibañez is a contracted physicist at CISA, INIA-CSIC. Carlos E. Blanco is a collaborating geographer at CISA, INIA-CSIC. At the time this article was written, Dr. Lim Seunghyun and Kathryn Fillman were graduate students at the University of Minnesota's Center for Animal Health and Food Safety (CAHFS). Dr. Kaushi Kanankege was a researcher and veterinary epidemiologist at CAHFS. And Dr. Andres M. Perez was the endowed chair of global health and food safety at the University of Minnesota and the director of CAHFS.



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Seeking to Eradicate Malaria, Zambia Turns to Geospatial Data

In 2021, there were an estimated 247 million cases of malaria in the world, which resulted in about 619,000 deaths, according to the World Health Organization. Ninety-five percent of those cases and 96 percent of deaths related to malaria that year occurred in Africa.

Zambia, a landlocked country in southern Africa with a population of about 19.6 million people, is among the 20 nations in the world that suffer from the highest incidence of malarial infections and deaths. To implement programs to eradicate the disease from Zambia, the country's ministry of health created the National Malaria Elimination Centre (NMEC) in 2016. In 2020, four technical partners joined forces to provide mapping tools and technical support to help the government distribute indoor residual spray and insecticide-treated nets.

Using ArcGIS technology, the partners—which included spatial data solutions company Geo-Referenced Infrastructure and Demographic Data for Development (GRID3); two data-driven health organizations, Akros and PATH (formerly known as the Program for Appropriate Technology in Health); and the US President's Malaria Initiative—supported Zambia's ministry of health in using geoenabled maps to enhance the government's malaria eradication planning and resource allocation. High-resolution population data and georeferenced settlement, health facility, and other points-of-interest data—all of which was generated by

GRID3—was used to create these maps. The government was then able to use the maps during microplanning sessions, wherein teams in local districts ensure that their areas have the appropriate resources for each vector control intervention.

Developing Grids and Creating the Atlas

GRID3—the geospatial technical partner on the project—works with government organizations throughout sub-Saharan Africa to generate, validate, and use geospatial data. The organization's core geospatial data products include datasets on population, settlement, infrastructure, and boundaries.

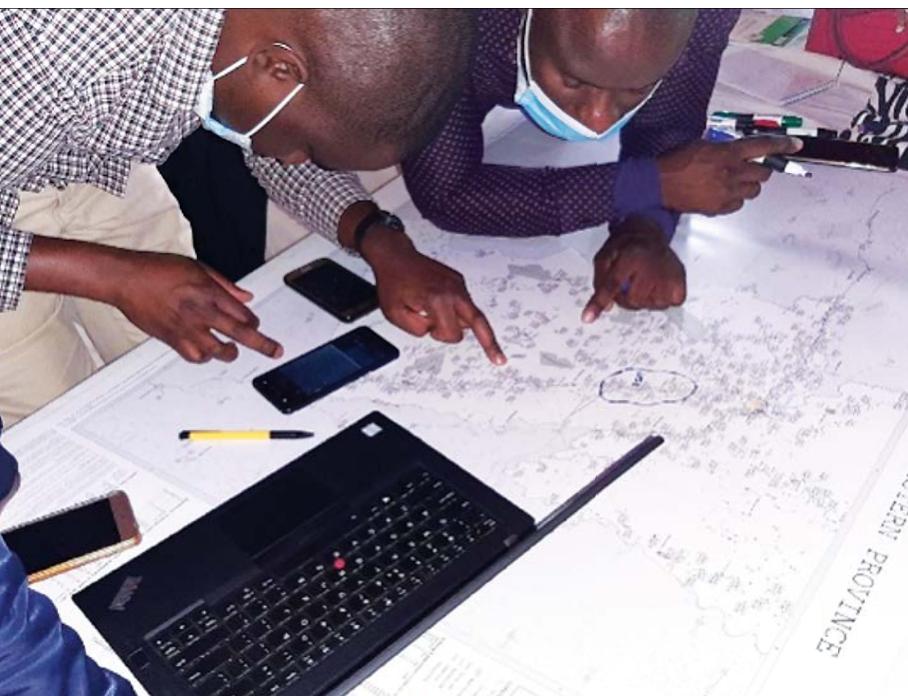
Working in close collaboration with the other technical partners on the Zambia project, staff members at GRID3 used ArcGIS Pro and ArcPy to create a national atlas of microplanning maps to help Zambia's government plan its vector control campaign. The team employed GRID3's high-resolution gridded population estimates, settlement extents, residential structure counts, administrative district boundaries, and the locations of key landmarks such as health facilities and schools. In addition, the team at Akros further refined its estimates on population and structure counts using field-verified data that Akros and Zambia's ministry of health captured in previous years via Akros's Reveal platform. The platform is a geospatial microplanning and data collection

tool that field teams use to ensure that everyone targeted in a health campaign receives the service, whether it's indoor residual spraying or mosquito nets.

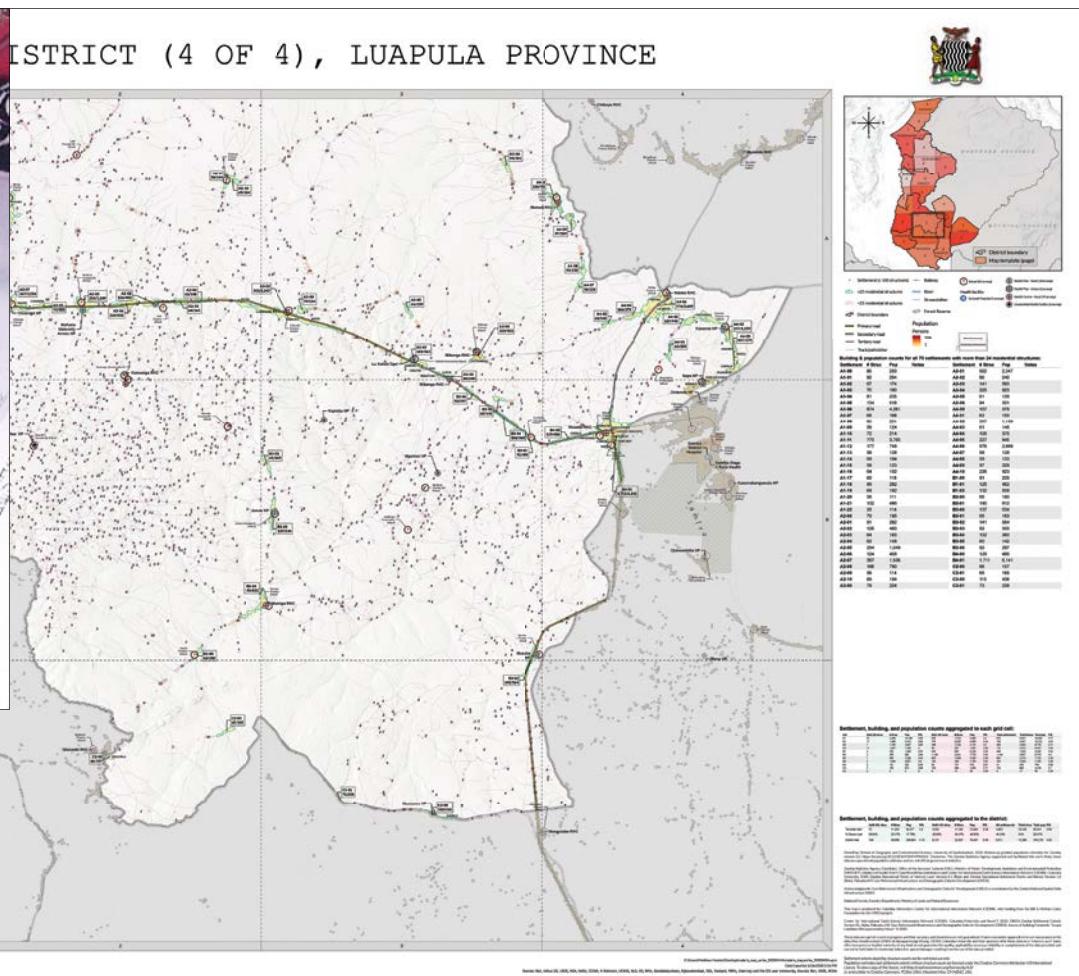
To create the atlas, GRID3 staff employed the Grid Index Features tool in ArcGIS Pro to divide each of Zambia's 116 districts into a 289-cell static index grid. They used this index grid to determine the extent of each map page that would be included in the map series. The pages were set to a 4:3 (landscape) or 3:4 (portrait) aspect ratio to ensure that each map could be subdivided into equal-area grid cells.

Staff then employed the Grid Index Features tool again on the original index grid output to subdivide each map into a series of nested grids. This allowed the related tabular summaries of the grid features—which show the total estimated population and the estimated number of livable structures—to be included on the maps, enabling users to review the summary statistics of each subdivision within the map document. The team also included a terrain hillshade as an embedded basemap to provide users with additional spatial context, such as rivers, wetlands, and areas of high elevation, to help with planning efforts.

"The maps were used during the microplanning process to analyze the country's population distribution at a granular level," said Olena Borkovska, implementation lead at GRID3. "The

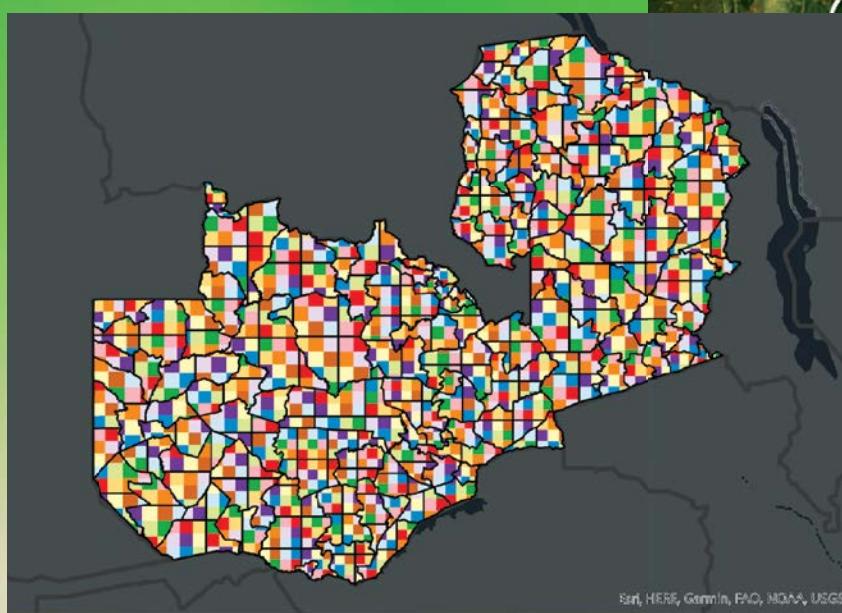


↑ In 2020, vector control management teams in Western Province, Zambia, used the maps during microplanning sessions to plan indoor residual spray distributions.



↑ This map of the Mansa district, in Zambia's Luapula Province, was created using the dynamic map template to help with the government's malaria eradication campaign.





↑ Geo-Referenced Infrastructure and Demographic Data for Development (GRID3) developed a grid system for Zambia using district boundaries to produce a map study area before creating nested grids (shown) that show summary statistics for each cell.



↑ Settlement extents, which are polygons representing areas where there is likely a human settlement based on the presence of buildings, are detected in satellite imagery.

gridded nature of the GRID3 population dataset provided flexibility in calculating the population in settled areas. It presents a detailed picture of where people in Zambia live and can inform which vector control method can best be optimized, considering the dispersed population, resources, and costs.”

Detailed Maps Lead to Action

The partners provided digital and print copies of the resultant maps to government staff members at district health offices to help guide the vector control planning process. District planners appreciated the granular data on the maps, the consistent process for developing them, and the fact that the maps were available electronically and in print.

“The GRID3 maps were useful in our preparation and planning because they show all the facilities and the structures in the area,” said Beauty M. S. Pallu, the malaria elimination officer for the Chongwe district in Zambia. “Using this information, we were able to select where to put up depots and wash bays that are optimal for operational indoor residual spray activities and determine the

number of resources needed at each location. We are also able to estimate how many structures to spray in a particular area.”

In 2020, 112 out of Zambia’s 116 districts used the maps during NMEC-led microplanning sessions to improve resource estimates for distributing indoor residual spray and insecticide-treated mosquito nets. According to Akros, use of the maps also helped minimize the overlapping deployment of indoor residual spray resources and mosquito nets to the same areas—one of the major goals of NMEC’s 2020 vector control strategy.

The maps were updated in 2021 and used to support malaria eradication efforts in Zambia in 2021 and 2022.

Equipping Governments with Geospatial Data

The operational data developed for this project was done in collaboration with Zambia’s National Spatial Data Infrastructure (NSDI) Steering and Technical Committees, as well as other

government agencies, including the Zambia Statistics Agency, the Ministry of Health, the Ministry of Education, and the Ministry of Lands and Natural Resources. It is now being used for other Ministry of Health programs, such as immunization planning, and can be employed in other government-led health interventions throughout the country.

And this is just one example of GRID3’s efforts to support national governments in collecting, producing, and maintaining geospatial data for health-related interventions, according to Borkovska.

“In the past five years, GRID3 has seen a successful adaptation of core geospatial data layers and the use of GIS technology by governments in the Democratic Republic of the Congo, Nigeria, Zambia, Burkina Faso, Mozambique, Sierra Leone, and Kenya,” Borkovska said. “Government stakeholders are becoming better equipped with a sufficient understanding of GIS technology to use it in the decision-making process in the health sector.”

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Deep Learning Model Unlocks Potential of Solar Energy Development

By Andy Bohnhoff, Platte River Analytics

Solar power presents an immense opportunity for generating sustainable and green energy. Realizing its full potential requires identifying suitable locations for solar panel installations.

Pivot Energy, a national renewable energy provider headquartered in Colorado, needed assistance locating parking lots across various areas of interest that are appropriate for potential solar panel implementation. Using advanced GIS technology, a team from Esri partner Platte River Analytics helped Pivot Energy do this accurately and efficiently.

By leveraging a deep learning model from Esri, the team at Platte River Analytics extracted parking lot surfaces from high-resolution imagery. The team then used geoprocessing tools in ArcGIS Pro to conduct more precise measurements and calculations of potential sites.

The results of this analysis provided Pivot Energy with invaluable information, empowering staff to make data-driven decisions and plan out solar power adoption efforts more effectively.

The Benefits of Parking-Lot-Based Solar Development

Parking lots offer significant yet underutilized space for solar power development. They possess key characteristics that make them ideal for generating solar energy, such as large surface areas, unobstructed exposure to sunlight, and proximity to electrical infrastructure

connections. In addition, paved parking lots typically have very low slopes, are designed to drain, don't compete with other land uses, and aren't in full use all the time.

Solar-powered parking lots can provide numerous environmental and economic advantages to owners and communities as well. They can be quickly equipped with electric vehicle (EV) charging stations. This not only enables EVs to be powered directly by solar-generated energy, promoting clean transportation, but it also reduces electricity costs for owners and operators and opens avenues for potential revenue generation through energy sales. In addition, offering EV charging to customers attracts car owners who will spend money in the area while charging their vehicles.

All these are reasons why Pivot Energy saw the need to scour parking lots across the East Coast and, eventually, the nation to see which ones are ideal for solar energy development.

A Quick, Automated Way to Detect Suitable Parking Lots

To automate the detection of parking lots in Pivot Energy's areas of interest, the team at Platte River Analytics relied on Esri's Parking Lots Classification – USA deep learning model, available in ArcGIS Living Atlas of the World.

Developed by the Esri analytics team, this prebuilt model is trained to identify parking

lots within sourced areal imagery. Like the more than 65 other deep learning models that the Esri analytics team has developed to detect objects ranging from Arctic seals to power lines, the Parking Lots Classification – USA model automatically extracts the assets from imagery without users having to invest time or money in training data or personnel.

For this project, the team at Platte River Analytics needed to use high-quality, submeter data that allowed the model to identify and analyze land features as detailed as parking lots. The team acquired one-meter resolution National Agriculture Imagery Program (NAIP) imagery from the United States Geological Survey's EarthExplorer web app. The imagery in this app has been acquired by the US Department of Agriculture during agricultural growing seasons from 2003 to the present.

After downloading the NAIP imagery, the Platte River Analytics team seamlessly integrated the deep learning model into its ArcGIS Pro workflow. The team processed the imagery with the model, which automatically identified parking lots across dozens of Pivot Energy's areas of interest.

The model was easy to use. The initial area of interest that the team looked into was the size of a large US city, and it took less than 12 hours to both download the imagery and process it in ArcGIS Pro.

To further analyze the identified parking lots, the team at Platte River Analytics used the Raster to Polygon geoprocessing tool in ArcGIS Pro to convert the raster outputs into polygons. This enabled the team to get more precise measurements and calculate the size of each lot, providing valuable information to Pivot Energy so staff could begin conducting feasibility assessments and get started with project planning.

From there, the GIS team at Pivot Energy was able to study regulatory factors—such as floodplains,

tree cover, wetlands, and wildlife migration routes—around parking lots that were initially deemed acceptable for solar development.

Saving Dozens of Hours of Manual Work per Week

Taking a machine learning-based approach to finding suitable parking lots for solar panel installation enabled staff at Pivot Energy to make informed decisions quickly regarding which areas and specific parking lots could work for this endeavor. By using advanced GIS to assess parking lot locations and sizes, the developer can optimize project planning, ensure maximum energy generation capacity, and speed up the installation of solar infrastructure.

According to Rachel Mead, GIS manager at Pivot Energy, the process that the team at Platte River Analytics used to extract parking lots from imagery saved her own team more than 20 hours per week of manually searching aerial imagery for—and digitizing parking lots throughout—the company's areas of interest, which stretch across the United States.

