

ArcUser

The Magazine for Esri Software Users

**Nature-Based
Solutions Aim
to Fortify Point
Hope 66**

**Pretrained Geospatial
AI Models Can
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**How GIS Can Protect
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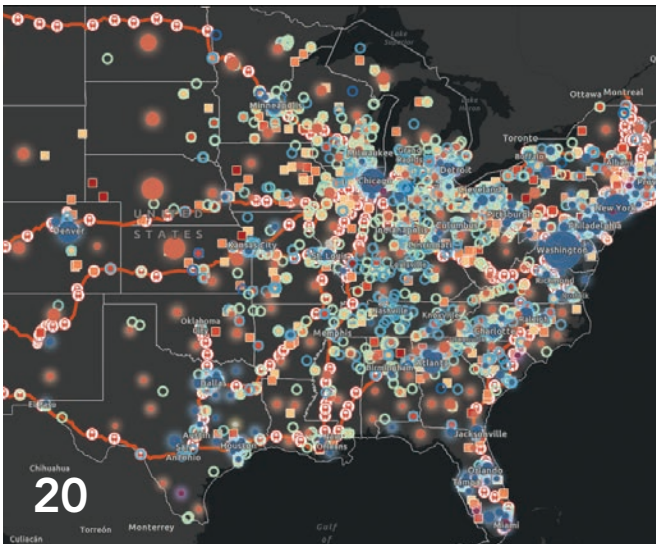
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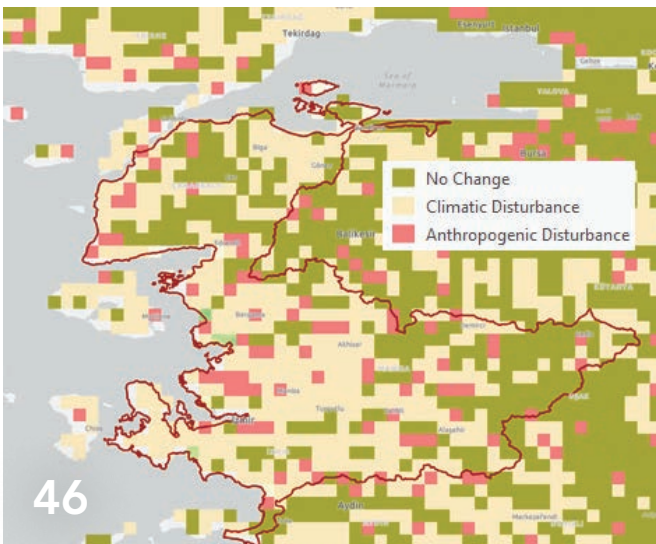
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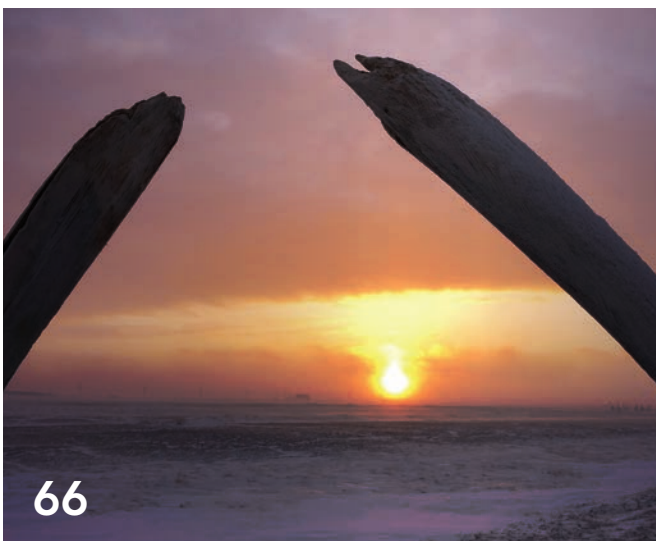
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GIS Tackles Challenges New and Old

Things often shift and change when a new year rolls around, and *ArcUser* is no exception. The magazine's founding editor, Monica Pratt, retired at the start of 2025, but *ArcUser* continues to highlight the vital work that GIS professionals do and the resources they use to address the world's most difficult challenges.

But for all the changes swept in by the new year, not all the challenges we face are new. Changing climate conditions, for instance, remain an ever-growing threat. In 2024 alone, the United States sustained 24 separate weather- or climate-related disasters with losses exceeding \$1 billion, according to the National Oceanic and Atmospheric Administration (NOAA). These include hurricanes Helene and Milton, winter storms in the Pacific Northwest, wildfire in New Mexico, and catastrophic tornadoes in the Midwest. Already, 2025 has seen devastating fires tear across Los Angeles County, decimating homes and businesses. The frequency and severity of these events show no sign of slowing. Which is not to mention the more gradual—but still consequential—effects of climate change such as rising sea levels and ever-more frequent droughts. The problem is now familiar, but it is no less existential.

As articles in this issue demonstrate, GIS is one of the most effective tools we have to address challenges like these.

Staff at the Oregon Department of Emergency Management are using ArcGIS Instant Apps to ensure that information about deadly wildfire is more accurate and accessible. On Turkey's Aegean Coast, GIS provides a clear picture of how progressively hotter and drier growing seasons impact olive production. In Point Hope, Alaska, drone imagery and GIS technology help local communities find a way to combat erosion and rising sea levels.

"Make plans ahead of time," urges Sunny Fleming in an article that showcases the myriad ways GIS departments prepare for and respond to climate-related threats. "Embrace GIS technology to collaborate and communicate. Leverage the technological resources that you already have. Use them to their full potential."

GIS plays a key role in allowing us to gather more data, plan more effectively, and respond more efficiently to the world's challenges. This idea is the lynchpin of every story in this issue, whether it is about using geospatial AI to respond to disasters, developing web apps with less code and less effort, or using ArcGIS Indoors to help students find their way around a community college campus. No matter the scale of the problem, GIS is and will continue to be instrumental in finding the way forward.



Ben Van Voorhis
ArcUser Editor

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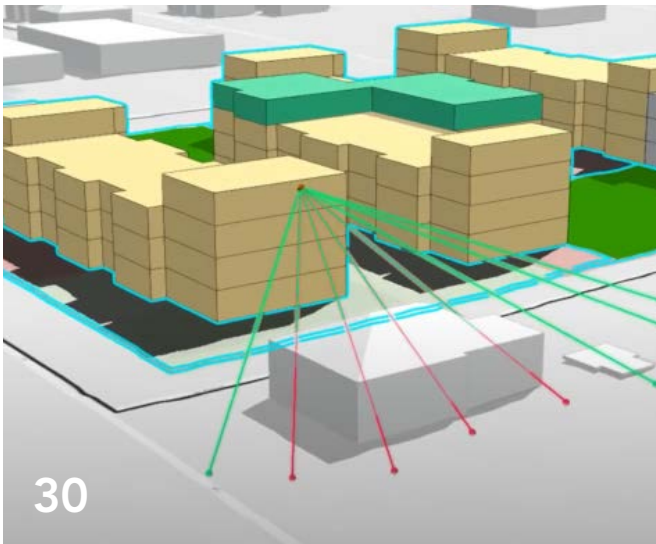
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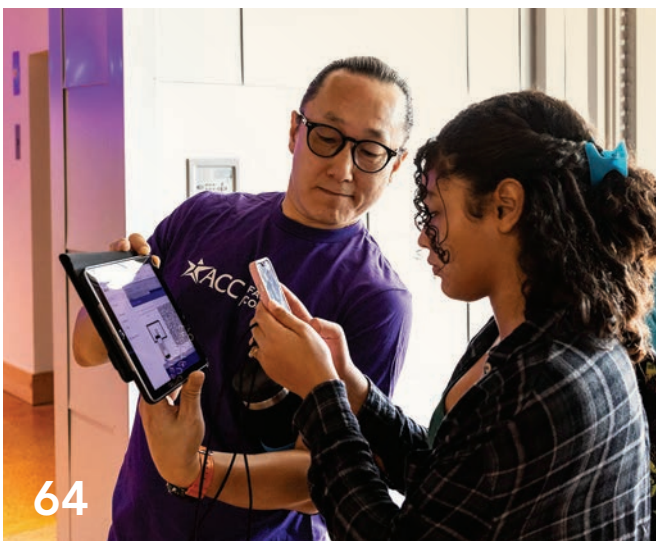
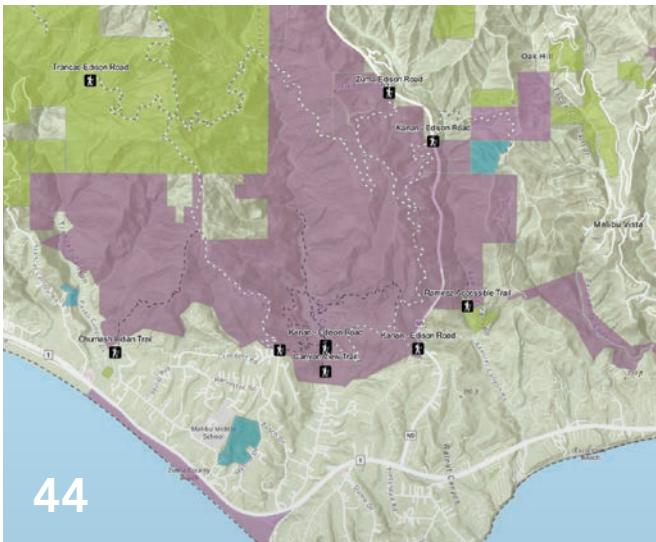
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Briefly Noted

→ Geospatial Data Included in Autodesk Forma

In a deepening of their partnership, Esri and Autodesk agreed to integrate Esri's authoritative geospatial reference data into Autodesk Forma, cloud-based software that offers easy-to-use AI-powered tools to architecture, engineering, and construction (AEC) professionals for concept and schematic design.

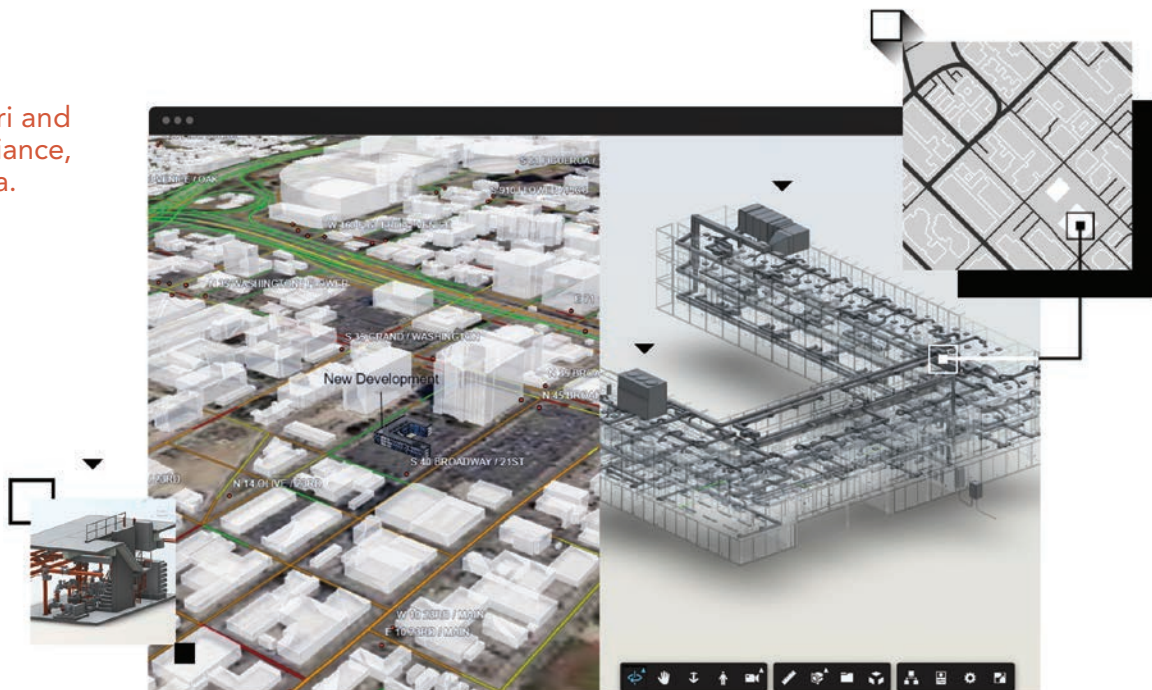
Historically, AEC professionals have used multiple tools during the planning phase, often leading to inefficiencies and data loss. The integration of ArcGIS data into Autodesk Forma addresses these challenges by providing cohesive, consistent spatial data and analytics from the outset.

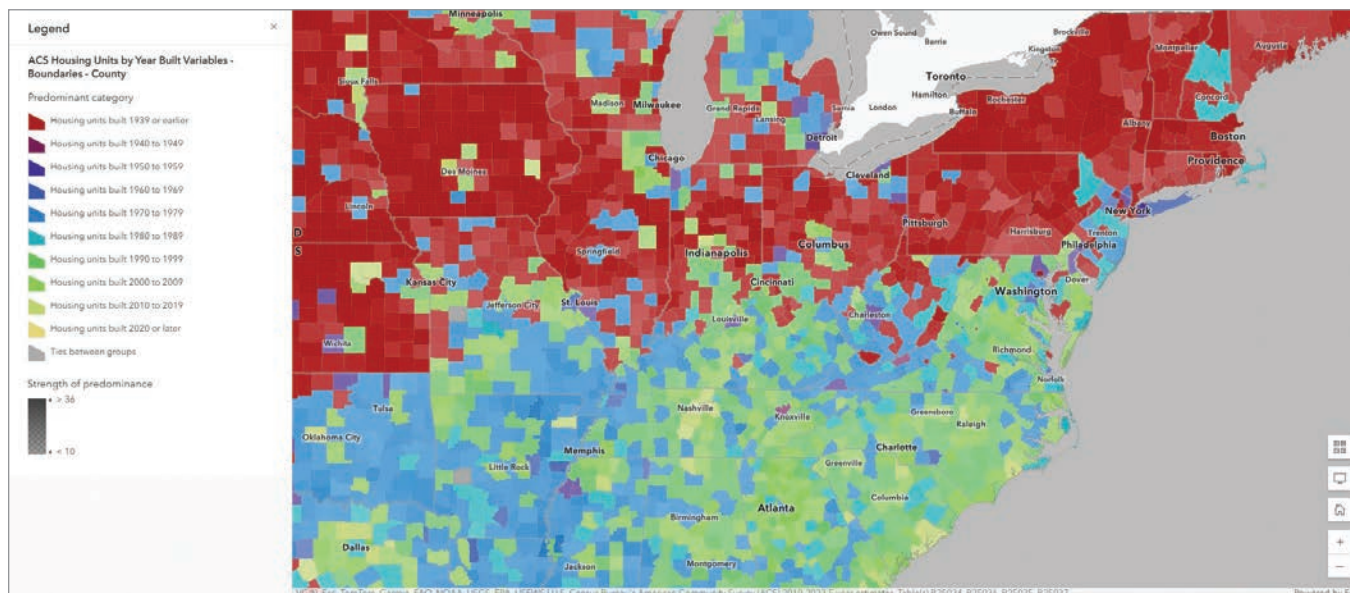
The inclusion of ArcGIS data—including basemaps and ArcGIS Living Atlas of the World data layers—in Autodesk Forma means that architects and planners can begin their designs with immediate access to comprehensive and cohesive geographic context. The combined strengths of GIS and building information modeling (BIM) technologies during early design and planning empower teams with enhanced mapping capabilities and improved collaboration, which can help reduce project costs and timelines.

"By partnering with Esri, we have committed to providing our customers with the unmatched geographic perspective that ArcGIS brings to the [AEC] project workflow," said Eric DesRoche, director of infrastructure business strategy at Autodesk. "With Esri's contextual data at their fingertips, architects and planners can use Autodesk Forma to design with location and sustainability in mind, leading to more resilient projects that can better support local communities."

To learn more about Esri and Autodesk's strategic alliance, go to go.esri.com/forma.

→ Autodesk Forma enables GIS teams and architects to collaborate seamlessly, access data quickly, and provide real-time feedback, leading to better decisions and improved project outcomes.





↑ The newly released US Census Bureau American Community Survey (ACS) 2019–2023 five-year estimates are available for free from ArcGIS Living Atlas of the World.

→ New American Community Survey Data Available in ArcGIS Living Atlas of the World

The 2019–2023 American Community Survey (ACS) five-year estimates are now available within ArcGIS Living Atlas of the World. These ready-to-use layers empower people to instantly begin to explore, map, and analyze the data. The multiscale layers have data for state, county, and tract levels. Having free access to these layers in ArcGIS Living Atlas significantly reduces the time GIS users spend on downloading and processing data.