"It has been a huge time-saver having access to the deep learning models provided by Esri," she said. "By automating this...we can save dozens of hours per week and realign that time to other projects."

Using Esri's Parking Lots Classification – USA deep learning model in ArcGIS Pro, the team conducted a test study of parking lot extraction in Golden, Colorado.



About the Author

Andy Bohnhoff is the founder of Platte River Analytics, which specializes in GIS mapping and analysis. He has a master's degree in GIS from the University of Denver and a bachelor's degree in geography from the University of Illinois. Bohnhoff's experience includes site selection in oil and gas, renewable energy, and real estate.

ArcGIS Workflow Manager Streamlines Data Sharing in Southern California

The Southern California Association of Governments (SCAG) is the largest metropolitan planning organization in the United States in terms of land and population size. Much of the agency's work supports local jurisdictions throughout Southern California—a region that consists of 191 cities and six counties; encompasses more than 38,000 square miles; and is home to nearly half of the state's 39 million residents.

SCAG's main purpose is to produce Connect SoCal, the long-range Regional Transportation Plan and Sustainable Communities Strategy that outlines how to help Southern California grow efficiently and sustainably. To prepare for Connect SoCal, SCAG initiated a local data exchange process to gather the most up-to-date information on topics such as land use and socioeconomic forecasts from local jurisdictions. This data helps SCAG better understand how the region is developing and meeting its targets in terms of mobility, housing, and the environment.

As a longtime Esri customer, SCAG sees the value in taking a geographic approach to tackling planning challenges. To modernize the organization's current data contribution process and increase efficiency in data collection, SCAG deployed ArcGIS Workflow Manager. Now, SCAG can automate communications and has more flexibility with sharing data, which enables the agency to better manage and track contributions from local jurisdictions.

A Challenging Data Management System

The SCAG Regional Data Platform (RDP) is a system for collaborative data sharing to enable better planning at the city, county, and regional levels. One of the goals of the RDP is to provide the organization's regionally significant datasets and resources to local jurisdictions to facilitate transparency and collaboration throughout Southern California.

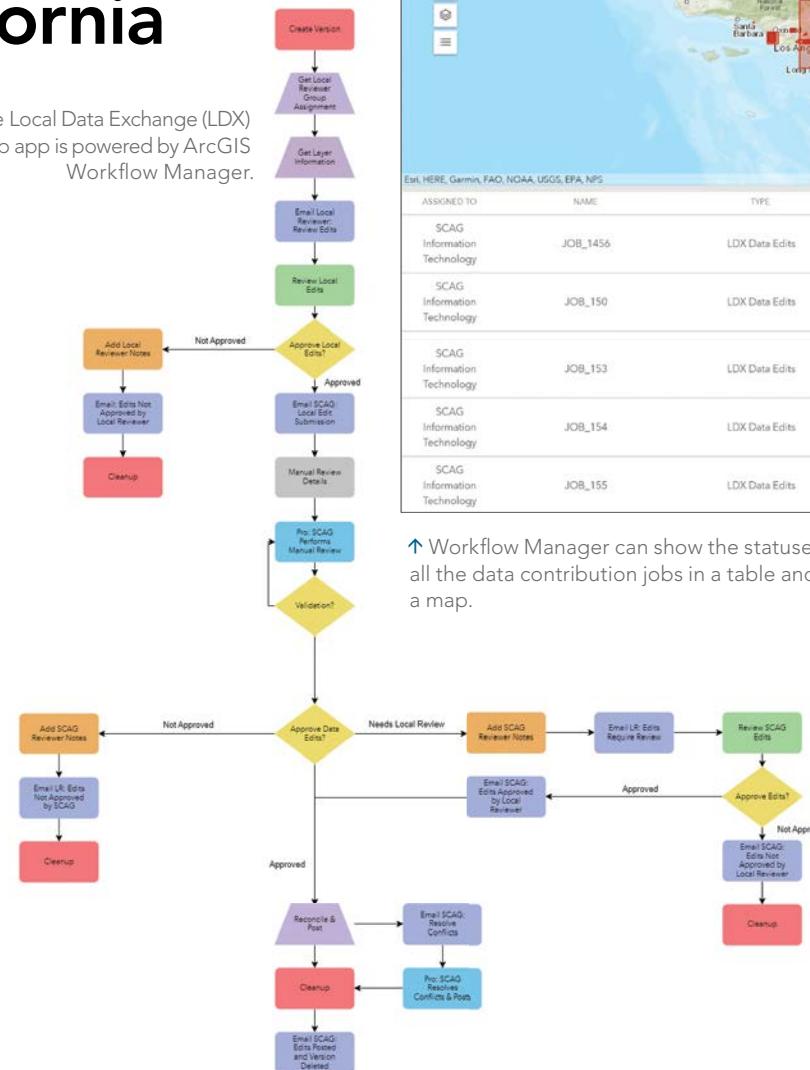
An important part of this initiative is the exchange of data that takes place every four years when SCAG connects with local jurisdictions. Jurisdictions are asked to provide feedback on an estimated 30 data layers in six different categories that primarily deal with land use and socioeconomics. The jurisdictions' input is then incorporated into Connect SoCal and SCAG's database.

Due to a historical lack of standardized processes, however, data from each jurisdiction was typically sent to SCAG in different formats, such as marked-up maps or spreadsheets. Most of this feedback came in via mail and email.

According to Tom Vo, principal regional planner at SCAG, it was challenging to manage jurisdictions' input because each jurisdiction has a different set of land-use data with its own land-use codes. When SCAG received the data, staff had to translate it into standardized SCAG codes.

"Before, in my opinion, the process of collecting data took a little bit longer," said Vo. "When we received input, we would have staff keep track of it and put it into the system."

→ The Local Data Exchange (LDX) web app is powered by ArcGIS Workflow Manager.



With large volumes of data going back and forth between SCAG and local jurisdictions, the SCAG team sought a new enterprise solution to standardize the input process.

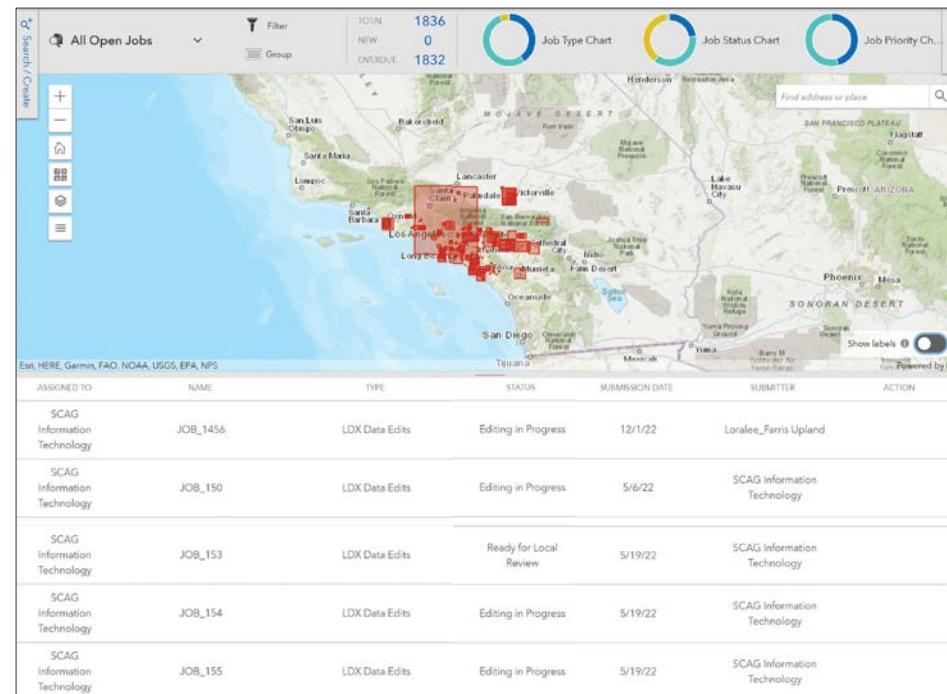
Establishing a Streamlined Data Exchange

Because SCAG's RDP was built on Esri infrastructure, Esri Professional Services suggested that the team implement Workflow Manager, Esri's scalable, GIS-based workflow management system. Staff members on the SCAG planning team are heavy users of ArcGIS Pro, so integrating Workflow Manager into SCAG's technology stack would be seamless.

"After looking at what planning wanted to do with the RDP, it became obvious that we would have a lot of processes that would require consolidation...and people being able to look back and know what they did," said Sean Tucker, lead GIS administrator at SCAG. "Workflow Manager was a good choice to have because it works with the other Esri elements, and we would have that collaboration."

Regional planners, including Vo, outlined what they wanted to get out of Workflow Manager, and then SCAG collaborated with Esri on the initial implementation. Because of the work SCAG does for the region, the team wanted the inaugural setup to be the industry standard.

"I think that was part of the reason why we really leaned on Esri," Tucker said. "[Esri has] the understanding of...how to collect data, how to collaborate with data, how to make sure that there's continuity."



↑ Workflow Manager can show the statuses of all the data contribution jobs in a table and on a map.

ArcGIS REST API to generate job details, contributing to more comprehensive tracking. APIs are also being used to extract the difference between a database version created by a user and the default version of the database.

"This way, it doesn't bring us the entire database," explained Mengdi Li, a senior regional planner at SCAG. "The dataset is very compact and easy to handle."

Workflow Manager helps SCAG with system management as well. Using Python scripting, the team can see where data comes from. Workflow Manager generates a summary table of all data contribution jobs in the system, and that can be converted into statistics, such as the percentage of jurisdictions that have provided input. This helps streamline various internal tracking and reporting tasks.

"Because we have limited resources right now, I saw opportunities to use Python to streamline the process. In our GIS team, we only have several people, but we have hundreds of jobs to deal with. So how to batch process jobs is very important to us," said Li. "We kind of rely on those ArcGIS APIs to help us get access to all the information and do the spatial analysis."

Enhancing Trust with Local Partners

Implementing Workflow Manager has streamlined the input process for SCAG, leading to improved transparency and efficiency.

Now, when an external user submits input, the SCAG team receives an email notification sent by Workflow Manager. This helps team members keep track of submissions and ensure their accuracy. SCAG staff members can view all contributions in ArcGIS Pro and incorporate the appropriate changes.

The new system also enables SCAG staff to more easily track what's in the system and how it has been incorporated in the database. Moreover, cities and other jurisdictions that use Workflow Manager can track the status of their inputs.

"This will enhance our communication and trust with local partners because now, when they provide data to us, it's not a black box anymore. They know exactly where their data is going, and they can keep track of that," said Vo. "That will also increase engagement and help us build consensus with different partners in the region."

Butterfly Conservation Gets a Boost from ArcGIS Field Maps

By Juan Carlos Torres, Mid-Willamette Valley Council of Governments

In 1937, the Fender's blue butterfly was considered extinct due to human activities' effects on its habitat. In 1989, however, approximately 4,000 of the species were discovered in the wild in Oregon's Willamette Valley. Eleven years later, in 2000, the Fender's blue butterfly was put on the endangered species list.

The habitat for these butterflies is highly sensitive to disturbances. The presence of Kincaid's lupine—a tall, thin, stalk-like plant with purple flowers—and other native lupines is a strong indicator of Fender's blue butterfly populations, since the plants are primary hosts for the insects' larvae and the butterflies pollinate the lupines. This means that the decline of lupines endangers Fender's blue butterflies, and decreases in butterfly populations imperil their own habitat. Thus, mapping the butterflies' habitat is crucial for protecting them.

To comply with federal protection laws, Yamhill County, Oregon, is mandated to identify, map, and protect Fender's blue butterflies' habitats. The county's public works department—which oversees grass mowing and herbicide spray operations along all county roads—has collaborated for many years with biologists and environmental agencies to collect information on butterfly habitat locations, identify areas where invasive species are present, and take measures to prevent the invasive species' proliferation.

Until recently, the public works department's mobile crews carried out these functions using paper maps and GPS receivers. But now, ArcGIS Field Maps provides all staff members with an efficient and comprehensive workflow for finding, recording, and visualizing data about the butterflies' habitats and worrisome invasive species.

A Complex Process Gets Simplified with a Single App

Identifying and mapping protected butterfly habitats and areas that contain invasive species can be a complex task, especially since some of the protected areas are under private management. Yamhill County mobile crews must take care to avoid spraying or mowing privately managed areas to prevent unnecessary herbicide use and conserve resources.

In the past, mobile crews would use paper maps and road markers and drive along county roads, stopping multiple times to determine where to spray, mow, and disinfect their equipment. This process was slow and cumbersome. For years, the Yamhill County Public Works Department sought a comprehensive solution that could help staff optimize their time and streamline their data recording processes. The ideal solution would also allow employees in the office to track public works vehicles in real time so mobile crews could receive notices when approaching protected areas.

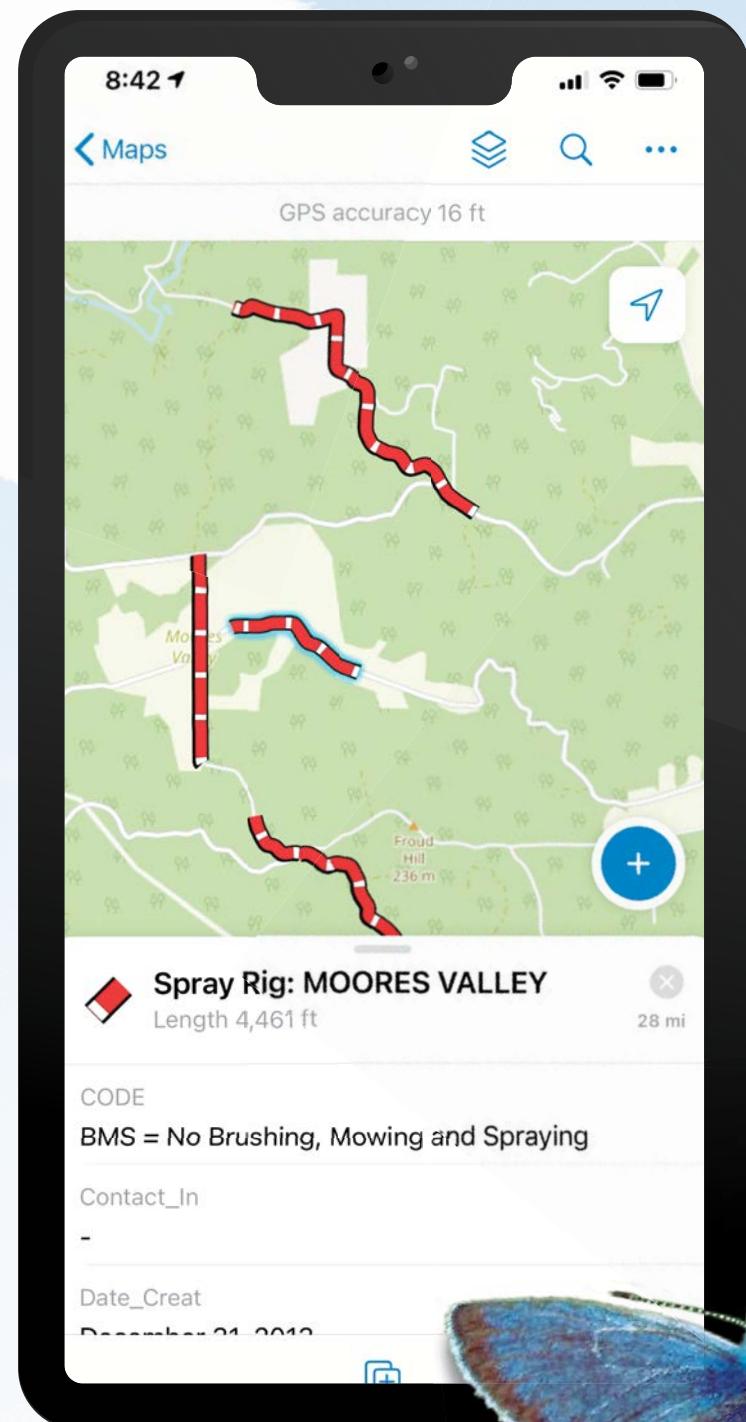
Yamhill County contracted with the Mid-Willamette Valley Council of Governments in Salem, Oregon, to find a comprehensive GIS solution that staff members could use to protect Fender's blue butterflies' habitats and grapple with invasive species. After researching potential GIS solutions, the joint team determined that Field Maps would work best, since it combines data collection, map viewing, and location tracking capabilities in a single app that was easy to use and deploy.

Digital Workflows Exceed Expectations

After cleaning and attributing all the GIS data that Yamhill County's mobile crews had already collected, a GIS analyst created maps of the protected areas and published them as GIS services in ArcGIS Online. The analyst then configured the maps for data collection and set up forms to input protected areas' attributes, feature templates to help mobile crews categorize their observations, and ways to share the maps. The feature templates, in particular, have been beneficial to Yamhill County staff members when defining default values for things like species type and land management specifications. For one thing, they address the county's long-standing challenge of getting mobile crews to use uniform naming conventions.

Since Field Maps was deployed two years ago, it has exceeded the Yamhill County Public Works

→ Buffer areas, in red, show where no brushing, mowing, or spraying is allowed.



Department's expectations. Using the app saves staff members and mobile crews time in finding butterfly habitats and invasive species; facilitates better data collection through its user-friendly interface; and, ultimately, improves habitat protection.

Crew members now use iPads with cellular data service to display their vehicle's precise location. Brightly colored maps within the app show protected areas and places with known invasive species, so mobile crews can easily find them. Each protected-area polygon also has a safety buffer—which indicates where mobile crews need to stop spraying and mowing—to account for potential GPS accuracy issues. And the app has become valuable for collecting and updating data in real time on new protected areas.