In addition, this year's update includes the ability to access vintage ACS data in ArcGIS Living Atlas with the pop-up function. The collection of 2010–2014 historical layers now has vintage information in pop-ups as well.

Census ACS data enables local officials, businesses, and researchers to understand what is taking place in their communities and helps community programs allocate resources. Access to the latest ACS data is crucial because many federal agencies are mandated to use it, and numerous nonprofits rely on it for grant applications, operations, and decision-making.

To learn more about the latest updates and how to use ACS data layers in ArcGIS Living Atlas, visit go.esri.com/living-atlas/acs.

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Pretrained Geospatial AI Models Can Streamline Disaster Response

By Vinay Viswambharan, Rohit Singh, and Priyanka Tuteja

Esri provides access to a curated library of more than 75 pretrained geospatial artificial intelligence (GeoAI) models that are accessible from ArcGIS Living Atlas of the World. These models are suited to perform a variety of AI tasks that address different business needs, such as extracting building footprints for urban planning, classifying structures for insurance purposes, or generating change maps from time series data.

In the wake of disasters like floods, fires, and earthquakes, the need for models that can detect or classify damaged infrastructure, as well as identify threats such as wildfires and floods, has become increasingly critical. Therefore, Esri has extended its library of models to address this urgent need, providing powerful tools for damage assessment and classification during disaster events. The following AI models are specifically designed to help first responders and analysts quickly identify areas at risk, assess the extent of damage, and manage emergency operations to streamline and enhance disaster response efforts.

This article provides an overview of each of these models as well as instructions on trying them out with your own imagery.

1 Damage Assessment (Drone Imagery)

This model addresses the need for rapid damage assessment in disaster-stricken areas, helping emergency response teams analyze the severity of damage from drone and aerial imagery. It is

trained on the Low Altitude Disaster Imagery (LADI) v2 dataset, which includes over 10,000 aerial images labeled by Civil Air Patrol volunteers. The model automatically identifies key features such as roads, damaged infrastructure, and hazards like floods or debris. By accelerating the identification of critical areas, the model helps emergency managers prioritize response efforts. It works with high-resolution aerial imagery collected by drones or small planes.

2 Wildfire and Smoke Classification

With wildfire becoming increasingly frequent and destructive due to the changing climate, early detection and monitoring are crucial for minimizing damage. This model enables the automatic classification of wildfires and smoke, detecting both active fires and early signs of smoke that may indicate the start of a fire. It uses imagery from aerial drones and ground-based camera systems, functioning in a variety of settings and lighting conditions. This allows wildfire management teams to continuously monitor remote forested areas prone to wildfire, facilitating quicker interventions and more effective resource allocation.

↑ Pretrained GeoAI models are designed to help first responders and analysts identify areas at risk, assess damage, and manage emergency operations.

3 Wildfire Delineation

Wildfire delineation is essential for accurately mapping the spread of active fires and assessing their impact. This model addresses the need for precise fire boundary detection by segmenting wildfire-affected areas using Sentinel-2 imagery. It helps emergency responders with risk assessment, evacuation planning, and resource allocation. In addition to delineating wildfires, the model can be applied to monitor volcanic lava flows, offering flexibility in managing different types of natural hazards. The model's high temporal resolution enhances its utility in real-time disaster monitoring.

4 Prithvi—Burn Scars Segmentation

Burn scars present a challenge for postwildfire assessment, as distinguishing between burnt and nonburnt areas is critical for effective recovery and landscape management. The Prithvi model, developed by NASA and IBM, addresses this by automating the detection of burn scars from multispectral satellite imagery acquired by the Landsat or Sentinel-2 sensors. It is fine-tuned on the Harmonized Landsat (HLS) Burn Scar Scenes dataset, making it highly effective for identifying burn scars on a large scale. The model's application of machine learning allows it to map the aftermath of wildfires, enabling emergency responders to assess damage and plan recovery efforts more efficiently.

5 Prithvi—Flood Segmentation

Flood monitoring and management are critical for mitigating the impact of floods, particularly in disaster-response efforts. This use of the Prithvi model automates the detection of flood-affected areas using high temporal resolution multispectral satellite imagery (Landsat and Sentinel-2). Fine-tuned with the Sen1Floods11 dataset, this model precisely identifies submerged regions, enabling responders and policymakers to assess flood extents more efficiently. By leveraging earth observation data and deep learning, Prithvi enhances the ability to monitor floods in real time, offering valuable support for evacuation planning, resource allocation, and postdisaster recovery efforts.

6 CLIP Zero-Shot Classifier

The CLIP Zero-Shot Classifier, a unique model in its class, offers a flexible solution for classifying images without the need for task-specific training. This model is powered by OpenAI's Contrastive Language-Image Pretraining (CLIP) and allows users to define custom categories, making it ideal for disaster response, urban

monitoring, and environmental analysis. This model works with both individual images and large image collections, performing well across different lighting conditions and locations. It not only assigns a class to each image but also provides a probability score, helping users prioritize results more effectively.

Next Steps

To explore Esri's pretrained damage assessment and classification models, follow these steps to try them out with your own imagery in ArcGIS Pro, ArcGIS Enterprise, or ArcGIS Online:

1. Fire up your web browser and navigate to ArcGIS Living Atlas of the World.
2. At the top of the page, search for "dlpk", short for deep learning packages.
3. Browse the search results to find deep learning packages relevant to your workflows.
4. Click any package to view more details, access comprehensive instructions, see model metrics, and explore guides to help you get started with the model.
5. Explore the pages and guides (links.esri.com/pretrained-models) to learn how to integrate these models into your workflows.

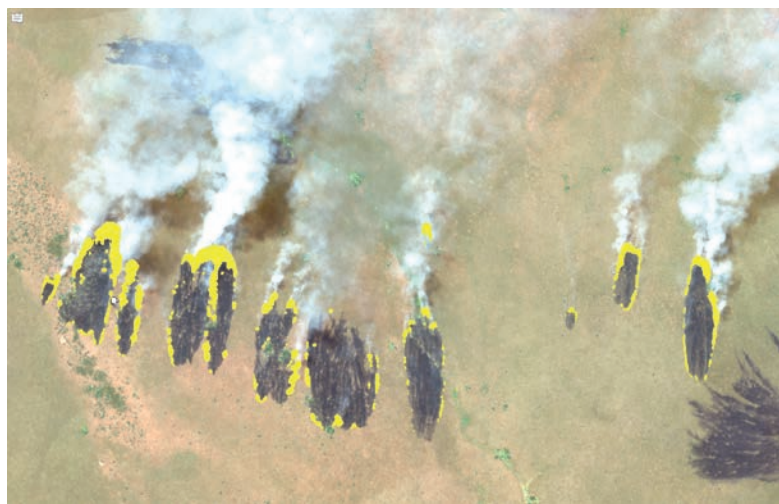
About the Authors

Vinay Viswambharan is the principal product manager on the imagery team at Esri, with a zeal for remote sensing, AI, and everything imagery.

Rohit Singh is the director of Esri R&D Center, New Delhi, India, and development lead of ArcGIS artificial intelligence technologies and ArcGIS API for Python.

Priyanka Tuteja is a senior product engineer on the GeoAI team at Esri R&D Center, New Delhi.

↓ The Wildfire Delineation model can help emergency responders with risk assessment, evacuation planning, and resource allocation.



► Create Reference Maps in ArcGIS Pro with the Calculate Color Theorem Field Tool

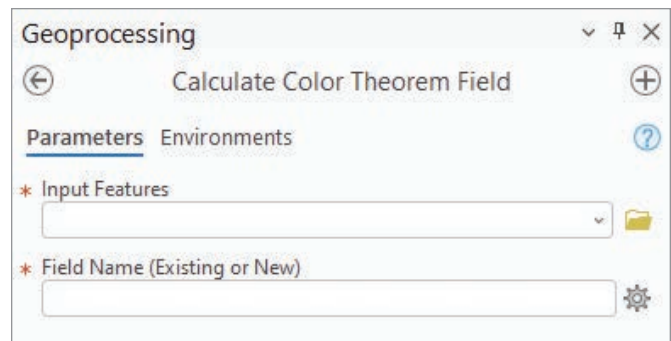
By Chris Wesson

You have likely made or come across many political maps in atlases or wall maps of the world. Or perhaps you have created your own maps of administrative regions, states, counties, or plot boundaries, or made other polygonal reference maps.