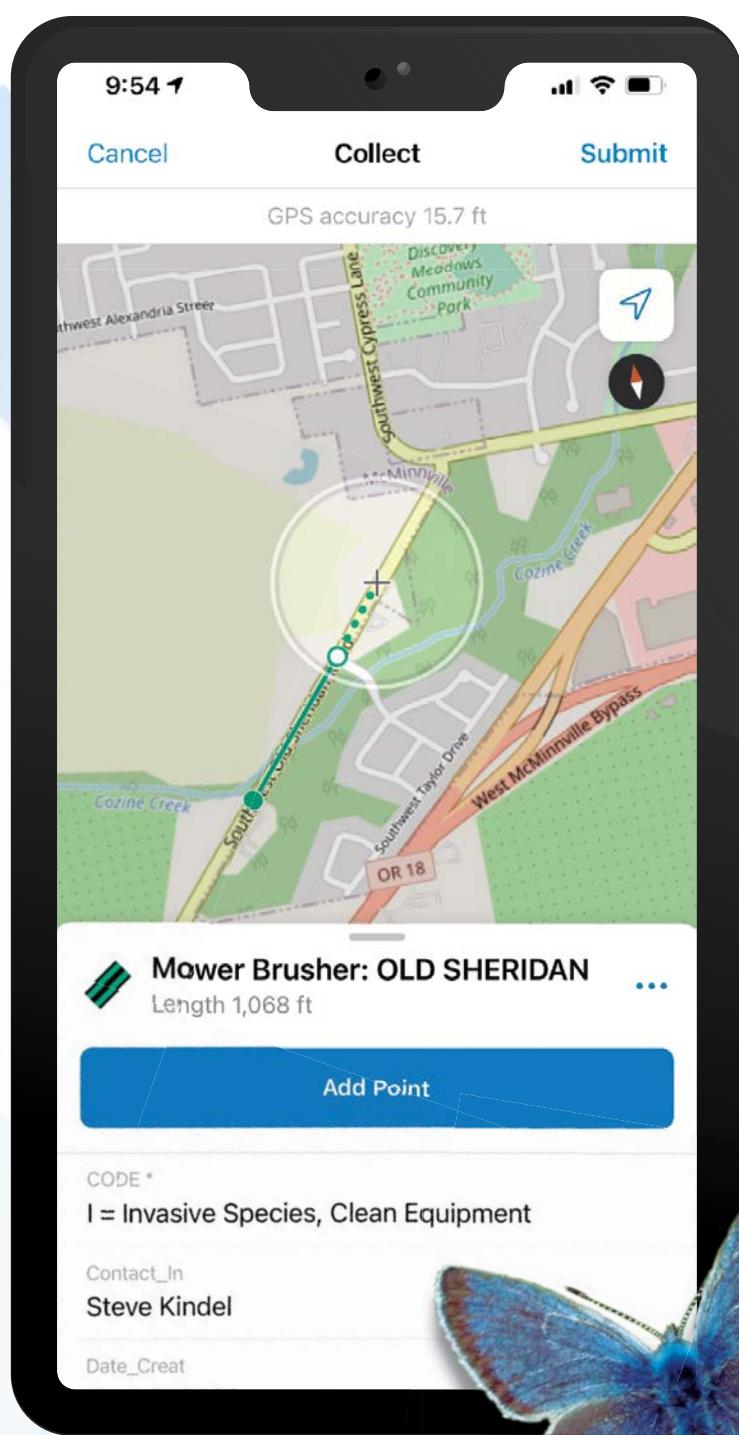
Different custom versions of Yamhill County's Field Maps deployment have been created to cater to the

mowing and spraying crews' distinct requirements. The team is planning to further improve real-time tracking accuracy as well by pairing Field Maps with higher-precision Global Navigation Satellite System (GNSS) receivers and implementing the app's new geofencing capabilities.

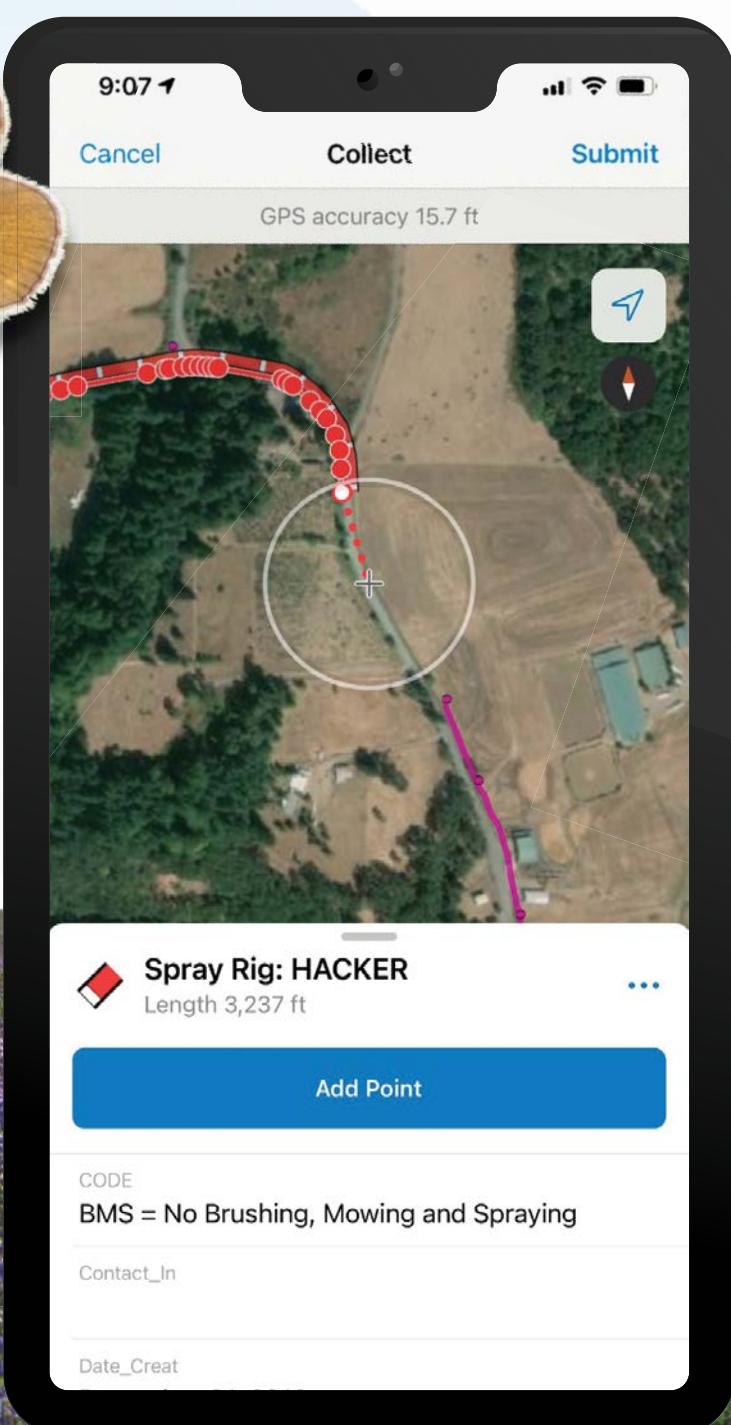
GIS Serves Conservation Projects Well

Protecting Fender's blue butterflies has been very successful in Oregon. In February 2023, the Fender's blue butterfly's status was updated from endangered to threatened.

Yet the species remains vulnerable to changes in climate and rising temperatures, which also impact lupine habitats. Organizations and residents throughout the Willamette Valley must continue to ensure both species' survival. In Yamhill County, the use of GIS has played a very important role in this great task—and it can do the same for other, similar conservation projects.



↑ Mowing crews that work in areas with invasive species can use ArcGIS Field Maps to see, in real time, where they need to disinfect their vehicles.



← With Field Maps, mobile crews that conduct spray operations can be tracked in real time.

About the Author

Juan Carlos Torres is a GIS analyst and developer for the Mid-Willamette Valley Council of Governments.

Railroad Company Digitizes with GIS, and "Everything Changes"

OmniTRAX, a short line railroad management company headquartered in Denver, Colorado, operates 25 railroads that span the east and west coasts of the United States and extend north into Canada. That's a lot of properties and other assets to track and maintain—not to mention being able to communicate information about these assets to railroad general managers and safety teams.

Getting a current, accurate picture of these assets and understanding how to effectively maximize their potential value can be a challenge under the best of circumstances. But OmniTRAX's properties are often hundreds of years old; are geographically

dispersed; and were acquired at many different times, meaning property records were not organized consistently.

In 2017, OmniTRAX undertook an effort to collect and organize these property records, digitize the boundaries of the properties, and consolidate all property-related information into a single online platform built on ArcGIS Enterprise. To access data from this system, a custom GIS app was created using ArcGIS Web AppBuilder. This app opened property and track data to all employees.

Today, the system is known as OmniMAPS and serves as both a data repository and a go-to source of information.

The initial aim of developing the OmniMAPS system, according to Leah Twombly, director of the IT enterprise services team at OmniTRAX, was to gain a better appreciation of the organization's real estate assets.

"Ultimately, it's about confirming ownership of *what* and *where*, but there was also a desire to be able to make better use of the information we have," she said. "That meant providing better access for the layperson in an easily usable and recognizable format that they can latch onto without much training. At the most basic level, users need to know whether a document exists and how to get to it."

OmniTRAX now uses ArcGIS Field Maps to verify that assets in the field match the company's records.

OmniTRAX operates 25 short line railroads and specializes in first- and last-mile freight delivery.

By collecting and consolidating all that information, the effort supported multiple groups across the organization with purpose-built apps drawn from a common data source. This opened new doors for OmniTRAX to make improvements in business management and customer service.

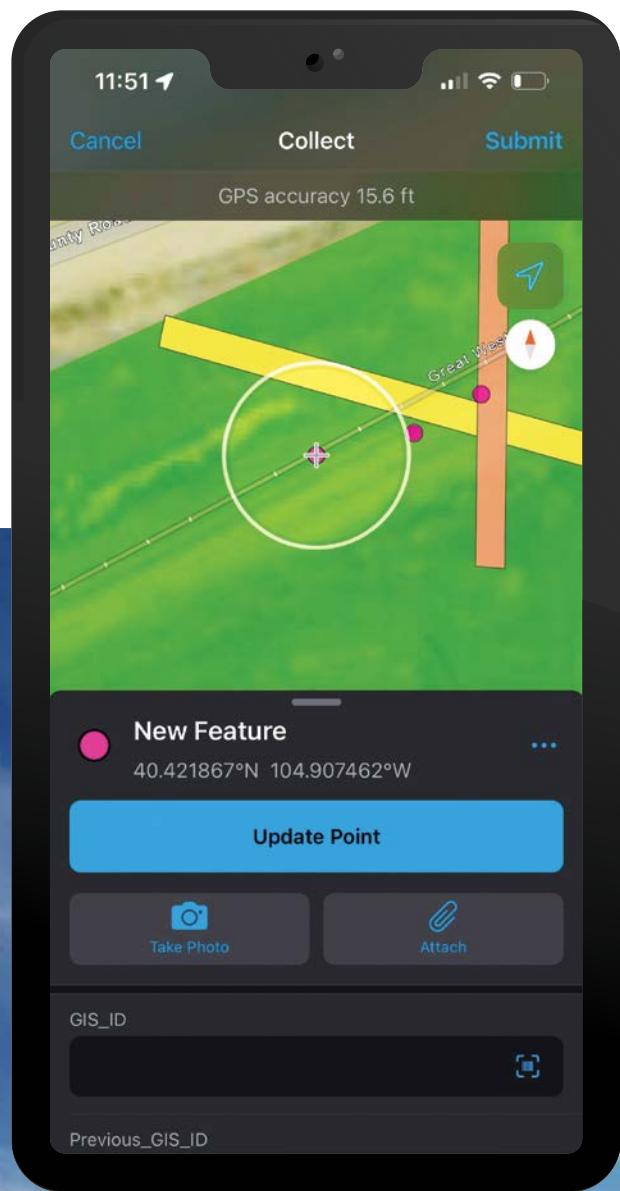
The Challenge of Gathering Data

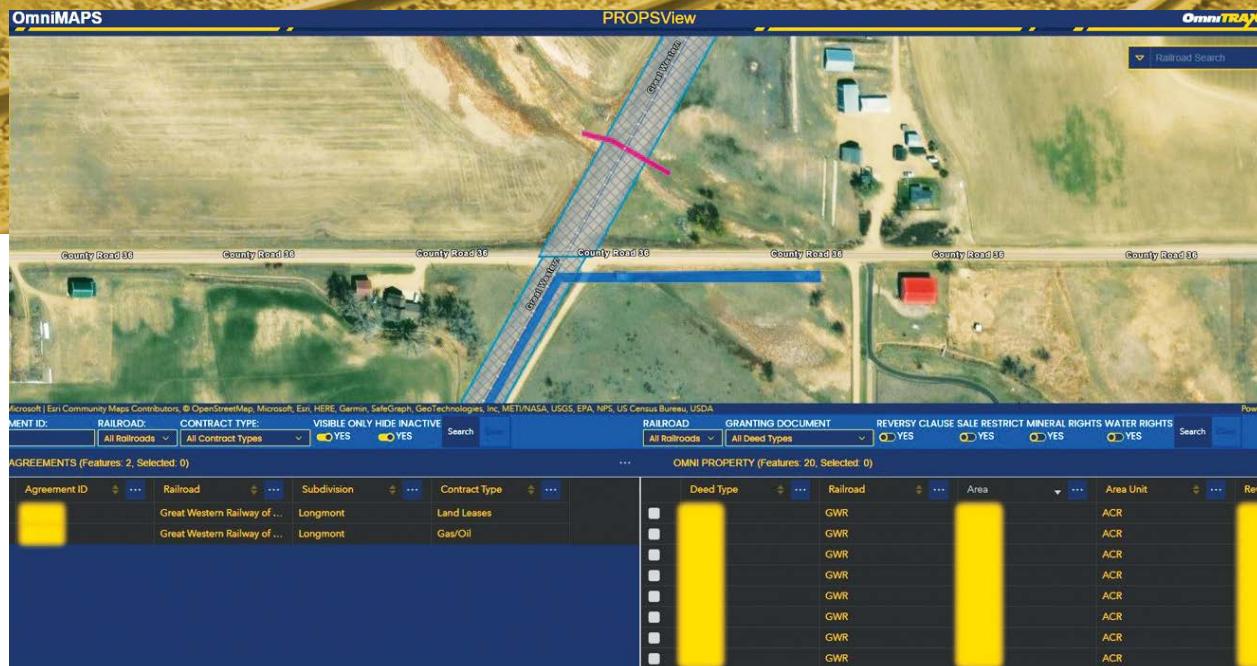
Since property data was distributed across different railroads—and even across different groups at each railroad—gathering it all proved to be the heaviest lift from the outset of the project.

"Collation involved some serious legwork," said Twombly. "[It entailed] the painful process of reading through all of the descriptions of utility crossings and deeds and representing those in the geodatabase. There are hundreds if not thousands of documents now referenced."

Property records also needed to be verified in the field to ensure that actual assets matched the company's records. This led OmniTRAX to ArcGIS Field Maps, which saved crews a huge amount of time when inputting data.

"The Field Maps app makes it really easy to go out and do audits," said Mike Garcia, senior GIS business systems analyst at OmniTRAX. "If we have a utility crossing at a given location, we need to be able to verify it. But what happens if at a pole location there are five wires instead of the recorded three? Or what if it's an underground utility? We need to know to accurately communicate what's actually been done."





↑ Property boundaries have been digitized and organized into a single platform built on ArcGIS Enterprise.

Additionally, field operatives conducting these audits can use Field Maps to look two or three miles up- and downline and flag anything they need to be aware of.

"When we make acquisitions, field staff can go out and tell us what's there and also what's missing from the records," said Twombly. "It helps flesh things out a little more."

A Sea Change for Efficiency

Since 2019, when the first app was released, the OmniMAPS platform has grown to host five apps, built on ArcGIS API for JavaScript and Esri's Calcite Design System. Currently, OmniMAPS experiences up to 50 unique user logins a day. Many are from OmniTRAX's tax and finance, real estate, and economic development divisions, but interest throughout the rest of the organization is expanding.

"The railroad general managers have been terrific proponents of picking this up and being able to deal with property and asset management queries," said Twombly. "[They] are going to be big users, as are the safety teams, who will be better able to identify things that they need to look at more closely."

The most immediate impact has been an increase in efficiency across all departments. Previously, Twombly spent as much as half an hour digging up information based on loose descriptions of documents. Now, that information is available for users to search for in the new document viewer with just a few clicks.

"All the folks throughout the company are currently having to wear several different hats," said Twombly. "Helping to reduce the number of tasks they have to complete means that they can really focus on priorities."

"You can search for something in an instant," added Jason Berryhill, chief information officer at OmniTRAX. "And you can see what business services you can offer if you have all the data at your fingertips. Here's a picture of where our properties connect and how we can provide easements. 'Our track runs right up to your location, but your building's dilapidated; maybe it's time to invest.' [GIS] is fantastic for visualizing all that."

Ever-Expanding Possibilities for GIS

As Berryhill began to understand what GIS could do, he started coming up with ways to expand these helpful efficiencies in the future.



"There's a lot of appeal, from an operational perspective, [to] knowing precisely where our locomotives are at all times and whether they're running or idling and still burning fuel," he said. "[Having] up-to-the-moment information means we can take action."

Furthermore, this location-based perspective led to ideas about how OmniTRAX could improve its customer service.

"How can we, as an industry often seen as archaic, offer transparent services to our customers that we haven't in the past?" Berryhill asked. "Knowing where our customers' cars are at all times allows event-based updates—'Here's a picture of your car arriving on our property.'

The combination of camera technology and GIS tools like OmniMAPS could give OmniTRAX this type of real-time visibility into its assets without the cost of putting sensor technology on every car. Berryhill pointed out that as a short line railroad, OmniTRAX is a first- and last-mile delivery specialist, not an end-to-end deliverer of freight. But the ability to provide greater visibility strengthens its partnership with larger railroads, and the combination of camera systems and GIS can provide OmniTRAX with another way to deliver that service.