In these applications, polygons themselves are the subject. There is no thematic field or choropleth value to color by. Instead, the creator wants to add a fill to make it easier to see the different shapes—where one ends and another one begins.

According to Megan Johnson at the National Center for Supercomputing Applications (NCSA), “For a world map to be useful, each country must be easily distinguishable from the next.” Conversely, if we color in every country differently, it becomes visually overwhelming and similar colors start to look thematic or of the same group.

To address this issue, the Calculate Color Theorem Field tool in ArcGIS Pro can help you color map polygons while ensuring that any two adjacent polygons will not have the same color.

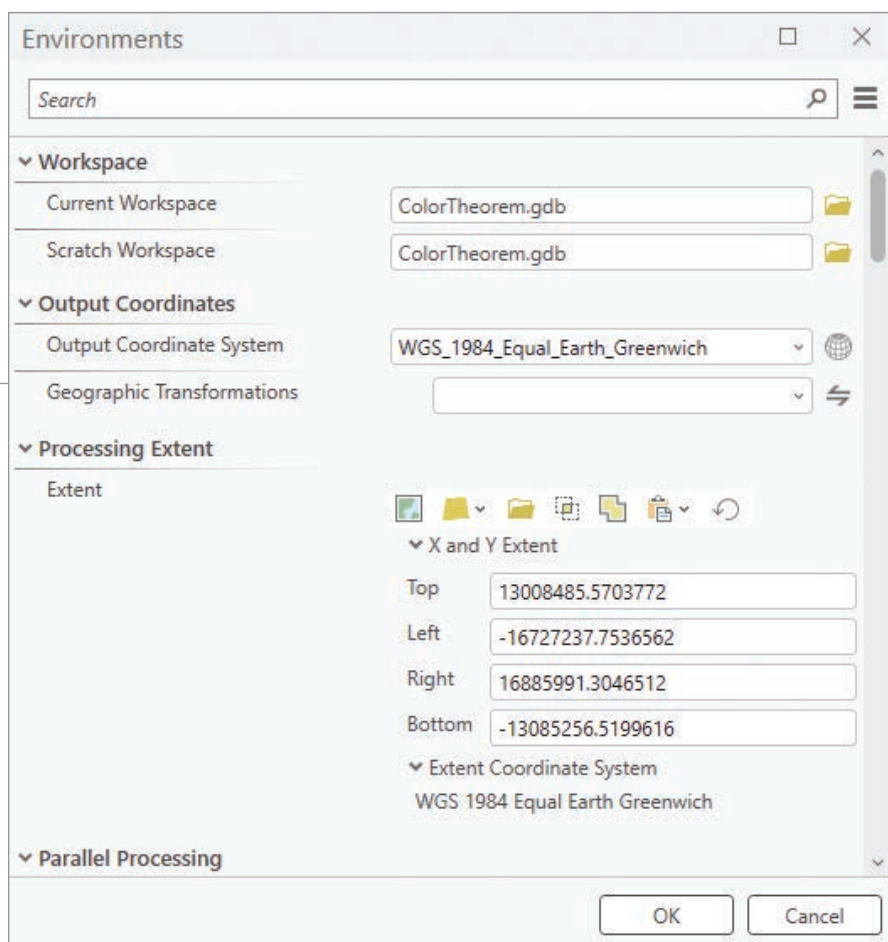


↑ Select the input features you wish to color as well as the name of the field.

The idea that a contiguous set of two-dimensional polygons can be colored with no more than four or five colors (while still ensuring that any two adjacent polygons will not have the same color) has

↓ This map was created by running the Calculate Color Theorem Field tool on Natural Earth data, applying colors, and pasting the map into a customized version of the *Equal Earth* map. This map projection was created by Bojan Šavrič, Tom Patterson, and Bernhard Jenny.





↑ Use Environments to run the tool on different geographic extents.

been around since the 1800s, but debate around this idea continued until 2005. Since then, developer samples and solutions both from Esri and from users in various GIS ecosystems have emerged, but generally, most cartographers have chosen to color these polygons manually.

While there is still a case for cartographers' manually improving certain decisions, this tool automates as much of the process as possible.

Welcome the Calculate Color Theorem Field Tool

With most solutions until now, data needed to be contiguous (have no gaps), have no overlaps, and be composed of only single-part features. But GIS data and use cases are often not quite that simple! Also, Esri developers were very keen that none of these solutions should be prohibitive. So, rather than enforce four or even five colors, this tool works out both neighbors and proximity using graph theory, and respects and retains multipart polygons. Doing this keeps the number of colors used low while ensuring that the color of every neighboring, overlapping, or very near feature is different.

Rather than dictate colors, the tool provides an integer field that you can use with the Unique Values renderer to effectively color by number with a palette of your own choosing. Some data providers already provide color index fields with their datasets in a similar fashion.

To get started using the tool in ArcGIS Pro, follow these steps:

1. Search for the tool or find it in the Cartographic Refinement toolbox (Cartography Tools).
2. Select the input features you wish to color and the name of the field (existing or new) that will contain the new values.
3. Run the tool to populate the chosen field with an integer value (e.g., 1 through 5).
4. Now, open the Symbology options, then choose Unique Values. Choose the updated integer field and a suitable color scheme. That's it!

If the resultant field has many unique values, it is likely that this is caused by a lot of overlaps in your data or by duplicate geometries. You may want to consider some

data cleansing before running the tool again.

To ensure that certain polygons are assigned the same color value—a mainland extent with a chain of islands under the same sovereign rule, for example, or a country and its enclaves—then make them a multipart feature and the tool will treat them as one.

The tool is designed to use as few colors as possible and to use them evenly. However, under some circumstances, our tool does not use the minimum number of colors. This is usually when the data is noncontiguous, overlapping, or multipart. Solutions that enforce minimum colors often won't run on such scenarios.

If you wish to reduce the number of colors, you can edit the field for manual fine-tuning after running the tool, or run the tool several times on different geographic extents. To set the processing extent, go to the Analysis ribbon and, under Geoprocessing, choose Environments.

About the Author

Chris Wesson is a senior product engineer on the ArcGIS Insights and ArcGIS Pro teams at Esri specializing in location analytics and map production. He enjoys showing how to turn data into insightful or compelling stories through geographic and data visualization. Along with product development and GIS, Wesson has a background in science and finance and is experienced in business intelligence and cartography.

Fighting the Opioid Epidemic with Access to Services, Data, and Resources

By Mindy Longoni, Chelsea Nivison, and Jeremiah Lindemann

Like so many communities, Mahoning County, Ohio, has seen an increase in unintentional drug overdoses and overdose deaths in recent years. According to the Centers for Disease Control and Prevention (CDC), more than one million people have died from drug overdoses in the last couple of decades. The majority of these deaths involved an opioid.

These chilling statistics represent an epidemic that affects virtually every community and cannot be ignored. And since the opioid epidemic is a community issue, it makes sense that improving outcomes starts at the community level. In most communities, public health agencies provide resources that educate residents about opioids, offer prevention services, and—if necessary—connect people with a substance use disorder to the appropriate treatment and recovery resources.

However, keeping an accurate and up-to-date inventory of these resources can be complicated. New providers become available while others close, and operating hours and contact information

can change over time. Nonetheless, opioid resources must be available when people need them.

While Mahoning County provides great programs and services, staff at the county public health department knew these programs could be more effective. Its services could reach more people if they were more widely known. The county also wanted to more effectively share epidemic-related data collected since 2016.

In 2023, Bharat Chaturvedi, a public health epidemiologist with Mahoning County Public Health (MCPH), attended the Esri User Conference in San Diego, California. At the ArcGIS Solutions booth at the Expo, he discussed the issue with a product engineer, who introduced Chaturvedi to the Opioid Epidemic Outreach solution. The product engineer described how organizations like MCPH had adopted the solution with great results.

The Opioid Epidemic Outreach solution, part of the ArcGIS Solutions collection that is included with ArcGIS Enterprise and ArcGIS Online subscriptions, helps public agencies create and

→ MCPH’s Opioid Epidemic Outreach website includes an interactive dashboard with key demographic information.



The screenshot shows the 'Opioid Treatment Locator' interface. On the left, there is a sidebar with a search bar and a list of providers. The main area is a map of Mahoning County with red circular markers indicating treatment center locations. The map includes labels for 'Mahoning', 'Youngstown', and 'Center Rd'. The interface is clean and user-friendly, designed to help users find nearby treatment services.