GIS has opened the door to a much larger set of possibilities at the railroad and arguably enables OmniTRAX to deliver a host of services ahead of its larger peers.

For instance, noted Berryhill, OmniTRAX could tie more of its mandatory safety reporting or business intelligence to GIS. Additionally, drone imagery data could be leveraged for a wide range of uses across the organization.

But wherever OmniTRAX decides to go next, it's clear that merely consolidating all its records into the OmniMAPS system has already taken the company in a new, more efficient direction.

"Once you digitize," said Berryhill, "everything changes."

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Intelligence Analyst Empowers Colleagues Across the NYPD with GIS

"I love GIS. I'm passionate about it," said Hayley Gerkman, intelligence research specialist for the New York Police Department's (NYPD) Intelligence and Counterterrorism Bureau. "I just want people to use it and love it as much as I do because I know how effective it is."

Throughout her career, Gerkman has been a change agent for GIS by building relationships and trust with colleagues and showing them how the technology—and geointelligence in general—can enhance their work. She understands the importance of using the geographic approach to solve critical and urgent problems. And she makes bold moves to achieve her goals.

"She's in a division at the NYPD—counterterrorism and intelligence—that's naturally isolated, and she's a woman and a civilian. Yet she's gone in there and demonstrated with hands-on technology in real-life situations why the geographic approach and ArcGIS technology can really move the needle not only in intelligence but also across the NYPD," said Dave LaShell, Esri's account manager for the NYPD. "It's a really forward-thinking way for the NYPD to operate."

"She doesn't just sling apps for presentations either," echoed Nadine Hughes, program manager for the NYPD's Esri Advantage Program. "She provides an easier way for people across the organization to access the GIS data and technology they need. That's a real leadership move."

Gerkman says she was into maps as a kid growing up in Colorado. So when she entered the University of Colorado to study geography and sociology with emphases in GIS, cartography, and criminology, it was no surprise that she liked mapping technology.

"It was partially because someone lied to me and told me I'd make, like, \$100,000 straight out of college in 2003," she joked. "But really, I just fell in love with it."

After college, Gerkman took a job as a digital imagery analyst at Space Imaging (which was later bought out by DigitalGlobe, now known as Esri partner Maxar). She stitched together imagery from the India Remote Sensing satellite system, verifying the images' accuracy.

"There weren't too many commercial satellite companies at the time, so this was kind of an up-and-coming thing," Gerkman said.

She found it intriguing to work with imagery and believes that this experience helped her advance her career later on. But she missed using GIS, so her next position was as a GIS technician at Premier Data Services, Inc. Taking land parcel records kept on microfiche, she developed a GIS model of the Bureau of Land Management's land grid in several states. She also did a stint as a geospatial analyst for engineering consulting firm Michael Baker International, where she helped map the national pipeline system for the Department of Homeland Security.

From there, Gerkman landed a job as a geospatial intelligence analyst at the National Geospatial-Intelligence Agency (NGA). She was initially assigned to the Levant team, which covers Syria, Lebanon, and Israel. She liked the work, especially since she was one of the few GIS analysts among imagery specialists. But she'd always wanted to be in law enforcement. So when a position detailed to the Federal Bureau of Investigation (FBI) soon opened up within the NGA, Gerkman went for it—despite the position being one or two bands above her level at the time. She got it.

"The FBI had just started its journey into GIS, so we were supporting their efforts as they stood up their GIS program," Gerkman said.

She worked on a smaller team that was doing regional intelligence. When her supervisory special agent received a promotion, Gerkman followed her to the counterterrorism unit.

"That was very cool," Gerkman said. "I got to work on a bunch of terrorism cases and did a lot of *[collaborative]* work."

Her supervisory special agent was promoted again, so Gerkman accompanied her to the FBI's Washington Field Office.

"They had just set up a *[GIS]* team, and there were a couple of analysts who were really eager to use the technology," Gerkman remembered. "We all worked together to try to build up the Washington Field Office's group. It was wonderful."

After spending six years in Washington, DC, however, Gerkman became restless and wanted to move.

"On a whim, I was able to get a 30-day tour-of-duty change," she said. This sent her to New York City. "I just said, 'I've got 30 days to convince them that I need to stay up here.' And in 30 days, I convinced them that the New York Field Office really needed me."

Until Gerkman got to the FBI's New York Field Office, the team had never really used GIS or geospatial intelligence (GEOINT).

"Intelligence is already complicated, but in New York, I always had to think outside the box and say, 'How can GEOINT enhance all these investigations?'" she mused. "Because they weren't familiar with GIS, I was constantly marketing it and coming up with creative ways to show agents how it would enhance their cases and be the technology they never knew they needed."

According to LaShell, that's what Gerkman excels at.

"She doesn't overwhelm people with tech," he said. "She always knows which person to go to and builds a relationship with them before bringing forward the relevant technology. She goes to the right people with the right idea all the time."

After six years in New York, the NGA tried to call Gerkman back to Washington, DC. But she and her wife had built a life in Brooklyn, where they'd started raising two sons. They wanted to stay. Gerkman contacted a former colleague to see if the NYPD had any openings in intelligence. The agency did. Thus began a new journey.

"When I came in, I was shocked to find out that the NYPD had just set up a contract with Esri. I wondered how they did GIS before," Gerkman recalled. "So I was an intelligence analyst working cases, but I also started showing them the ways of GIS. Just like at the FBI, it's an uphill battle because I have to show every single person a way that GIS can help them. And how can I reach 55,000 people—and 30,000 police officers—with the one-woman show I'm running? There's so much capability, and there are so many different use cases."

But she's doing it. Gerkman often shows up to important briefings with leaders up and down the NYPD chain of command with visual aids she's built using ArcGIS StoryMaps that show the evolution of a situation or an event—complete with photos, videos, and interactive maps. One project that this was particularly effective for was an initiative to clean up graffiti around the city.

"Law Enforcement Explorers, who are kids that participate in an NYPD program for them, go to sites that the community has labeled as graffiti-filled and clean them up," Gerkman explained. "The commissioner wanted me to map out everything so each precinct could identify where they wanted the kids to go paint. As these groups were going out and painting and posting about it on social media, we were live-updating the public-facing map. You could see the progress and click on a point and see the before-and-after photos. It was so successful. I believe it was the first time we'd ever done anything like that."

Developing proof-of-concept projects like this can really elevate GIS within an organization, according to Gerkman. She advises current and aspiring geospatial leaders to be strong communicators who can get their points across quickly and effectively.

"That helps people get excited about GIS, and then you can start leading them toward using it more often," she said. "Now that people at the NYPD are more aware of what GIS is, it's easier for them to incorporate it into their everyday work and analytical projects."

Gerkman recently became a certified trainer through the State of New York and is building the first GEOINT course for the NYPD. She hopes this can help expose more people to the powers of GIS and empower them to use it themselves.

"Maybe I'll be out of a job soon," she quipped.



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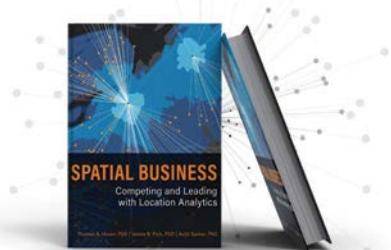


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To Detail Its Vast Work, State Forestry Commission Turns to ArcGIS StoryMaps

By Abi Dhakal, Alabama Forestry Commission

In Alabama, where more than two-thirds of the state is covered in forestland, the Alabama Forestry Commission (AFC) is tasked with protecting, managing, and educating people about all 23 million acres of forest. Staff members do this by helping coordinate natural disaster and emergency responses; performing prescribed burns; working to eradicate invasive species; equipping forest landowners with the tools they need to properly manage their forested properties; and providing information to the public, schoolchildren, government officials, and volunteer fire departments.

Over the past few decades, the AFC has increased its use of GIS. Recently, the state agency moved from using a desktop-based GIS

to implementing ArcGIS Online and ArcGIS Enterprise, which have enabled staff members to expand what they can do with GIS. With the right infrastructure in place, AFC executives Rick Oates and Will Brantley decided in 2022 to present the agency's work, initiatives, and accomplishments to the public in an ArcGIS StoryMaps narrative. The AFC was also able, for the first time, to submit its annual report to the governor in the same format.

Fostering Seamless, Long-Term Collaboration

Developing an attractive web page—featuring photos, videos, audio recordings, web maps, and other apps to tell the AFC's stories as they unfolded every

day—was intended to make it easy for anyone to understand the agency's diverse involvement in forestry management activities across the state.

With maps and apps, the AFC can show where it has implemented forest stewardship programs, managed specific invasive species, done forest pest detection and control, set up best management practices (BMPs), conducted prescribed burns and other wildfire-suppression activities, and engaged in emergency response operations. The idea was to have all this available on a one-stop website so that forestland owners, industry stakeholders, government partners, and the public could see how the AFC succeeds in its mission to “protect and sustain Alabama’s forest resources” each year.

Enterprise are implemented and used together—was key. This allowed the GIS team to share content created in ArcGIS Enterprise—including layers, maps, and apps—to ArcGIS Online, where the ArcGIS StoryMaps story was being built. It also enabled the team to take advantage of newer features available for ArcGIS StoryMaps in ArcGIS Online, since these features are typically released in ArcGIS Online before being rolled out to ArcGIS Enterprise.

In addition, the AFC's new GIS setup allowed the employees working on the ArcGIS StoryMaps narrative to seamlessly incorporate data from the AFC's Microsoft SQL Server database. With the AFC's old GIS, employees could map forestland owners' properties, but any work that the AFC did, such as prescribed burns or invasive species control, was only documented in the SQL Server database—not GIS. Luckily, it was standard practice to record the latitude and

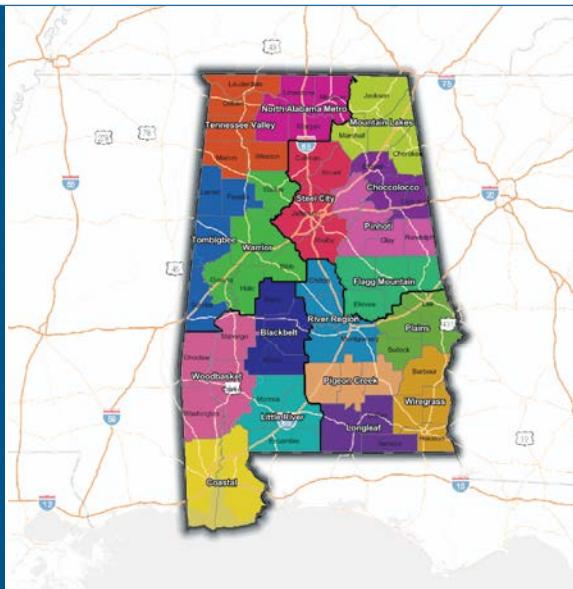
MISSION

1. Protect the state's forests from wildfires, invasive species, and harmful insects and diseases.
2. Sustain and manage the state's forest resources by assisting landowners using professionally applied stewardship principles and technical assistance.
3. Educate Alabama citizens on how the state's forest resources contribute to abundant timber and wildlife, clean air and water, and a healthy economy.

Various forestry initiatives and accomplishments relating to the three-fold mission stated above will be highlighted in the dashboard below.

Above and Beyond

Additionally, the Commission assists with emergency response following hurricanes, tornadoes, ice storms, floods, and other natural disasters. During emergency operations, AFC employees help clear roads and transport people, equipment, and supplies. They also provide critical staffing to emergency management centers across the state.



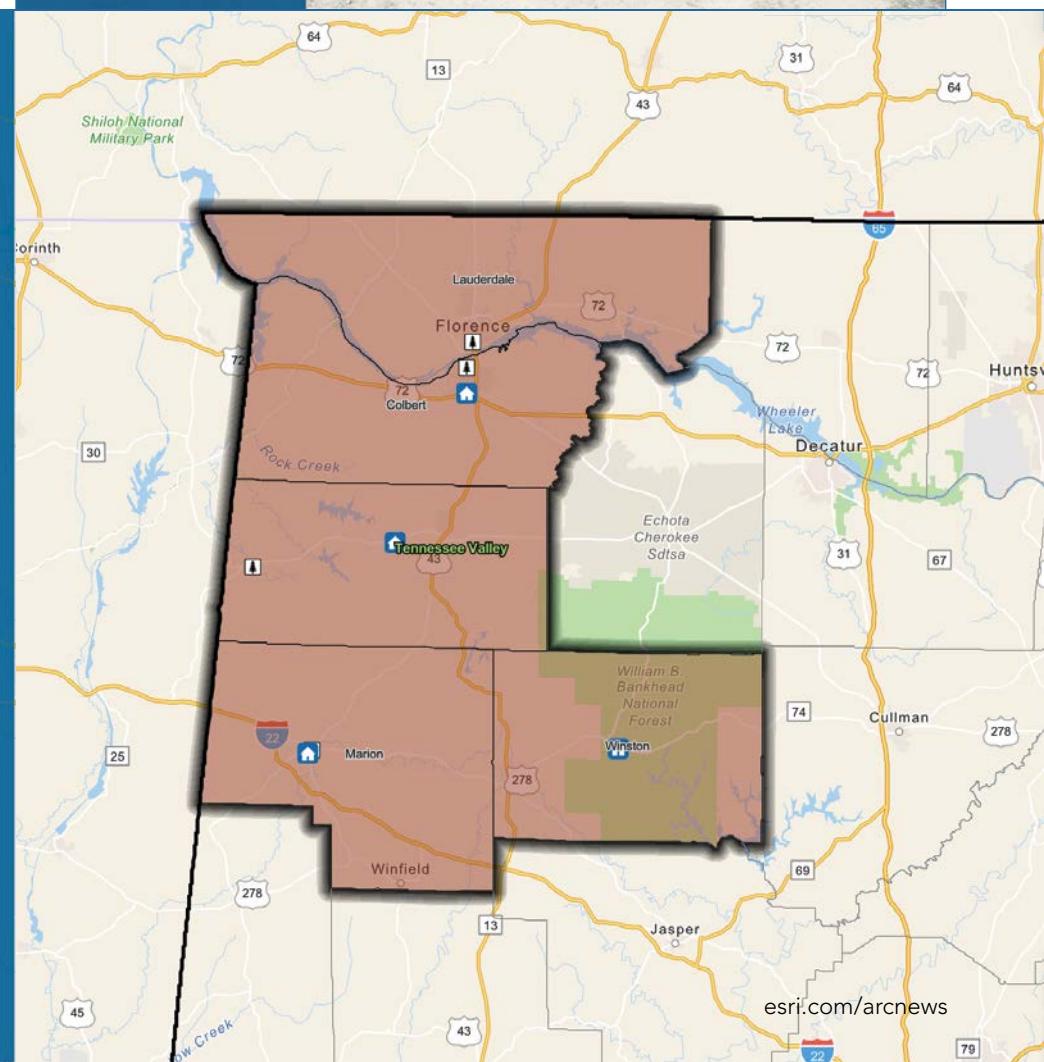
↑↓→ The Alabama Forestry Commission's (AFC) ArcGIS StoryMaps story depicts highlights from each work unit, the 18 areas the AFC splits the state into.



On March 29, 2022, the Stone Gate Fire in Shelby County engulfed almost 800 acres of forest land. If not for these men and women of the AFC, many more acres of timber, and perhaps even numerous homes, could have been destroyed.



Tennessee Valley Work Unit and AFC Drone Coordinator participated in the annual Farm Day event for Lauderdale County schools. They had the opportunity to discuss the important role of forestry in agriculture, as well as some of the AFC's technological advancements in using drones and other resources to make forest management and protection an easier task.





◀ A dashboard shows the breakdown of Alabama's forestry resources.

longitude of each work site in the SQL Server database, so once ArcGIS Online and ArcGIS Enterprise were up and running at the AFC, the two systems performed together seamlessly. Now, the GIS team can easily take the latitude, longitude, and other information stored in the SQL Server database and generate maps of the AFC's work and accomplishments.

An Interactive Record of Work and Accomplishments

The resultant ArcGIS StoryMaps narrative begins with a message from Oates, Alabama's state forester, who says that the AFC's varied activities are intended to provide "a rich, diverse, and both naturally and socially accommodating forestry infrastructure in Alabama."

The navigation bar consists of nine sections that introduce readers to the AFC and its work

and depict highlights from each work unit (the 18 areas the AFC uses to split up the state). Heat maps illustrate the various threats that Alabama's forests face. And several dashboards show the AFC's biggest accomplishments for the year, recent wildfire activity, and Alabama's forest resources (which are further broken down into more comprehensive analyses of each work unit).

As the leading steward of Alabama's forests, the AFC uses GIS to conduct investigations of wildfires, invasive species, and forest pests throughout the state's woodlands. It also helps landowners and residents of Alabama weather adverse impacts from tornadoes and hurricanes, since these can be devastating to people's well-being and property. The AFC's foresters take daily measurements of more than 5,600 research plots throughout Alabama to provide the agency with the most up-to-date forest data available. And the AFC puts great emphasis on urban forestry, with staff members leading public awareness and education campaigns year-round across

the state. All of these activities are reflected and summarized in pictures, videos, audio recordings, maps, dashboards, and text blocks throughout the ArcGIS StoryMaps story.

Scrolling through the narrative, viewers can see heat maps that show areas where forest health is of concern—whether due to insects, disease, or wildfires. These maps also reveal areas where the AFC has seen an abundance of accomplishments, such as where prescribed burns have been conducted to help prevent wildfires from getting out of control. And a dashboard at the bottom of the narrative depicts timber production by wood type across the state.

Positive Reception Sparks an Ongoing Project

Since the public-facing ArcGIS StoryMaps story was initially released in late summer 2022, it has accumulated more than 8,000 views—a number that continues to grow each day. The National Association of State Foresters also featured the

story in its weekly newsletter in January 2023. AFC leaders and staff members have been impressed by this reception and infer that the public is responding positively to this method of presenting data.

Internally, being able to use ArcGIS StoryMaps to continually build and then present the AFC's annual report to the governor made the whole process much easier.

"The ability to update the story as *things are* occurring—using heat maps for fire occurrence and dashboards for dynamic accomplishment tracking—*is* greatly appreciated by agency leadership and the various program managers who otherwise invested significant amounts of time and effort in the production of the annual report each year," said James Chappell, the AFC's assistant division director for forest management.

Indeed, the ArcGIS StoryMaps project went so well that AFC staff members are using the app again to build the agency's 2023 annual report.

To see the ArcGIS StoryMaps narrative, go to arcgis/1DHJyL0. For more information about this project, email Abi Dhakal at abi.dhakal@forestry.alabama.gov.

About the Author

Abi Dhakal is the GIS manager for the AFC. He is responsible for administering ArcGIS Enterprise for agency employees across the state of Alabama. Dhakal has a master's degree in environmental analysis and management from Troy University.

▼ Prescribed burns conducted by the AFC help keep wildfires from getting out of control.

Photo: Alabama Forestry Commission

AFC personnel conduct a prescribed burn each year at Key Cave National Wildlife Refuge, located along the Tennessee River downstream from Florence in Lauderdale County.



From the Meridian

By Dr. Jason Post

Instructor, Arkansas State University



At What Scale Do Historically Excluded Geographers Become Visible?

When the scale of a map or analysis gets altered, viewers often see patterns or features that were previously indiscernible. When looking at geography as a discipline—or at geographers, being the discipline's representatives—it is typical to use broad scales. But at these meta levels, many practitioners get missed. They become invisible, hidden beneath a colonized and historically exclusive academe. At what scale(s) do geographers need to examine their own discipline to lift this veil?

In March 2023, the American Association of Geographers (AAG) and Esri teamed up to sponsor 13 outstanding geography students and their faculty mentors from Minority-Serving Institutions (MSIs) in attending AAG's annual meeting in Denver, Colorado. Nine of the students were from Tribal Colleges and Universities (TCUs). In addition to gaining exposure to the full range of conference offerings, the students received an orientation to the conference, recommendations for which sessions to go to, and an AAG staff escort—and even attended events in their honor. They met potential colleagues and new mentors and saw, through the thousands of sessions available, how many possibilities for study, careers, and community improvement there are within geography. Most of all, they got to experience what it feels like to be seen and appreciated at a large international conference. I believe and hope that this gave them a sense of belonging within AAG.

This balancing of scale—the ability to pay attention to the individual or a specific community within a larger group—is a perspective that defines the work of geography. Yet the very scale at which geographers sometimes view their

discipline can blur or erase the experiences and needs of students and faculty from historically excluded groups, whether by race, ethnicity, sovereign status as Native people, gender, sexuality, caregiver status, income, or disability. The Bridging the Digital Divide program (which I helped develop at AAG, based on my experience supporting Indigenous students) that led these 13 bright geographers to AAG's Denver meeting seeks to change the scale at which all geographers are viewed.

Bridging the Digital Divide was made possible through significant funding from AAG, the organization's members, and Esri. Its initial intent in 2020 was to meet MSI students' technology needs during the COVID-19 pandemic—funding laptops, internet service, software licenses, and enhancements to computer labs. Since then, the program has supported more than 20 MSIs, including 14 Historically Black Colleges and Universities (HBCUs) and 8 TCUs. But feedback from program participants indicated that historically overlooked students had many additional needs that must be addressed for them to thrive in school. The Bridging the Digital Divide committee took this into account when inviting the 13 MSI students to attend the Denver conference, considering their need for door-to-door transportation and childcare or elder care and providing all their meals and lodging during the meeting.

As a professor formerly at Tohono O'odham Community College, a tribal college in Arizona, and now at Arkansas State University, a research university where approximately one in five students is a member of a minoritized group, the

experience of designing resources and networking opportunities for marginalized students got me thinking about the scale of attention paid to their experiences and needs. To support students who inhabit invisible places, institutions, faculty members, and mentors must see past larger-scale approaches to student services and ask the students direct questions, such as "What are the barriers to your academic success, and how can we help with those?" and "What do you really need?" (Any organization, no matter its size or purpose, should also ask these questions of members of historically excluded groups.)

In the big picture of geography, too many marginalized geographers are invisible—particularly at the student level. Some of this is because of literal geographic or institutional scale. For example, many Indigenous students live in communities that are located far from research universities and offer few educational choices. In other cases, financial barriers and anxieties that stem from social pressures prevent students from even enrolling in college and, if they do start, make it difficult to continue. Students who are among the first people in their families to attend college may also be rendered functionally invisible when school-provided guidance and resources don't line up with their own lived experiences and needs. When some students leave their geography or GIS classes, for instance, they return home where there is no electricity or running water, much less Wi-Fi. These students often miss out on jobs and other opportunities and may struggle academically due to their circumstances.

What the geography discipline misses out on is how much each student has to offer. The experience at AAG's annual meeting this year reminded me of the extraordinary perspectives and ingenious problem-solving skills that these students possess—garnered not only within their own generation but also from the stories, understandings, and technical knowledge they have inherited from their families and tribes. The students who participated in the AAG meeting brought their perspectives, life experiences, and questions to sessions, workshops, and meetings with mentors and potential future employers. They took home big ideas, insight, and exposure to new tools that they can use to address the issues that most interest them.

To me, this is what geography is all about: generating positive change within a community. Geography and GIS offer powerful tools to use to understand demographics, identify trends, maintain and defend tribal sovereignty, manage

natural resources, and communicate traditional knowledge or place names to future generations. In ways that are very different but equally compelling, geospatial technologies can shed light on historic and current inequities in resource sharing, pollution, and a host of other community issues. Geographers and GIS practitioners owe it to these students and the communities they represent to put the tools of empowerment—geographic knowledge and GIS—into their hands. In my experience, enabling these students to collect, share, communicate with, and own their spatial data makes a huge difference in solving the issues that resource-limited, sovereign tribal communities face.

To do all this, geographers and those in geography-related disciplines need to radically reconfigure how they support their most financially and culturally vulnerable up-and-coming colleagues. This requires listening to students and scaling resources to the individual or collective needs of members of these communities. These young people's perspectives and ideas are worth hearing and encouraging!

And this is everyone's job. Whether you work at an MSI or other educational institution, a small startup, a large corporation, a local government, or a national agency, you are an important part of any ambitious change in this arena. No matter what your role is, there is something you can do. Simply bringing the scale of your own observations down to the more individual and community levels can yield great insight. So don't be afraid to get into the details. Gaining a complete understanding of any situation requires exploring patterns up close as well as from a distance. A strong map to a more just and equitable discipline will hold true across many scales.

Find out more about AAG's Bridging the Digital Divide program at links.esri.com/aag-digital-divide and consider donating to the cause at aag.org/bridging-the-digital-divide.

About the Author

Dr. Jason Post is an instructor of geography at Arkansas State University and a former GIS instructor at Tohono O'odham Community College, where he also advised and mentored students. As a volunteer member of AAG's Bridging the Digital Divide committee, Post helped shape this technical assistance program for students at MSIs and TCUs.

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

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Here's How to Take Immediate Climate Action

The themes of the 2023 Esri User Conference—*creating the world you want to see and bringing science to action*—continue to resonate.

It's been another year of bizarre extremes—of climate collapse, even—as human-caused climate change and a strong El Niño event have combined to create an atmosphere that's warmer now than it has been in the past 125,000 years.

In July, the global average daily temperature of the earth was higher than humans have ever recorded. Phoenix, Arizona, reached a temperature of at least 110 degrees Fahrenheit (43.3 degrees Celsius) for 31 straight days, shattering its previous record of 18 consecutive days, and with little in the way of nighttime cooling. China reportedly set a new heat record of 126 degrees Fahrenheit (52.2 degrees Celsius). The Persian Gulf International Airport in Iran reached a record-setting heat index (the combination of air temperature and dew point to estimate a "feels like" number) of 152 degrees Fahrenheit (66.7 degrees Celsius). Additionally, a superheated atmosphere has held onto an inordinate amount of moisture, causing record-breaking rains and flooding all over the world.

As my friend and colleague Dr. Katharine Hayhoe, chief scientist of The Nature Conservancy, often says, "Climate change is loading the weather dice against us." The more carbon we produce, the more the dice are loaded against us, and the worse conditions become—regardless of where we live. Everyone, everywhere is affected.

It continues to be clear that climate change is the most critical challenge of our time. It requires immediate and effective action, including cutting our carbon emissions as much as possible. But there is another effective action we can take: applying GIS, which is uniquely suited to address this singular challenge.

Now, anyone can learn how to take climate action with GIS, guided by rigorous science and sound workflows. And it comes at no cost!

How is this possible? Many of you, dear readers, will likely have guessed that I'm talking about a massive open online course (MOOC).

Esri has a rich catalog of very successful MOOCs delivered by Esri Academy (esri.com/mooc), and the newest offering is GIS for Climate Action (go.esri.com/climate-mooc). The course began on October 25, but there is still time to join and catch up! Registration for this first offering of the course closes on November 8 at 11:59 p.m. (PT). It will run again, however, in May and June 2024.

The Benefits of Taking a MOOC

MOOCs have become one of the fastest and most effective means of transferring knowledge and skills to those who would normally not have access to this information—especially given the costs of higher education. These courses also offer a very effective mode of learning that can easily complement or supplement traditional university learning.



Esri MOOCs are free of charge, come with free access to the software and authoritative data that learners need, and are taught by Esri's most skilled and communicative staff. Past students rate these courses highly for the ways in which they illustrate how to apply the geographic approach to create data-driven insight and help organizations, communities, and even individuals take effective action. Participants can work at their own pace, at any time of day or night, and Esri MOOCs typically require only about two to three hours of study per week. What's more, attendees can learn a lot from their peers all over the world via discussion threads and social networking, which can be quite fun!

Participants who finish all the coursework receive a certificate of completion that some colleges and universities may accept for continuing education credit or that may enable students to enhance their grade in an existing college course. MOOCs are also highly prized as professional development training for staff members in corporate or other organizational settings. This said, it is not mandatory to complete the MOOC; everyone can participate as much or as little as they are able to.

A Great Opportunity to Learn a Mix of Skills

Esri MOOCs introduce GIS concepts and skills such as visualizing data; using analytical tools to discern patterns and relationships; and sharing the results via maps, apps, and dashboards—all while learning about the latest advancements in ArcGIS technology. Thus, participants can use MOOCs as an important stepping stone on their journey toward gaining more extensive training.

GIS for Climate Action takes all this one step further by focusing exercises and discussions around the scientific principles of climate change. These include how to

define greenhouse gases and their causes and effects, how to best understand and advocate for net-zero emissions, how to distinguish the concept of mitigating climate change from the notions of adapting to and being resilient against it, and how to visualize climate change using various climate models.

The course also offers ample opportunities to simply talk about climate change. If you are worried about climate change and want to make a difference, taking climate action begins with the simple act of talking about it. Communicate how it affects the people and places you love and the issues you care most about, such as the implications of climate change on energy grids, food supplies, transportation, racial equity, and social justice. According to environmental journalist Sara Peach, "Talk" is the fertile field in which cultural change begins; in its absence, it's impossible for a group of people to solve a problem."

Gaining Exposure to Key Concepts, Approaches, and Organizations

Crucial questions that will be asked and discussed in the GIS for Climate Action MOOC include the following:

- How can you solve climate change-induced problems using GIS?
- How can web apps help you recognize climate change indicators?
- How does GIS actually track a carbon footprint—even the digital carbon footprint left every time you access a particular website?
- What are the ways that GIS tools best support greenhouse gas mitigation efforts, and how do you implement these tools yourself?
- How can you use ArcGIS Instant Apps or ArcGIS Dashboards to create apps



and dashboards that help identify the impact of climate hazards over time, including within the areas that you live and work?

- How do you assess vulnerability and risk using GIS, and how do you take that even further by creating and implementing a climate change adaptation plan?
- What does it really mean to take action in your own community through various service and education efforts?

GIS for Climate Action also incorporates many of the approaches employed in the United States federal government's US Climate Resilience Toolkit (toolkit.climate.gov) and its real-time Climate Mapping for Resilience and Adaptation (CMRA) geospatial portal (resilience.climate.gov). In addition to the main lessons, participants

will be exposed to amazing supplemental resources from other organizations that Esri partners with, such as Project Drawdown, The Nature Conservancy, the University of Redlands, and various state and local government agencies.

The new course has been a labor of love by an amazing team of colleagues at Esri, including coleader of Esri's climate community of practice Steve Kopp, Esri Disaster Response Program operations manager Jeff Baranyi, Esri commercial technology consulting team lead Jessica Bello, and Esri chief medical officer Este Geraghty.

Please join us on the path toward generating positive climate action and find out how to use the geographic approach to create the world you want to see. Register now at go.esri.com/climate-mooc. You have until November 8 at 11:59 p.m. (PT) to do so.

I'll see you in class!



Esri's Current Lineup of MOOCs

The grid displays six course cards:

- Spatial Data Science: The New Frontier in Analytics** (MOOC, Course opens Aug 30, 2023, 6 Weeks, Free, 1206995)
- Imagery in Action** (MOOC, Course opens Sep 20, 2023, 6 Weeks, Free, 185000)
- GIS for Climate Action** (MOOC, Course opens Oct 25, 2023, 6 Weeks, Free, 101)
- Going Places with Spatial Analysis** (MOOC, Course opens Jan 24, 2024, 6 Weeks, Free, 140700)
- Transform AEC Projects with GIS and BIM** (MOOC, Course opens Feb 14, 2024, 4 Weeks, Free, 150537)
- Cartography** (MOOC, Course opens Apr 3, 2024, 6 Weeks, Free, 139010)



← Esri's massive open online courses (MOOCs) average thousands to tens of thousands of enrollees each time they are given.

About the Author

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

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Two EOS Arrow GNSS receivers are shown in the foreground, one yellow and one green, displaying a map interface. A worker in a white hard hat and orange safety vest is shown in the background, looking at a tablet device. The background is a futuristic, glowing blue and red digital landscape.

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URISA Takes Action to Support Climate Resilience

By Laurie Williams, County of Marin, California

This summer, communities around the globe experienced extreme heat, floods, and fires precipitated by human-caused climate change. It is difficult to deny that in what some people are calling the Age of the Anthropocene, human activity has begun to significantly affect the earth's climate and ecosystems.

In opening the Plenary Session at the 2023 Esri User Conference, Esri president Jack Dangermond asked the audience to think about what kind of world they want to see. Dangermond believes that it is still possible to create a sustainable future—thanks, in part, to GIS professionals, who have a collective responsibility to imagine and create geospatial solutions. But GIS practitioners need to act now, he said.

At the Urban and Regional Information Systems Association (URISA), we couldn't agree more. As the premier international organization that supports GIS professionals, URISA is energized to take action and support members of geospatial professions in addressing climate change and its impacts.

Recognizing the issues that the world faces and understanding the role that URISA can and should play in solving problems related to climate change, URISA formed a community resilience task force in 2019 to address several questions:

- What current impediments exist for collecting and disseminating data?
- What best practices could be implemented that address these issues?
- What mechanisms exist or can be developed to increase awareness and collaboration between resilience researchers and GIS practitioners?
- What partnerships can be developed to better enable community resilience?

By 2020, the task force had evolved into an active committee within URISA. Now it is known as the Climate and Community Resilience Committee (CCRC). URISA then created the Climate Change & Climate Equity Working Group (CCCEWG) to work within the committee to help empower communities that are experiencing the impacts of climate change with geospatial methods and data. This work supports advocacy and policy change with a focus on the social, cultural, and ecological aspects of climate justice and equity. The working group's endeavors are based on the United Nations' Sustainable Development Goal 13: taking urgent action to combat climate change and its impacts.

To further its mission, the CCCEWG has developed several products and other offerings for GIS practitioners to use to engage in climate change-related geospatial data gathering and sharing, collaboration, and education.

A Hub Site with a Resource Library

The CCCEWG's main product is a site built with ArcGIS Hub that operates as a central location for geospatial tools, case studies, and other resources for people working on GIS-related climate change projects. The site developers' goals are to highlight resources and tools that are currently available and make the site a living repository on the URISA website. Available at links.esri.com/urisa-climate, the site sorts its resources by category, including carbon, equity, energy, heat, and floods.

Members of the CCCEWG are actively looking for resource submissions. Anyone who would like to share links to tools and case studies with this library should enter them into the ArcGIS Survey123 form on the CCCEWG website at links.esri.com/urisa-resources. The form also collects information from people who want to join the working group.

Climate Change-Focused Workshops

The working group has been active in developing climate change workshops for URISA's annual GIS-Pro conference. For the 2021 gathering in Baltimore, Maryland, the CCCEWG delivered a half-day workshop called Net Positive! Giving Back to Baltimore through Climate Action Planning. The goal of the interactive workshop was to help attendees make meaningful contributions to the City of Baltimore's Climate Action Plan by defining data gaps; investigating how climate affects Baltimore's residents—especially as this relates to equity and climate justice, cultures, and geographic areas; and exploring possible climate mitigation and adaptation strategies.