← The MCPH Opioid Epidemic Outreach website includes an interactive map of treatment center locations.

maintain a resource inventory, communicate important information about the severity of the epidemic, and promote resources available to community members in need. Each of the solutions contain apps, surveys, maps, feature layers, or ArcGIS Pro projects that can be configured to match organizational needs.

Prior to deploying the Opioid Epidemic Outreach solution, the county's process was consistent but time-consuming. Analysts entered monthly epidemic data into Microsoft Excel spreadsheets, which were used to produce charts. The resultant infographics were copied into a Microsoft Word document and distributed each month through a LISTSERV email. Each static report displayed only that month's data along with cumulative data for the year.

By adopting the Opioid Epidemic Outreach solution, MCPH moved from periodically distributing epidemic data via static reports to providing an interactive source of data with the MCPH Opioid Epidemic Outreach website (links.esri.com/MCPH). This site, created using ArcGIS Hub, provides data on overdose fatalities; the incidence of related infectious disease; and information on the location of prevention, treatment, and recovery resources. Dashboards provide statistics that compare the county with the nation; include epicenter visits and rescues; and describe the effectiveness and use of the opioid antagonist naloxone (Narcan) in the county.

The site also enables MCPH to provide resources that it couldn't before. Community members can visit the site to find information about prevention, treatment and recovery, or harm reduction. Maps direct people to the nearest opioid treatment centers.

In addition, outside agencies can now use the site to find data needed for grant writing and community reports.

"The Opioid Epidemic Outreach dashboard has streamlined our data sharing with our community partners," said Jennifer Patrick, a community health education specialist with MCPH.

MCPH's website now serves as the heart of the county's efforts to provide critical information about substance use disorders and treatment options available to the community. Chaturvedi notes that now, for both the agency and the whole community, anything and everything related to overdose resources is just one click away.

"Instead of sending out multiple reports and links to communicate information," said Chaturvedi, "we have a one-stop shop for all things related to the opioid epidemic here in Mahoning County."

Learn more about ArcGIS Solutions at links.esri.com/ArcGISolutions.

About the Authors

Mindy Longoni works as a senior product engineering writer on Esri's ArcGIS Solutions team. When she isn't playing with maps, language, or language related to maps, she enjoys spending time with her family.

Chelsea Nivison is Esri's product marketing manager for ArcGIS Hub.

Jeremiah Lindemann is an ArcGIS Solutions product engineer. He has more than 20 years of experience with Esri, including 6 years as an instructor with Educational Services and several years as a solution engineer on the state and local government global business team. For the last several years, he has been supporting public safety and health workflows with ArcGIS Solutions.

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

By Cassandra Perez

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

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

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

A Disconnected, Manual Process

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

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

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

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

Streamlined Data Integration

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

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

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

and use, and that connecting the cloud storage container was very straightforward.

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

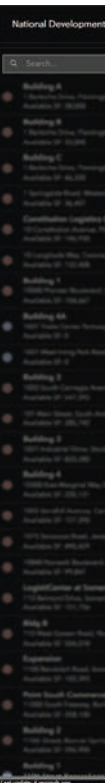
The integration process is now automated and set to a schedule. Azure Blob Storage refreshes multiple times per day, and the respective data pipelines are scheduled to run at the same cadence. Using this process, the data in ArcGIS Online is updated every few hours, ensuring that the latest changes are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

Real-Time Data Reflection

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

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

Data Pipelines has vastly improved the team's speed and reliability, according to Drumm. The scheduling feature that lets the location intelligence team schedule data updates based on a specified time frame is critical and helps ensure the availability of current data. The recurring Azure Blob Storage refresh operation takes only



seven minutes, and then the data pipelines that are connected automatically kick off shortly afterward to update the feature services in ArcGIS Online. In total, the updates take less than 20 minutes.

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

Automation Improves Accuracy

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

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

“The data update capability enables us to no longer rely on multiple sources and users for data input. Because of this, there

are virtually no human errors or manual time spent on the Esri side of things,” said Lawson. “This saves an average of 75 percent of our analysts’ total time spent on data update requests.”

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

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

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

The GIS team has now created hundreds of feature layers with Data Pipelines. With

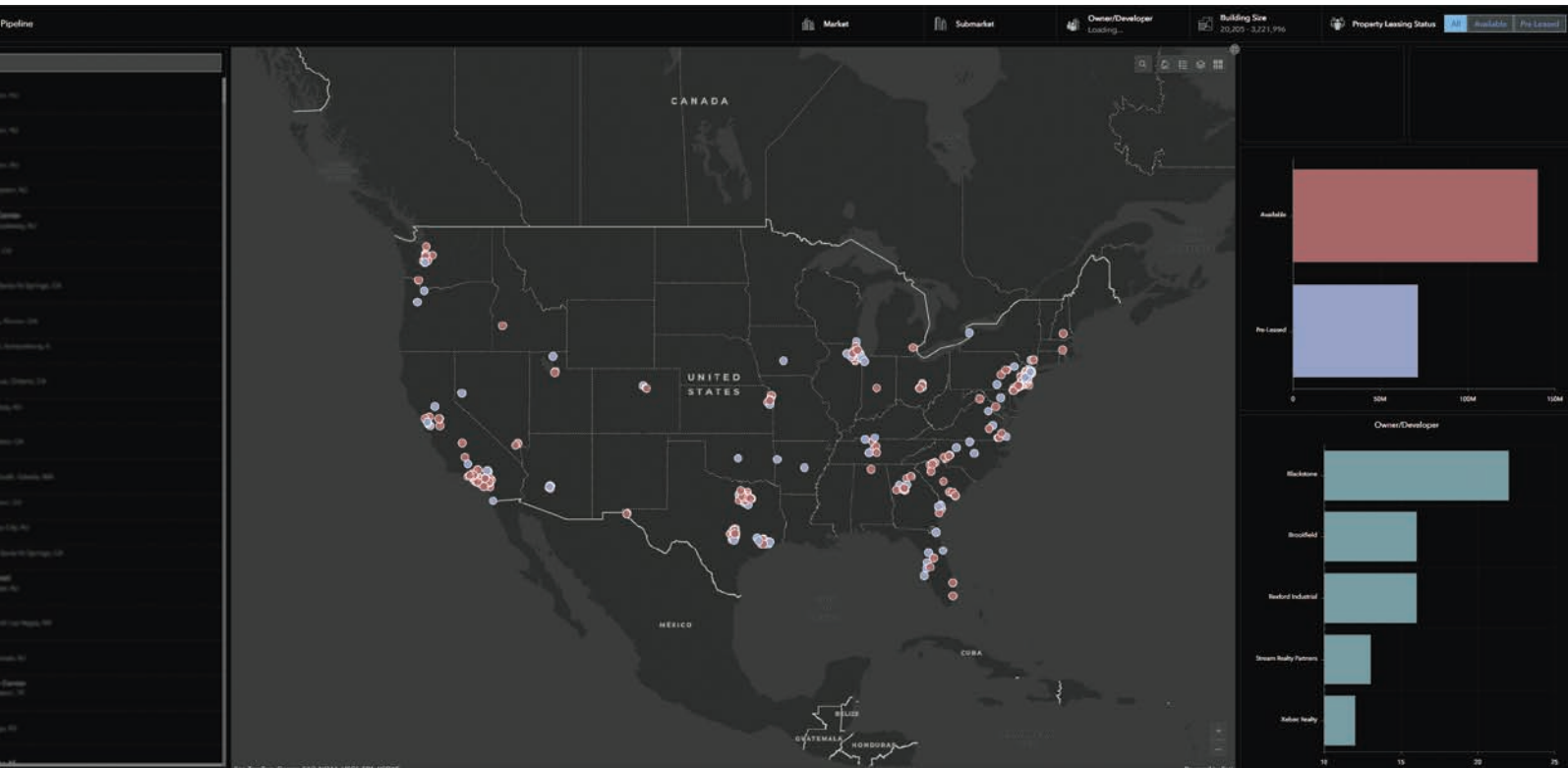
all that data being connected, accurate, and available in ArcGIS Online, deliverables such as a labor study or a site survey comparison can be done in a day, not weeks, helping KBC better serve its clients.

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

About The Author

Cassandra Perez joined Esri in 2018 as a content marketing writer. She received a master’s degree in mass communications from California State University, Northridge, and has almost 10 years of experience in writing and producing content for digital and print channels.

↓ Connecting real-time site availability data to ArcGIS Online has improved accuracy and efficiency.



↓ Hurricane Helene's extreme rainfall caused catastrophic flooding across multiple states.



Hurricane Helene Shines a Light on the Need to Operationalize Climate Action Plans with GIS

By Sunny Fleming

The night Helene hit Asheville in September 2024, we felt secure. We had a couple of jugs of water, stocked up the fridge on (very perishable) food, and made sure the grill had a full propane tank. We assumed we'd lose electricity for a few hours. My dad had been visiting that week, and while the news had some coverage about the forthcoming storm, the reporters didn't seem to be alarmed, so neither were we.

The next morning, I woke up to my husband yelling from the living room for me to get out of the bedroom—the room closest to the large pines in the backyard. I tried to turn on my light, but nothing happened. From 5:00 a.m. until noon, we sat in horror and awe as trees battled to stay upright in gusts upwards of 50 miles per hour. We hunkered down and got ready for a day without electricity.

We lost water. We lost cell service. Then, we ventured out and saw for the first time the incredible scope of destruction and death. The panicked scramble to reach our friends and call our families began.

Two days later, we found ourselves risking the gasoline to try to find a way out. Interstate 40 had collapsed on the west and was blocked by a landslide to the east. North of us, Interstate 26 had collapsed or was covered. We went south, into the path the hurricane's destruction. Dodging landslides and downed trees, we made it first to Greenville, South Carolina. From there, we drove through Atlanta, then Chattanooga, and finally made it to Nashville.

With connection to the outside world restored, images and video documenting what we'd just left behind began to pour into our phones. I found myself glued to social media, looking for official information about plans and resources but finding none.

Planning for a Changing Climate with GIS

It's tempting to believe that Helene is the pinnacle of natural disasters that nature can throw at us, but it isn't. The reality is that the climate is changing, and we (as a global community) must plan appropriately.

Nashville, well-seasoned in responding to natural disasters, has done just that. The city doesn't just have a climate action plan in the form of a PDF document. City staff have communicated the plan brilliantly through a story created with ArcGIS StoryMaps. The app is public and, therefore, so is the data. This fosters meaningful collaboration and transparency and helps operationalize this information.

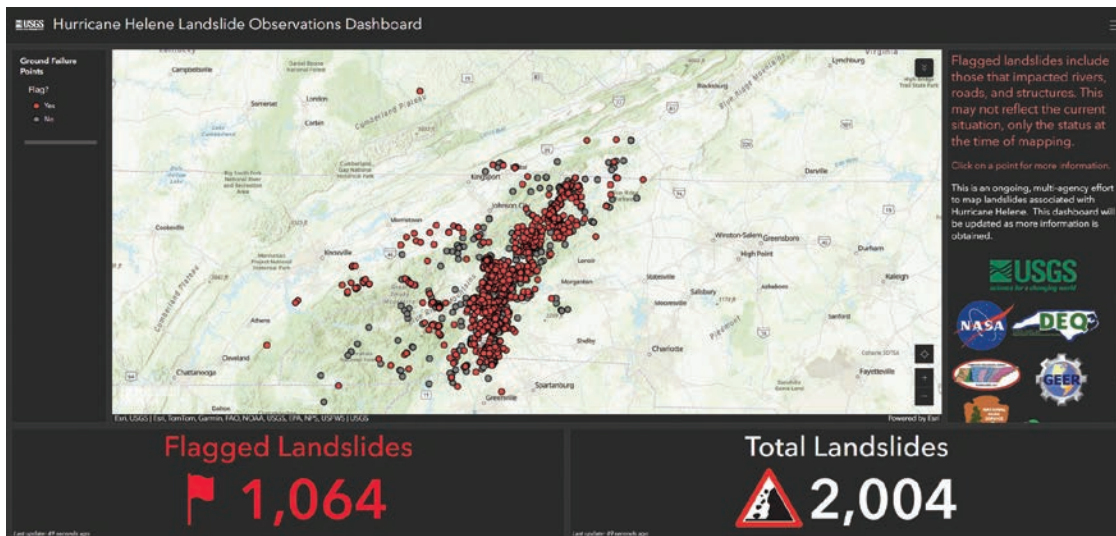
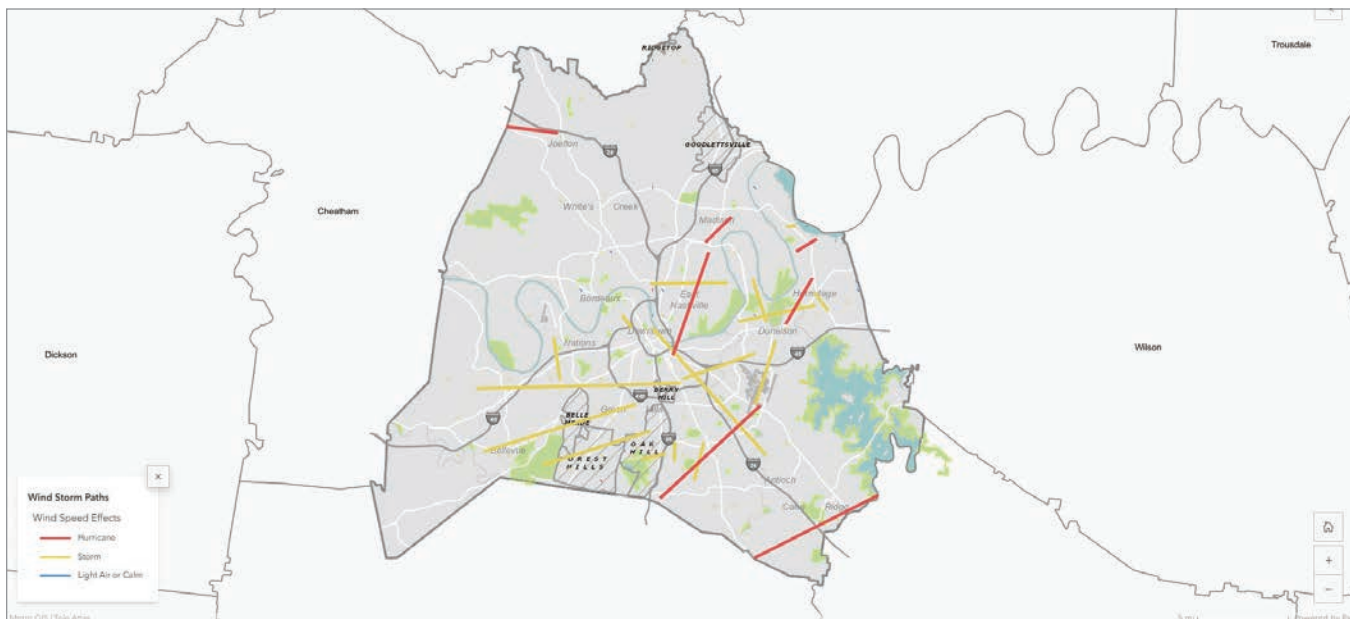
In my professional life, I champion the use of spatial technology to support understanding, planning, and action, particularly where

it pertains to the work of my beloved community of environmental professionals. I have the honor and privilege of seeing amazing, life-saving implementation of these tools every day.

But also, right now, I know we can do better. We can do more. And there is simply no excuse anymore to not fully leverage this technology.

Preparation

Let's stay in Nashville for our first example. Kendra Abkowitz is the senior director of sustainability and resilience with the mayor's office at the Metropolitan Government of Nashville & Davidson County. Abkowitz told local TV station WKRN that the main goal behind the story the city created with ArcGIS StoryMaps is "better equipping Nashvillians with information and starting a



↑ This screenshot from Nashville's ArcGIS StoryMaps story shows one of many maps that examine climate data from across Davidson County.

← USGS is just one of numerous federal, state, tribal, local, and civilian organizations that worked together to rapidly respond to Hurricane Helene, sharing maps and apps like this one to help operationalize its response.

conversation so that the next time we do have an extreme weather event hit us here in the city . . . we are well informed and we're better prepared to be responsive to it."

Response

Geospatial artificial intelligence (GeoAI) has also played a significant role in the response to Hurricane Helene. For example, the United States Geological Survey (USGS) created the Hurricane Helene Landslide Observations Dashboard with ArcGIS Dashboards. The tool is simple on the front end, but the points you see are derived from information extracted from satellite imagery and analysis. As the earth observation industry expands, so too do its practical applications for the data.