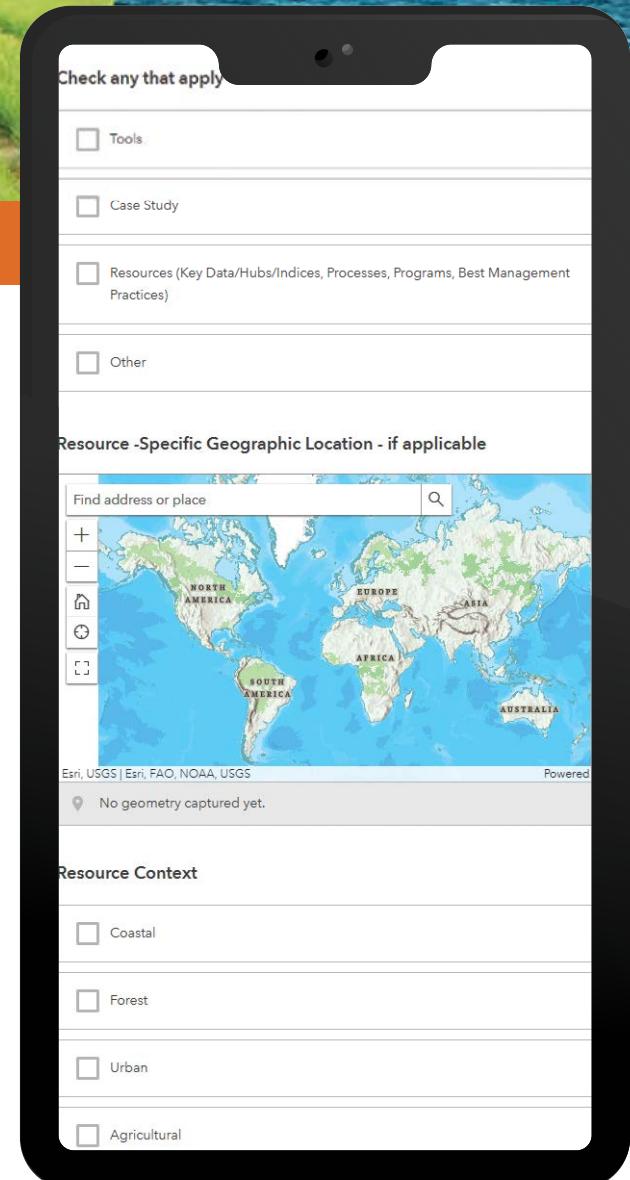
At the 2022 GIS-Pro conference in Boise, Idaho, the CCCEWG presented a workshop titled Taking Climate Action and Achieving a Carbon Neutral Future. Breece Robertson, former impact officer for the nonprofit organization One Tree Planted, and Teresa Townsend, past president of URISA, discussed nature-based solutions for supporting climate action at local, regional, national, and global scales. Workshop participants learned that protecting or restoring ecosystems and creating parks and open spaces that advance health and climate resilience could provide one-third of the mitigation benefits needed to meet carbon reduction goals. GIS professionals have a tremendous opportunity to contribute by identifying where these solutions would have the biggest effects and tracking and verifying those impacts into the future.

Organizational Adaptation Within URISA

CCCEWG volunteers are also working close to home by encouraging URISA and its members to take steps to benefit the planet.

Understanding that part of URISA's mission is to promote conferences and that people must travel to these gatherings, which affects carbon emissions and the climate, the CCCEWG has gathered tips for how attendees can reduce their travel footprint. The working group messaged this advice through social media channels and on the URISA and CCCEWG websites ahead of the 2023 Esri User Conference, and the group will continue to promote greener travel to all URISA events.

To celebrate URISA's 60th anniversary in 2022, the organization planted 1,014 trees during the GIS-Pro conference in Boise.



↑ Anyone with tools or case studies to share can enter their details in an ArcGIS Survey123 form.

The trees were donated by attendees and others in partnership with One Tree Planted. Members of the CCCEWG continue to look for opportunities for participants in future conferences to help offset their travel during the registration process.

In addition, the CCCEWG is currently preparing a call to action to be adopted by URISA's board of directors to formalize having the group join and support organizations that are endeavoring to create a sustainable and resilient future. For example, the CCCEWG seeks to support the United Nations Global Compact, which provides a framework for businesses around the world to conduct their work sustainably.

Seeking Volunteers

URISA, the CCRC, and the CCCEWG are always looking for more volunteers to help with climate action committees and working groups. Anyone who would like to join these efforts should enter their contact information at links.esri.com/urisa-contact.

About the Author

Laurie Williams, GISP, leads GIS efforts for the Marin County Flood Control District and Marin County, California's public works department. She enjoys working on interdisciplinary teams and finding solutions for a wide variety of issues, including climate change, watershed management, land use, and habitat preservation.

Managing GIS

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



Startup's GIS-Based Solution Enriches Infrastructure Planning

Planning and siting new linear infrastructure—such as power lines, roads, railroad tracks, and pipelines—is a complex process. Searching for suitable routes and optimal locations for new projects can be challenging, requiring relevant technical, regulatory, and environmental knowledge as well as coordination among many stakeholders.

Arcadis Germany, a globally recognized engineering company with a focus on innovation and sustainability, is seeking to revolutionize the way linear infrastructure projects are planned, designed, and executed. The company's digital solutions team is leading the digital transformation of environmental project planning by providing expertise in GIS and spatial data management to projects that range from updating railways and transportation systems to modernizing power grid networks.

To address the needs of engineering companies like Arcadis Germany, Esri startup partner Gilytics (gilytics.com) has developed Pathfinder, a multiuser, cloud-based decision-making platform that is rooted in GIS. Pathfinder optimizes infrastructure design, planning, and routing—and emphasizes sustainable grid development—with awareness of multiple spatial and nonspatial parameters. This increases stakeholder engagement and, ultimately, transparency.

Simplifying a Long Process

Conducting effective infrastructure planning requires staff at Arcadis Germany to collect and review all the relevant data that informs planners of a project's area restrictions.

Before implementing Pathfinder, the digital solutions team at Arcadis Germany used GIS to manually review planning rules to ensure that people and environments are protected. This entails verifying that infrastructure is built at safe distances from urban areas and residential buildings and that environmentally sensitive areas are preserved. Additionally, to assess the suitability of a particular plot of land or route, planners must consider technical and cost constraints.

Thus, spatial planning for infrastructure projects is a long process that requires multiple revisions based on feedback from a variety of stakeholders. Evaluating and comparing project results and visualizing alternatives requires advanced GIS capabilities and tools that, in the end, simplify the assessment process.

Arcadis Germany was given the opportunity to test and use Pathfinder during one of its large-scale transmission line projects in Germany. The digital solutions team was impressed.

"The software is intuitive and offers great advantages in corridor identification and routing, especially if you work with multiple [types of] geodata," said Frank Dünkel, head of digital solutions at Arcadis Germany.

Combining Routing and Siting Algorithms with Advanced GIS

Pathfinder is available as an ArcGIS Pro add-in. This enables GIS users like Arcadis Germany's digital solutions team to employ Pathfinder's routing and siting optimization algorithms while using ArcGIS Pro and its advanced analytical capabilities. This

means team members don't have to spend time building large or complex models.

The add-in allows users to easily create and test project scenarios. For Arcadis Germany, for example, this allowed team members to plan the connection of large offshore wind farms in northern Germany with the country's industrial centers in the south. The team used ArcGIS Pro's data management tools to import and prepare GIS data for the project. Once the data was ready, the team accessed the Pathfinder add-in's scenario planning capabilities. Team members were able to use buffers to incorporate

The Esri Startup program gives emerging businesses an edge by helping them integrate spatial functionality into their products and services. Learn more about the program at developers.arcgis.com/startups.

project requirements, like ensuring that specific environmental areas and social elements are protected. Team members also assigned suitability costs to each area to either allow proposed routes to cross sensitive areas or block them from doing so. And customized multicriteria decision analysis and routing algorithms allowed the team to adjust planning rules and minimize costs.

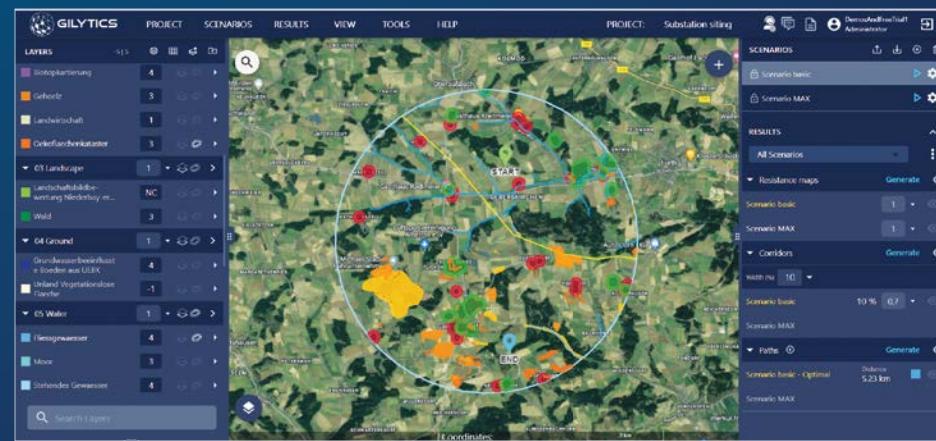
Being able to automate the planning process and generate results using the Pathfinder add-in enables those involved in a project to make target-oriented decisions. In addition, projects are automatically copied in Pathfinder's cloud environment, which makes it easy to visualize the results in both 2D and 3D and communicate interactively with stakeholders.

"Gilytics' Pathfinder definitely speeds up planning processes [by] several weeks [and] up to months, depending on the existing know-how and the project requirements," said Dünkel. "In particular, for users who do not program themselves, the software represents an enormous benefit, as the no-code environment is easy to handle. So Gilytics' Pathfinder provides almost every team member with a possibility to calculate corridors as an estimate for optimal routing in planning phases. Results can be visualized, documented, and easily exported. This way, team capacities can be distributed much more flexibly, and a lot of time can be saved."

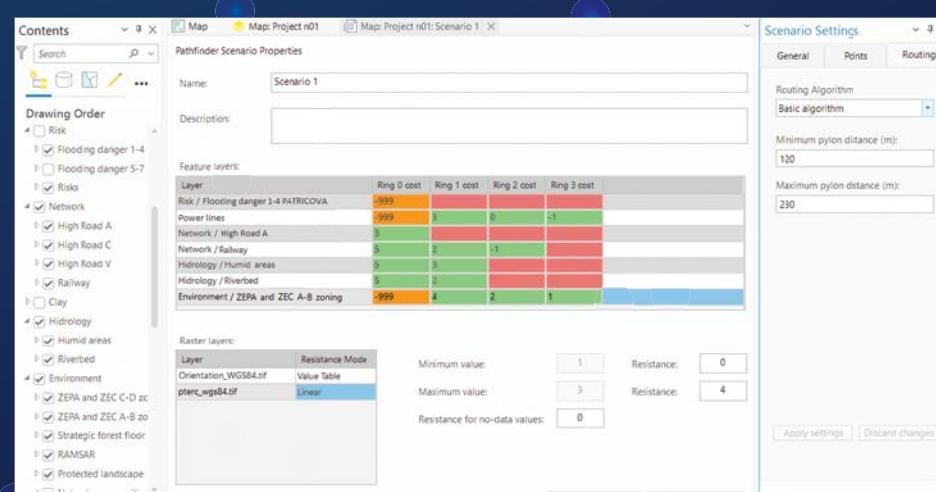
Fostering a Participatory Feedback Loop

By helping users collect and share feedback and quickly create interactive alternative designs, Pathfinder is enabling companies like Arcadis Germany to streamline the infrastructure design process, improve project visualization with 3D imagery, and increase transparency. What's more, the integration of Pathfinder with ArcGIS Pro allows planners and engineers who are experts in different fields—from environmental analysis and technical constraints to cost assessments—to run their simulations, share them with colleagues and other stakeholders, and develop a more participatory feedback loop.

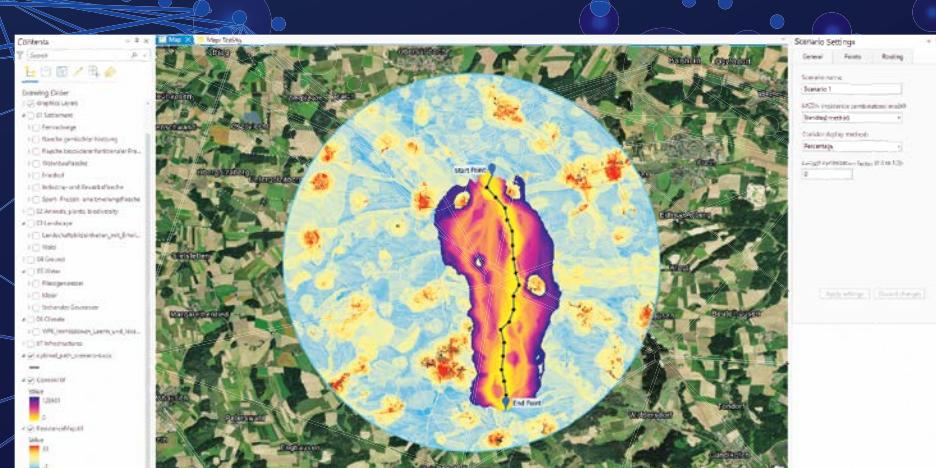
Pathfinder can be downloaded from ArcGIS Marketplace. For inquiries about trial opportunities, licensing options, and other ways that Gilytics can empower engineering and planning teams, email Elena Rodriguez Tormo, client relationship and project manager at Gilytics, at elena.rodriguez@gilytics.com. For more information about Arcadis Germany, email Frank Dünkel, the company's head of digital solutions, at frank.duenkel@arcadis.com.



↑ Pathfinder is a cloud-based, collaborative, GIS-based platform that helps streamline the infrastructure design process.



↑ With Pathfinder, an ArcGIS Pro add-in, planners can easily apply constraints to a project.



↑ Pathfinder enables users to create and test project scenarios when planning new routes.

Esri Partners Support Customers through Crucial Transitions

When organizations need to improve operations, update planning procedures, and streamline data management, Esri partners can help. See how four partners aided two utilities, a roadwork planning commission, and a county government in updating their GIS implementations so they could remain agile while continuing to grow.



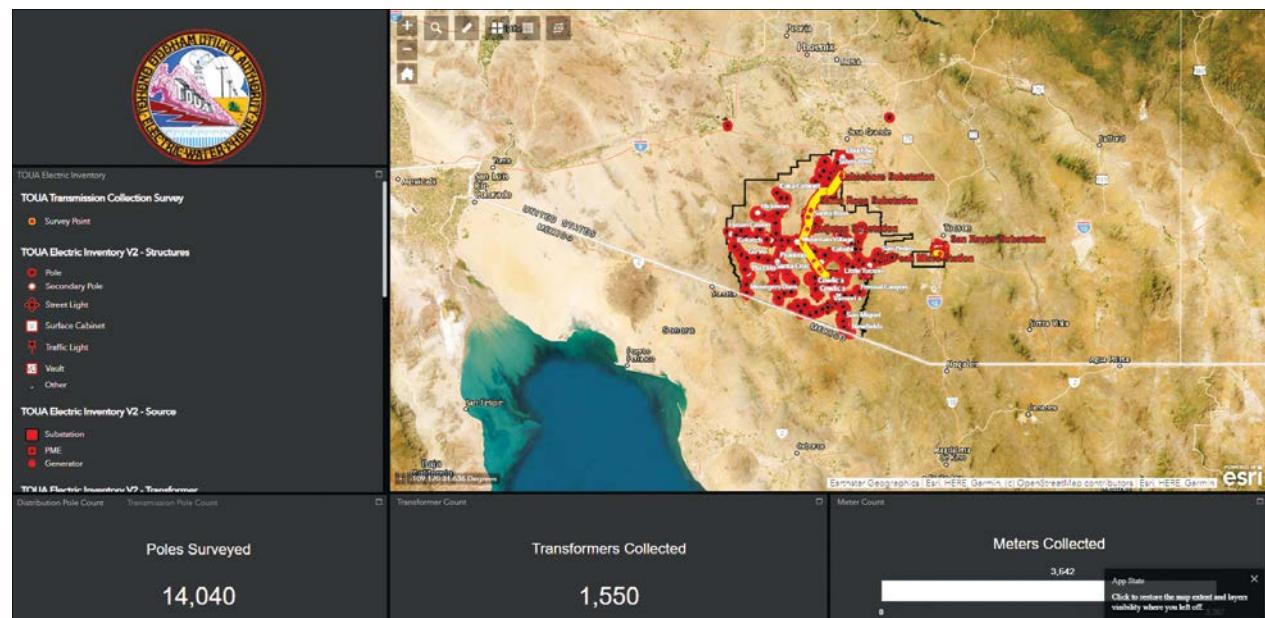
Modernizing a Rural Utility

The Tohono O'odham Utility Authority (TOUA) in southern Arizona operates a full network of utilities including electric, water, and telecommunications. For years, staff at TOUA struggled to maintain existing plant records and develop systems to aid with operating the authority's networks and dispatching field crews. They relied largely on paper maps and handheld GPS devices that weren't set up to collect important attribute information about TOUA's assets in the field.

Seeking to accurately map assets and expand the authority's broadband network by deploying fiber optics to the villages within the Tohono O'odham Nation, a Native American reservation, TOUA partnered with [Palmetto Engineering and Consulting](#) (palmettoeng.com) for engineering and GIS services. After conducting a full data review, the team at Palmetto determined that TOUA needed to do a complete inventory of its field assets.

Using high-accuracy GNSS devices, ArcGIS Online, ArcGIS Pro, and ArcGIS Field Maps, the Palmetto team worked with field personnel at TOUA to inventory the utility's existing infrastructure and conduct broadband field design. The resultant map showed TOUA's current field assets, as well as what would be added in the future. Working with Palmetto to collect field data and apply GIS practices in the real world enabled team members at TOUA to understand their GIS as it was being created and take ownership of their workflows so they could be more self-sufficient. Palmetto also provides ongoing training to help the TOUA team evolve its records system as Esri technology advances.

The partnered collaboration options in ArcGIS Online have allowed Palmetto to provide ongoing engineering services and assist



↑ The Tohono O'odham Utility Authority's (TOUA) Network Operations Center helps staff members monitor assets and deploy field crews to assess and repair damaged infrastructure.

TOUA in procuring grant funding. They also enable Palmetto to aid TOUA in conducting broadband data collection reporting for the Federal Communications Commission, a requirement for the utility to continue expanding broadband into the underserved communities of the Tohono O'odham Nation.

As TOUA's broadband network buildout proceeds, the partnership between the authority and Palmetto remains fruitful. The GIS that's in place today allows TOUA to assess damages in a timely

manner and restore services to customers within the reservation when needed. Additionally, the ongoing GIS training and engineering services that Palmetto provides to staff at TOUA help employees in the authority's Network Operations Center monitor and operate the various services it provides to the reservation.

The teams at Palmetto and TOUA continue to develop new solutions and training to support the authority's operations and help build a brighter future throughout the Tohono O'odham Nation.

Matching a Customer's Needs

The Scottish Road Works Commissioner (SRWC) aims to improve the planning, coordination, and quality of roadwork performed throughout Scotland. When road authorities and utility

companies need to coordinate and plan a project, they enter the details in the Scottish Road Works Register (SRWR).

Since 2006, Esri UK partner [Symology](#) (aurora.symology.com) has provided the SRWR to the SRWC as a hosted solution. The solution was integrated with GIS using ArcGIS Engine as the

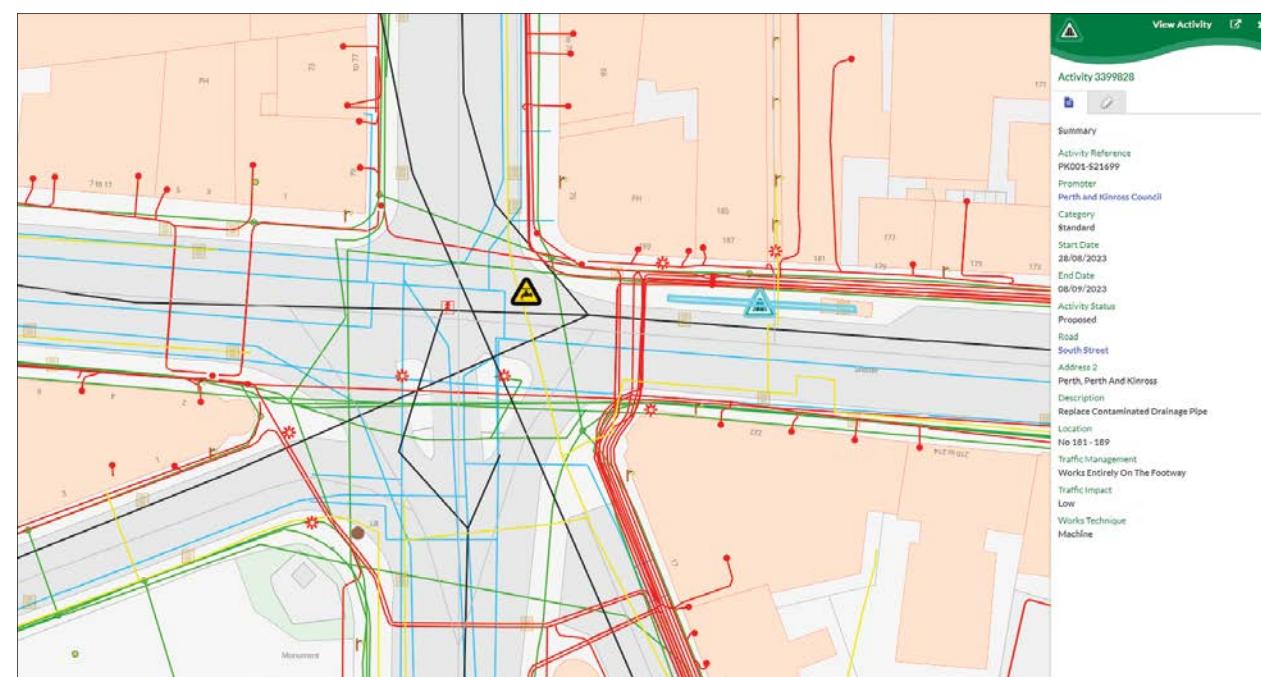
underlying mapping platform. While this version of the SRWR was robust and feature rich, the SRWC eventually required a more modern, platform-independent user interface.

For several years, Symology had been working on creating a new platform for its products and services called Aurora. It is a browser-based solution that's hosted in the cloud using ArcGIS Enterprise running on Microsoft Azure. Aurora is accessible from any device, and its background mapping is served out from ArcGIS Online.

The new solution matched SRWC's needs, and in July 2020, the organization agreed to be the first customer to implement the new platform. Aurora's flexibility immediately proved invaluable for SRWC, as members of the SRWC community adapted their working practices during the COVID-19 pandemic. The solution enabled more than 3,000 users to work remotely from any web browser.

In addition to implementing Aurora's main, browser-based user interface, the team at Symology provided mobile apps for Android and iOS using ArcGIS Maps SDKs for Native Apps. This enables users to record inspections, document when roadwork projects begin and end, and view maps of underground equipment—all out in the field. More than 60 percent of roadwork inspections in Scotland are now recorded using mobile devices, increasing the accuracy and timeliness of data in the SRWR.

Since Aurora went live in Scotland, over 50 additional companies, agencies, and local highway authorities across England and Wales have also implemented the platform.



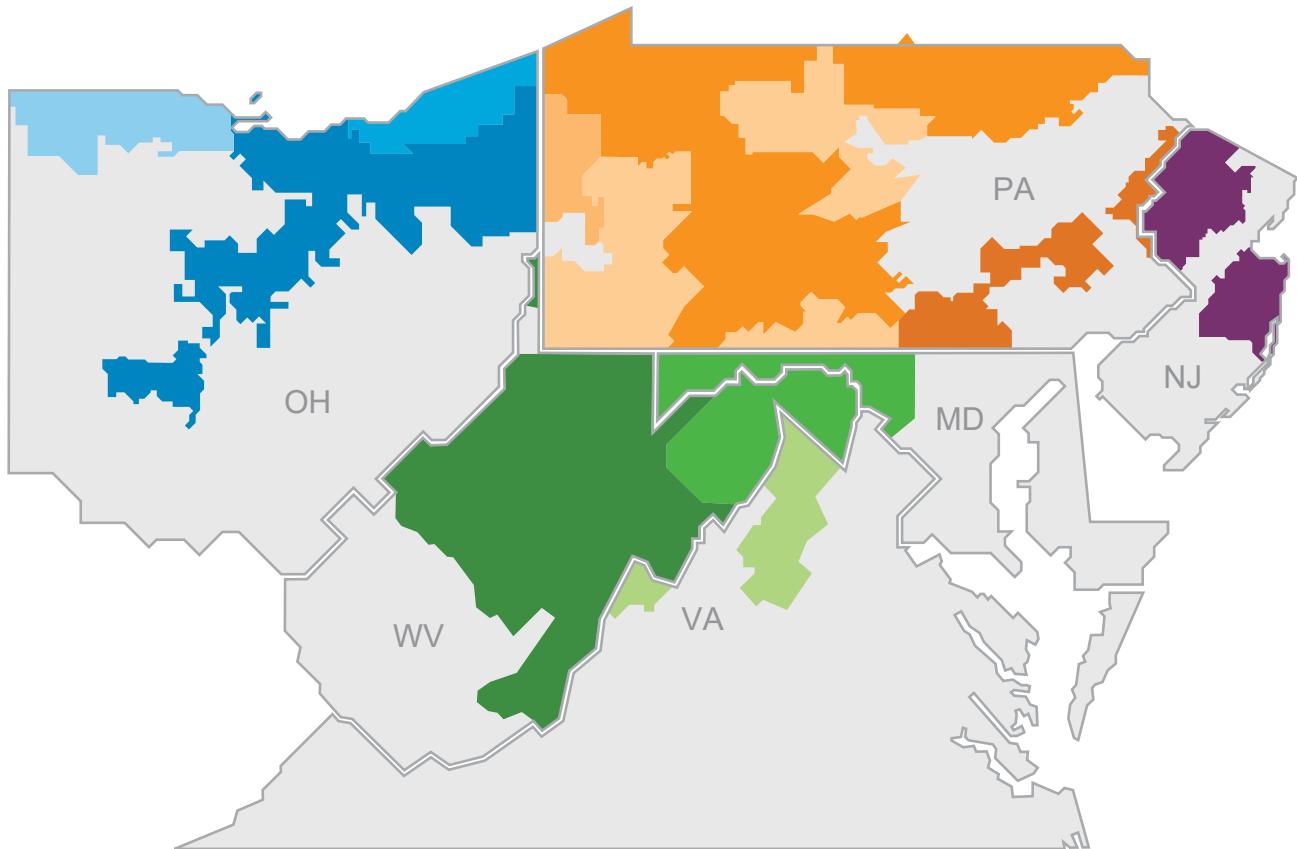
↑ With Aurora, users can record inspections, note when roadwork projects start and stop, and view maps of underground equipment.

Improving Operational Efficiency

FirstEnergy is one of the largest investor-owned electric systems in the United States, with 10 regulated distribution companies that serve 6 million customers via more than 269,000 miles of electric power distribution lines. As part of an effort to modernize its grid, FirstEnergy recently deployed ArcGIS Utility Network to over 650 end users across all 10 of its operating companies. This makes it one of the largest Utility Network implementations in the United States in terms of the number of users and the number of assets managed by the system.

FirstEnergy implemented Utility Network as part of a larger effort to update and improve its operational technology. The company had a heavily customized legacy mapping system that had exceeded its useful life span. The system was no longer supported by the vendor and lacked the capabilities needed to address modern utility changes. FirstEnergy wanted a solution that would enable it to perform advanced network analytics and supply detailed asset information to Oracle's Advanced Distribution Management System (ADMS). After evaluating several options, Utility Network stood out as the solution with the best performance, most advanced capabilities, and strongest prospects for future development.

SSP Innovations (sspinnovations.com) led the 150-person project team—consisting of staff from FirstEnergy, Esri, and RAMTeCH (another Esri partner)—that carried out the implementation. The team optimized business operations; developed a network model for 2,200 substations and 8,500 circuits; migrated data from FirstEnergy's legacy GIS; integrated FirstEnergy's ADMS implementation; and conducted more than 18,000 hours of user training. The team also implemented SSP Productivity, a focused suite of tools that help GIS editors edit data, perform network planning and analysis, and manage work more quickly within Utility Network.



▲ FirstEnergy has 10 regulated energy distribution companies, which serve 6 million customers across several US states.

With FirstEnergy's new system, employees across the utility can share data and collaborate in real time, completing business processes faster and with better insight. Advanced network modeling, data visualization, and analytics are driving improvements in operational efficiency and situational awareness. Moreover, because FirstEnergy made a healthy investment in

change management strategies during the project, user enthusiasm for and adoption of the new system were excellent. The project was completed without making any customizations to the core Utility Network product and with minimal adjustments to FirstEnergy's budget and schedule.

Streamlining Coordination and Collaboration

Waukesha County, Wisconsin, and its 37 municipalities have been building and maintaining a parcel dataset since the early 1990s. Data updates and upkeep fall primarily under the county's purview.

It was arduous for the county to manage and publish parcel data from multiple entities that have distinct data structures, formats, and naming conventions. This often led to inconsistencies in integrating and maintaining the parcel data. Due to the decentralized

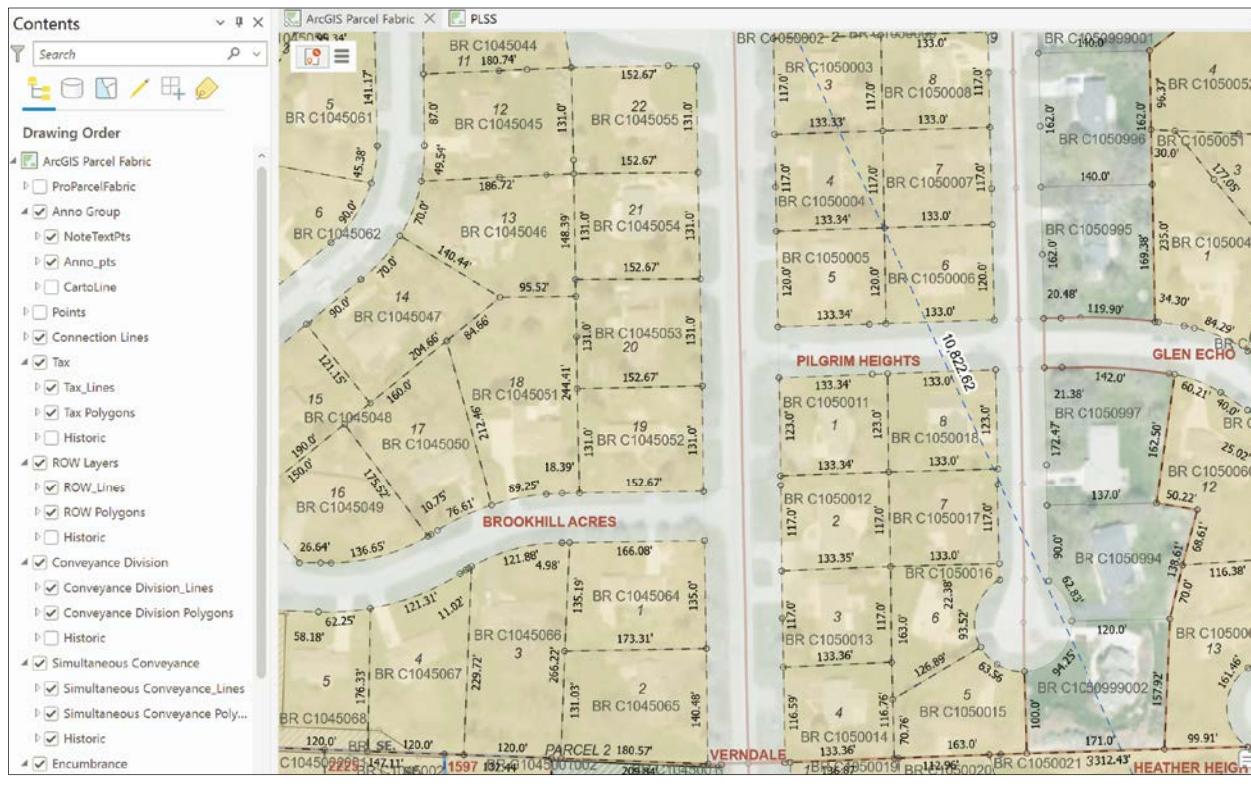
nature of parcel data management, sharing and collaboration among different entities was complex and time-consuming—and the lack of standardized processes made it challenging to publish and exchange data efficiently or ensure data accuracy and integrity. What's more, three cities—Brookfield, New Berlin, and Waukesha—opted to do their own parcel mapping. This caused the periodic publication of the county's data to be plagued with

edge matching and conflation issues and made it difficult for the county to coordinate and foster consistent workflows.

With ArcMap being retired in 2026, staff at Waukesha County recognized that they needed to migrate to a more modern system with greater flexibility and built-in efficiencies. So the county sought assistance from land records specialist **Panda Consulting** (pandaconsulting.com), the first Esri partner to receive the Parcel Management Specialty designation. In addition to helping the county move to ArcGIS Pro and start using ArcGIS Parcel Fabric, Panda assisted with optimizing its parcel data management workflows, identifying areas for improvement, implementing streamlined processes and workflows, and training county staff members so they had the necessary skills to manage parcel data effectively.

These changes ensured greater data accuracy, consistency, and quality; improved collaboration; streamlined workflows; and made staff at both the city and county levels more efficient in maintaining parcel data. Additionally, having all the data stored in ArcGIS Parcel Fabric—the only source for staff members to use to create related web maps and apps—eliminated the need to aggregate the data for publication and sharing purposes.

◀ Waukesha County now uses ArcGIS Parcel Fabric to manage and update parcel data.



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

The Relevance of Cartography

A Cartographer's Perspective

By Tim Trainor

President, International Cartographic Association



A Gathering of Cartographers and GIScientists That Looks Toward the Future

Cartographers, geographic information scientists (GIScientists), heads of national mapping agencies, representatives from various institutions and businesses, mapping practitioners, and map enthusiasts converged on Cape Town, South Africa, in August for the 31st International Cartographic Conference (ICC). In all, 845 participants from 78 countries shared a venue for three integrated events: the ICC, a three-day meeting of the United Nations Committee of Experts on Global Geospatial Information Management in Africa (UN-GGIM: Africa), and two workshops sponsored by the SDG Data Alliance.

This was the second time that the International Cartographic Association (ICA) convened its biennial conference in Africa. In 2003, the 21st ICC took place in Durban, South Africa, and four African countries participated. This year, 33 African nations were on-site to engage with colleagues from around the world.

While the ICC was underway, the UN-GGIM: Africa hosted leaders and their teams from across the continent to discuss how to advance their national and regional geospatial and cartographic activities. Representatives to this meeting were also included in the ICC program, where they attended various events and engaged in the conference's extensive program.

The SDG Data Alliance workshops brought additional colleagues to Cape Town. The first workshop focused on African countries' experiences in developing Country-level Action Plans (CAPs). These are guides for how to implement an Integrated Geospatial Information Framework (IGIF) that offers a holistic approach to developing a National Spatial Data Infrastructure (NSDI).

The second workshop centered on using technology and data to advance the UN's Sustainable Development Goals (SDGs). This effort starts by taking the results from a country's CAP and—using Esri's Sustainable Development Goals solution along with each country's geospatial, statistical, and other data—beginning to address the current circumstances in that country. To work toward achieving the SDGs, national governments can gather geospatial information as part of their CAP, which, in turn, reveals areas where action can be taken on specific SDGs. Using Esri's solution-based approach rather than having each country build its own custom technology allows governments to use GIS and mapping to more easily address their specific circumstances and advance their own interests.