Recovery

Recovery can mean many things for a community. Whether in recovering ecosystems, restoring assets, or rebuilding the social fabric of a community, GIS plays a role. One thing that struck me during my experience with Helene is the number of public inquiries about location. *Where can we get gas? Where is there electricity? Where can we go to get water and food? Where are my loved ones?* For answers, people find maps intuitive.

In Santa Rosa, California, after a 2017 wildfire, the city used ArcGIS to provide public-facing, near real-time updates on recovery of city infrastructure.

Mitigation and Adaptation

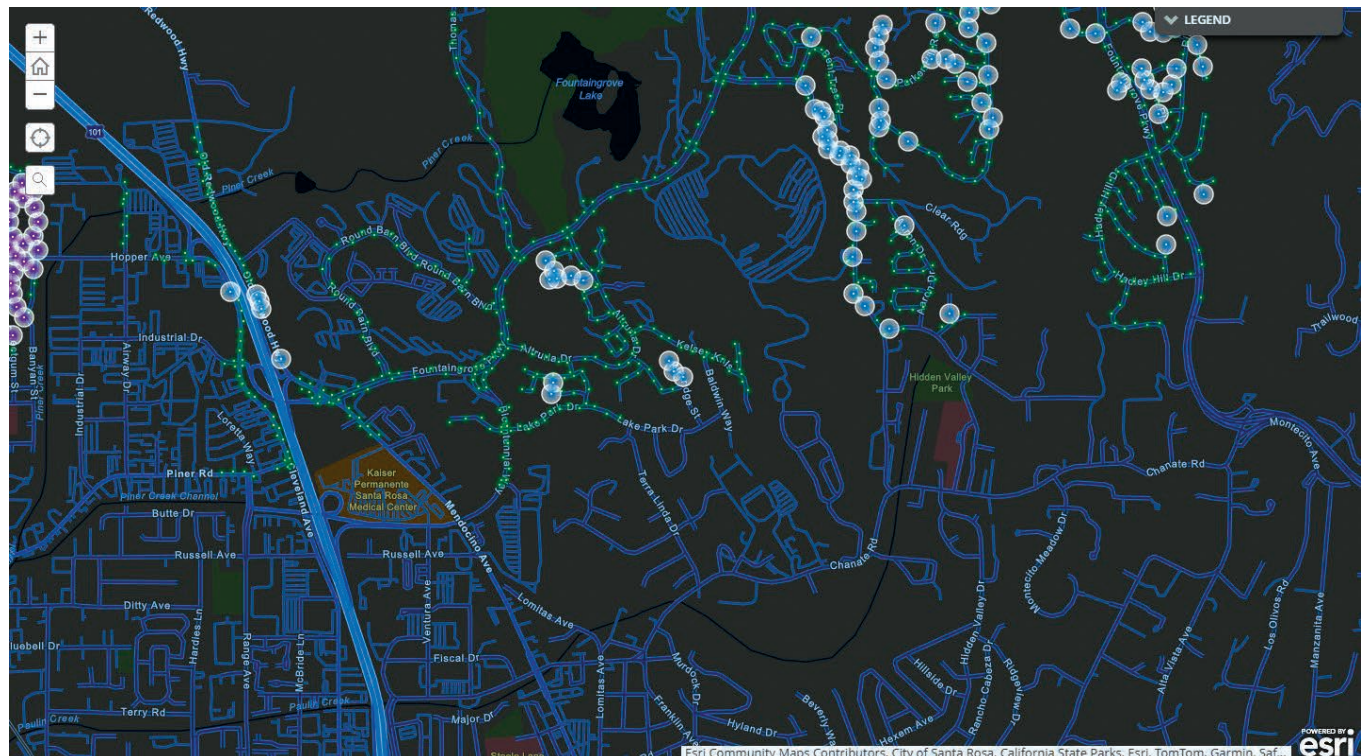
The reality we now face is this: At some point in all our lives, if we haven't already, we will experience the consequences of a major natural disaster as a result of worsening extreme weather patterns. The Environmental Protection Agency (EPA) Climate Pollution Reduction Grants program provides nearly \$5 billion in grants to states, local governments, tribes, and territories to plan and implement climate action plans. Too many times, climate action plans are released as a PDF and not operationalized across a government's operations or used to support community action.

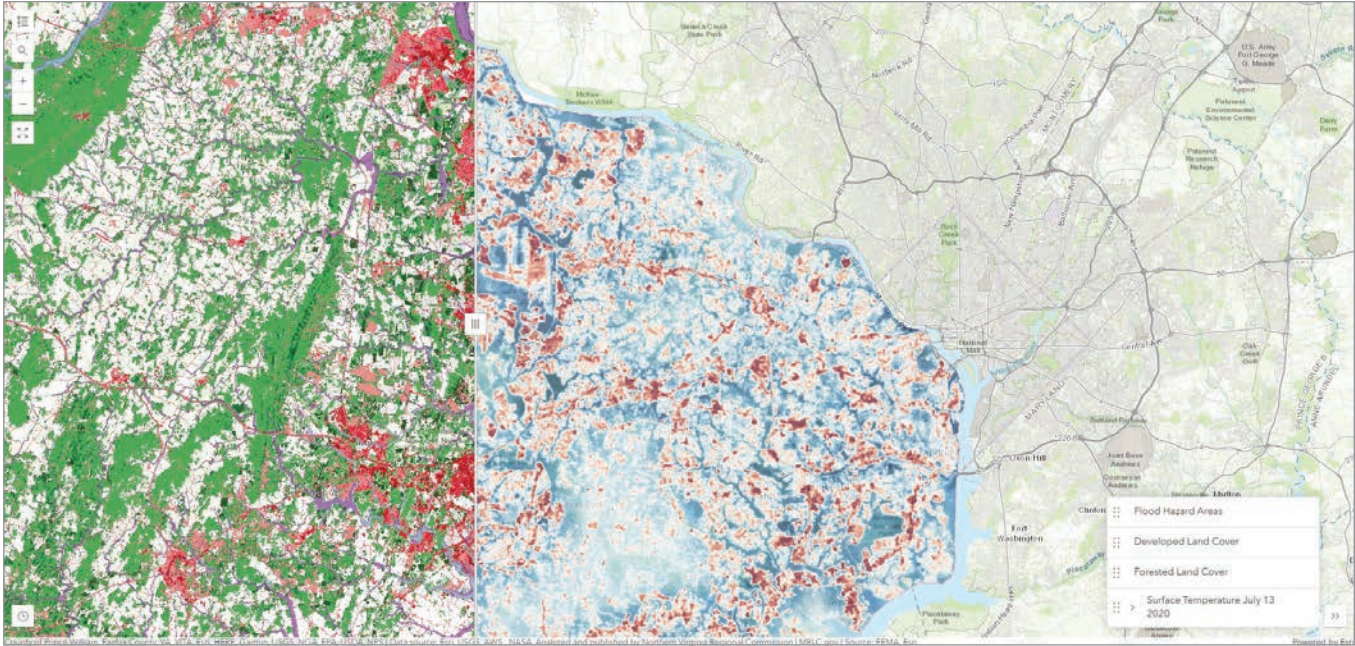
However, the number of public-facing maps and apps for climate action planning is growing. The Northern Virginia Regional Commission has developed an app that covers numerous local climate-related issues with open data and maps to help others explore and understand subjects such as heat islands and land use. And the City of Falmouth, Maine, used a map-based application to enable the community to provide comments, place them on the map, and upvote user-submitted ideas. This ensures that the community is able to give feedback throughout the entirety of a process, not just at the beginning.

What We Can Do Now

Helene is derived from Greek for "shining light." My hope is that our experience with Helene serves as a beacon, a wake-up call to governments everywhere and of every size to take action now.

↓ The map in this screenshot is part of a suite of maps showing assets in the city of Santa Rosa after a 2017 wildfire and their repair status. The map is focused on streetlight repair.





Falmouth Climate Action Plan

Home Get Involved About Maps and Data Climate Hazards **Community Input Map** Falmouth Sustainability Webpage

Falmouth Climate Action Plan

Tell Us Anything!