Many countries are working to better understand their circumstances via the 17 SDGs, but in too many cases, the data that's available represents the entire country. This is only useful when making country-to-country comparisons. Disaggregated data, along with the geospatial

information needed to disaggregate data (such as lower-level geographic area boundaries) currently need attention.

The role of a cartographer is to make maps that enlighten the public and inspire leaders to make decisions that improve the lives of their constituents. When data is missing, a cartographer can map the gaps to draw attention to areas within a country—or even to specific types of data—that need to inform planning and decision-making. This is the kind of engagement that occurs when representatives from different institutions converge in one place to share their experiences and plan for what's next.

Bringing organizations together is important for very simple reasons. There is strength in numbers. Where there is a common cause and excitement about what is possible, good things happen.

Cartography and geographic information science (GIScience) can contribute to that excitement. Maps stimulate people's imagination. But to do that, maps must—and do—change with the times. Cartography and GIScience are like chameleons adjusting to their environment: they align with, and sometimes lead, the technological advancements that open new avenues for cartographic practice and developments in GIScience.

The ICC in Cape Town certainly had all the elements needed to stimulate attendees' imagination. Participants got to experience global experts' keynote speeches on topics that ranged from how to use maps to make just climate transitions to how economic geography can drive sustainable development. Attendees got to see the inspiring presentations that cartographers and GIScientists gave about their work and browse the cartographic products from individuals, organizations, and national mapping agencies that were on display in the International Map Exhibition. Attendees also saw competition-winning cartography from

children all over the world and experienced technical exhibitions put together by various organizations and companies.

Presentations from this year's ICC proceedings and publications spanned a variety of topics. Examples included conducting analysis and mapping for the SDGs, marine cartography, using cartography and GIScience to address climate change, the future of the geospatial ecosystem, open data, education and training, cognitive issues in geographic information visualization, how to make maps and graphics for people who are blind or have other vision impairments, user experience, location-based services, and employing cartography for early warning and crisis management. The papers and abstracts featured at the 31st ICC are available in the following publications:

- *Advances in Cartography and GIScience* at links.esri.com/ica-advances
- *Proceedings of the ICA* at links.esri.com/ica-proceedings
- *Abstracts of the ICA* at links.esri.com/ica-abstracts

Select papers are also published in the *International Journal of Cartography*, available at tandfonline.com/journals/tica20.

In addition to exploring all the offerings at the conference, participants were able to take part in technical tours in and around Cape Town that gave them a glimpse into local projects that focus on biodiversity and conservation; agriculture, land reform, and rural development; and marine and coastal operations in the Indian Ocean and throughout southern Africa. These attendees also got to see a 3D city model of Cape Town, how the South African Navy Hydrographic Office functions, and the technologies and analyses that emergency policing and incident control personnel use for their operations.

As the wonderful experiences from Cape Town become fond memories, I am already looking forward to the next international gatherings for cartographers. In 2025, the ICA will meet in Vancouver, Canada, for the 32nd ICC. The ICA's General Assembly (GA) also met in Cape Town to ensure a healthy ICA and vote on the location for the next GA meeting in 2027. It is important for the ICA to be global in its vision, and the locations of the ICC and GA need to reflect that. The delegates voted to have the 2027 ICC and GA meet in the Middle East for the first time—in Tel Aviv, Israel—where delegates, cartographers, scientists, and representatives from national mapping organizations will again seek to advance the field of cartography.

One other responsibility of the GA is to elect the next ICA Executive Committee. Georg Gartner, professor of cartography at the Vienna University of Technology in Austria, will return as ICA president as I move into a past president role. I look forward to reading his forthcoming columns in *ArcNews* over the next four years.

↑ Young cartographers received scholarships to attend the International Cartographic Conference (ICC) in Cape Town, South Africa.

← Attendees of the 31st ICC browsed the cartographic products that were on display in the International Map Exhibition.

About the Author

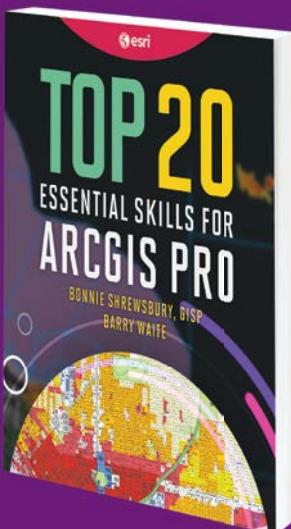
Tim Trainor is a part-time consultant to the UN and is the former chief geospatial scientist for the US Census Bureau. He is a member of the US Federal Geographic Data Committee's National Geospatial Advisory Committee, has served as cochair for the UN Committee of Experts on Global Geospatial Information Management, and was the senior agency official for geospatial information for the US Department of Commerce.



Top 20 Essential Skills for ArcGIS Pro

By Bonnie Shrewsbury and Barry Waite

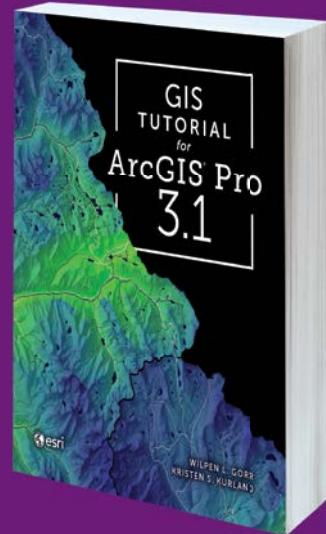
Get on the fast track to using desktop GIS with *Top 20 Essential Skills for ArcGIS Pro*. The book, written at an introductory level, features simple, step-by-step exercises that teach readers how to work with spatial data, create maps, and perform basic analysis. Each chapter introduces a skill, lets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



GIS Tutorial for ArcGIS Pro 3.1

By Dr. Wilpen L. Gorr and Kristen S. Kurland

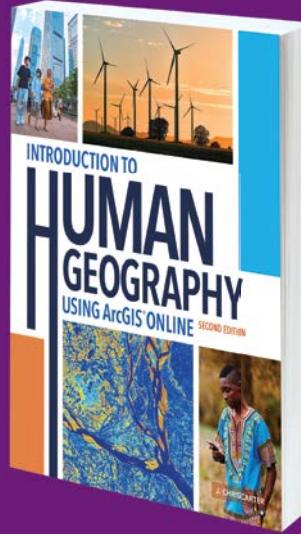
GIS Tutorial for ArcGIS Pro 3.1—the fifth edition in a series—is the book of choice for classroom-based and self-taught learners who seek to develop their expertise with Esri's premier desktop GIS technology. Revised for ArcGIS Pro 3.1, the book features new datasets, exercises, and instructional text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



Introduction to Human Geography Using ArcGIS Online, Second Edition

By Dr. J. Chris Carter

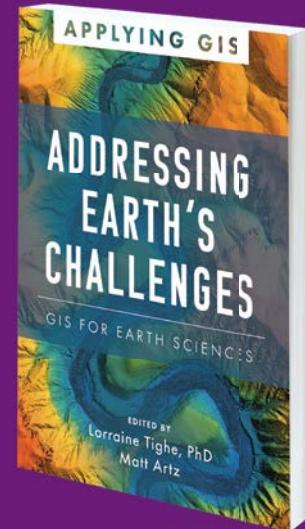
Introduction to Human Geography Using ArcGIS Online, Second Edition, brings the essential concepts and theories of human geography to life by integrating web maps into the subject matter. Dr. J. Chris Carter explains topics such as migration, race and ethnicity, food and agriculture, manufacturing and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



Addressing Earth's Challenges: GIS for Earth Sciences

Edited by Dr. Lorraine Tighe and Matt Artz

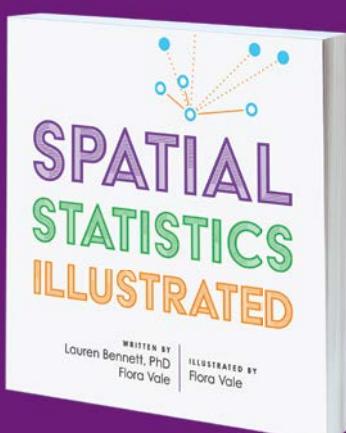
In *Addressing Earth's Challenges: GIS for Earth Sciences*, find out how organizations that work in geoscience, sustainable energy, environmental monitoring, climate science, meteorology, and marine science use GIS to streamline workflows, make decisions, boost operational efficiency, and foster civic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



Spatial Statistics Illustrated

By Dr. Lauren Bennett and Flora Vale, illustrated by Flora Vale

Thanks to the vast amounts of data and incredible computational power that are now at people's fingertips, data science has permeated nearly every aspect of life. But with so many algorithms and buzzwords floating around, it can be difficult to figure out where to start with solving complex problems. The good news is, there has never been a more exciting time to learn about spatial statistics, which employs geography to help quantify patterns, trends, and relationships. *Spatial Statistics Illustrated* helps readers learn the concepts behind the spatial statistics tools that are part of the ArcGIS system. Dr. Lauren Bennett and Flora Vale rely on approachable explanations and simple drawings to explain widely used spatial statistics methods, including how they work and when to employ them. June/September 2023, 176 pp. Ebook ISBN: 9781589485716 and paperback ISBN: 9781589485709.

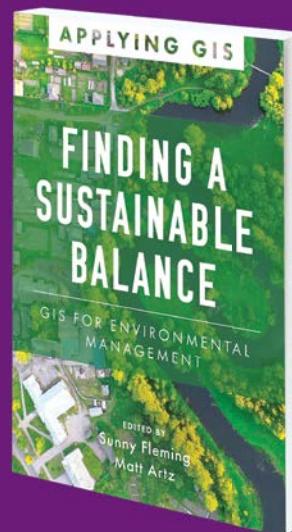


Finding a Sustainable Balance:

GIS for Environmental Management

Edited by Sunny Fleming and Matt Artz

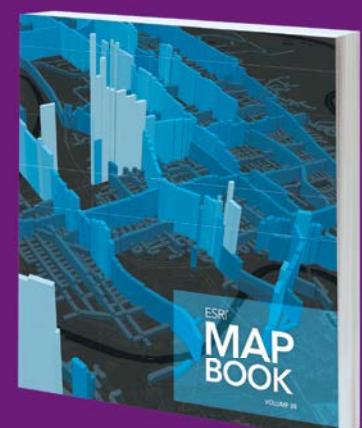
As humans continue to uncover and learn about the ecological challenges being faced by the planet, environmental and natural resource management jobs are becoming increasingly difficult. *Finding a Sustainable Balance: GIS for Environmental Management* shows how GIS can improve operations across land and wildlife management, outdoor recreation, and environmental regulation. The book is a collection of real-life stories about how several environmental and natural resource management organizations successfully use GIS to monitor environmental assets in real time, prevent environmental hazards from turning into disasters, and provide transparency that produces better outcomes for everyone. June/September 2023, 125 pp. Ebook ISBN: 9781589487598 and paperback ISBN: 9781589487581.



Esri Map Book, Volume 38

By Esri Press

Every year, the works of mapmakers from around the world are selected for *Esri Map Book* to demonstrate how GIS technology helps governments, businesses, and individuals achieve their goals. The 38th volume in the series continues this tradition, showcasing maps and apps that employ ArcGIS technology to evaluate the sustainability of resources, determine efficient transportation routes, mitigate the effects of natural disasters, and much more. For each map or app that is included in the book, there is a description of its purpose and how it was produced. September 2023, 140 pp. Paperback ISBN: 9781589487444.



For more information on all Esri Press publications, visit esri.com/esripress.

New Training and Certification Offerings

Training

New Instructor-Led Course

Developed and delivered by in-house experts, Esri's instructor-led courses are beneficial for anyone who uses ArcGIS software to support their daily workflows and enhance projects with geographic context.

A new instructor-led course—**Deploying ArcGIS Enterprise on Kubernetes**—is essential training for IT and GIS administrators whose organizations are preparing to set up an enterprise GIS on Kubernetes, a cloud-native technology. Over two days, attendees of this advanced class are introduced to cloud-native computing concepts such as containerization and microservices; explore infrastructure requirements for ArcGIS Enterprise on Kubernetes; and practice the workflows needed to create, manage, and scale an ArcGIS Enterprise deployment on Kubernetes. View course details at go.esri.com/kube-class.

Skill Building Starts—and Never Ends—at Esri Academy

Are you curious about a new ArcGIS app you've heard about? Do you need to learn a specific ArcGIS technology-supported workflow to perform your job? You can do this through Esri Academy, the online destination that hundreds of thousands of people use each year to jump-start their learning on a range of GIS topics. Bookmark the Esri Academy catalog at esri.com/training/catalog and visit it often to explore the latest offerings.

The following e-Learning resources were recently added to the catalog:

- **Getting Started with Imagery and Remote Sensing:** This free course covers high-level concepts in remote sensing science and explores several imagery apps.
- **Using Tile-Based Processing in ArcGIS Drone2Map:** This free, 55-minute ArcGIS Lab immerses imagery specialists in a realistic scenario in which they need to process drone-captured imagery, evaluate the results, and share an orthomosaic as a tile layer for public consumption.
- **Getting Started with ArcGIS AllSource:** This seminar takes intelligence analysts on a 30-minute guided tour of ArcGIS AllSource.

Live Training Seminars Are Back

After taking a hiatus due to the COVID-19 pandemic, live training seminars have returned to Esri Academy! These free, interactive, one-hour live streams feature subject matter experts who share tips and best practices for using GIS, present guided software demonstrations, and answer questions from the audience. View all live training seminars at esri.com/lts.

Make Your Mark in a MOOC

One of Esri's most popular massive open online courses (MOOCs), **Going Places with Spatial Analysis**, will start again on January 26. The course introduces spatial analysis concepts and guides participants through increasingly sophisticated analytical workflows. Suitable for new GIS users and anyone who wants to try the latest ArcGIS Online analysis tools, this free MOOC includes a certificate of completion. Register at go.esri.com/going-places-mooc.

And although Esri's newest MOOC, **GIS for Climate Action**, is already underway, registration is open through November 8. If you can't catch it this year, the MOOC will be offered again in May. (See page 30 for more details on this course.) Check out the full MOOC calendar at esri.com/mooc.

Certification

The Esri Technical Certification Program enables participants to validate their experience with ArcGIS Pro, ArcGIS Enterprise, ArcGIS Online, and related technologies. The certification team is hard at work developing a full roster of new exams that will be released next year.

Beta exams are a vital component of the exam development process. After the beta period closes, every exam question undergoes in-depth statistical analysis to ensure that the exam validates relevant skills. New this year, beta exams are open to anyone who is interested in achieving the certification. Just like with a released exam, a passing score earns the participant the certification.

Taking a beta exam gives participants the opportunity to be among the first to achieve a brand-new certification or a new version of a certification. Check out the following beta exam offerings:

- **ArcGIS Online Administration Associate**, offered November 9–28, 2023
- **ArcGIS Utility Network Associate**, offered December 7–26, 2023
- **ArcGIS API for Python Associate**, offered December 18, 2023–January 6, 2024

Beta exams are only open for a limited time. For registration details and exam information guides, visit go.esri.com/beta-exams.

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

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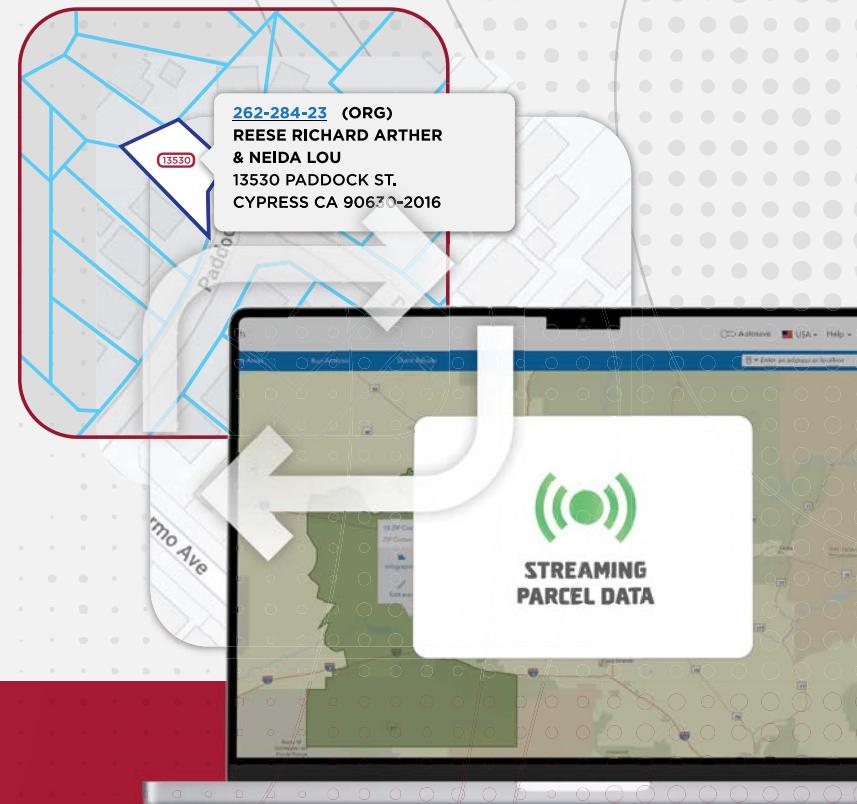
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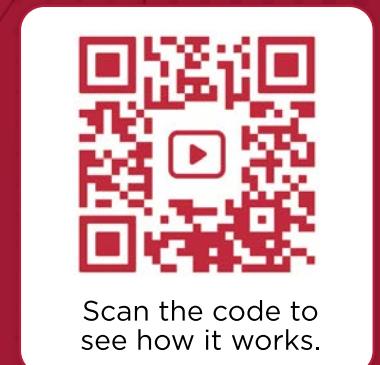
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