+ Submit a Report

Invasive Japanese Knotweed...	0
Walk/Bike options for Buckn...	0
Maine's coastal crust is rising	0
Reducing Vehicle Usage with...	2
Erosion on Shoreline Drive	1
Bad Intersection 3 of 3	0
Bad Intersection 2 of 3	0

↑ The Northern Virginia Regional Commission leverages GIS to publish simple, intuitive climate-related apps for the public.

← Maps like this one from the City of Falmouth, Maine, can help governments centralize and crowdsource information and facilitate community engagement with features like upvoting.

and destroy entire regions overnight. If you need assistance right now in response to any disaster or crisis, please visit Esri's Disaster Response Program page (esri.com/disaster). When you need help quickly, Esri can provide data, software, configurable applications, and technical support for your emergency GIS operations. This program will ensure that you get

Make plans ahead of time and embrace GIS technology to collaborate and communicate. Leverage the technological resources that you already have. Use them to their full potential.

Dodd Galbreath, the director for the Institute of Sustainable Practices at Lipscomb University, said, "As someone who has served on various regulatory boards over the past 30 years, I encourage all citizen representatives on these boards to love their neighbor. This means having to courageously and frequently say no to those who want to make it easier for people to buy, invest their livelihoods, and put all they have . . . at risk in a floodplain."

Data-driven decision-making that incorporates environmental knowledge to tell people no and to illustrate why and where is a compassionate action. Create a solid data-driven climate action plan that includes all aspects of your city: social, environmental, and economic. Stick to it. Say no when there is pressure to ignore the plan. Do it as an act of love for your fellow human. One poor decision may or may not have much consequence, but a series of poor decisions can cost hundreds of lives and billions of dollars

the help you need to understand the situation, make better decisions, and respond more effectively during a crisis.

To learn more about how GIS can help you develop, enhance, and operationalize your climate action plan, visit our [Confronting the Climate Crisis](http://links.esri.com/climate-plan) page at links.esri.com/climate-plan.

About the Author

Sunny Fleming is the director of environment, conservation, and natural resources solutions at Esri. With a background in plant ecology and botany, she has applied location intelligence throughout her career, from monitoring rare species in the field to helping state parks manage recreational assets across their systems. Through collaboration with GIS users, partners, and colleagues, she fosters a community of environmental professionals who use GIS to meet some of our world's most pressing challenges.

APTA'S INDUSTRY FOOTPRINT APP UNDERPINS ITS SUPPORT OF PUBLIC TRANSPORTATION

By Jim Baumann

According to the American Public Transportation Association (APTA), public transportation is a \$79 billion industry in the United States, employs more than 430,000 people, and supports millions of private sector jobs.

APTA, which supports and advocates for public transit initiatives, has long used ArcGIS technology to provide data analysis to its membership. This service evolved in the past few years into APTA's Industry Footprint application.

"The application collects, analyzes, and presents key statistics at the national, state, and local levels," said Matthew Dickens, senior director of policy development and research for APTA. "It provides insight into APTA membership, public transportation providers, transit services, transportation equipment manufacturing and the associated supply chain, and legislative contact information."

The app, created primarily using ArcGIS Pro and ArcGIS Online, is used by the association's 1,500 members as well as decision-makers to communicate information about public transportation projects, funding, and initiatives. With this information, the app helps APTA and its members communicate the significant impact of the public transportation industry across the country—the first step in advocating for more impactful and efficient public transportation.

Building the App

To develop the application, APTA collaborated with two Esri partners. SymGEO, a

Maryland-based company that specializes in geospatial data analytics, provided support for data development and cartography, while GeoMarvel contributed to application development and solution architecture.

"ArcGIS Online hosts all feature services and tabular data in the application," says Kevin McMaster, principal at SymGEO. "An ArcGIS web map supplies the cartographic symbology pop-up information and design. All data analysis is performed in ArcGIS Pro."

The Industry Footprint application retrieves data that has been preprocessed in ArcGIS Pro and uses the data to populate a series of graphs, charts, tables, and summary statistics for the user. A map-focused report is then created for the selected area of interest.

Data used in the app includes General Transit Feed Specification (GTFS) files, public transport equipment manufacturing locations, transit agency service areas, transportation grants, and current legislative district boundaries.

The GTFS data is used to distribute relevant information about public bus networks to riders in a series of text files.

"Each GTFS file includes a specific aspect of transit information including stops, routes, trips, and other schedule-related data,"

said Jon Nordling, CEO of GeoMarvel. “To use this data, we collect all available GTFS feeds from municipalities or transit authorities using Python scripting and combine them into a single data layer to identify bus stop locations. We then buffer out those stops by a quarter mile to help identify gaps in bus stop coverage.”

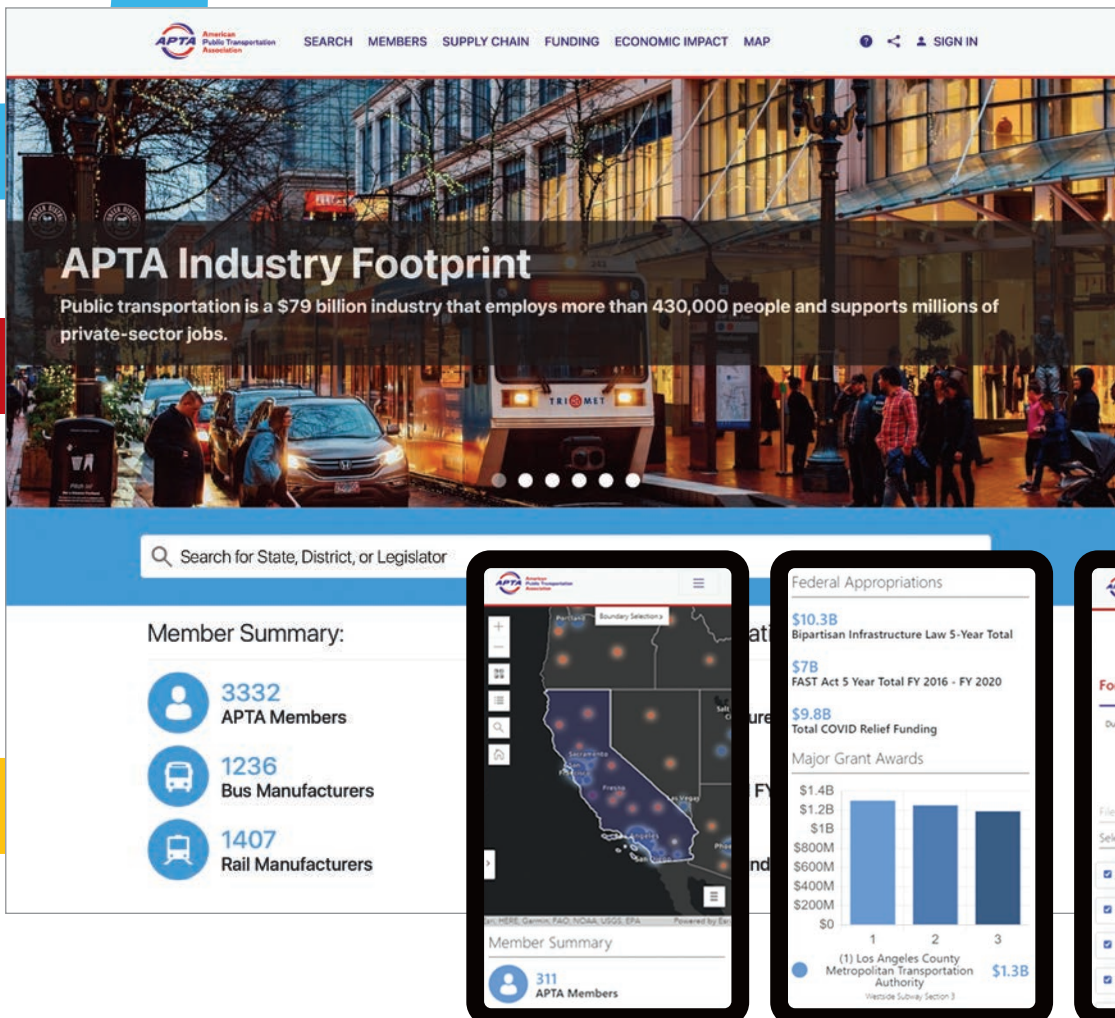
The Public Transit Opportunity Index was developed based on population density, access to vehicles, household income, frequency of solo automobile commuting, traffic volume, price of fuel, and current use of public transit.

To better understand the populations that use public transportation, APTA employs Esri Tapestry Segmentation, a data portfolio that classifies and provides detailed

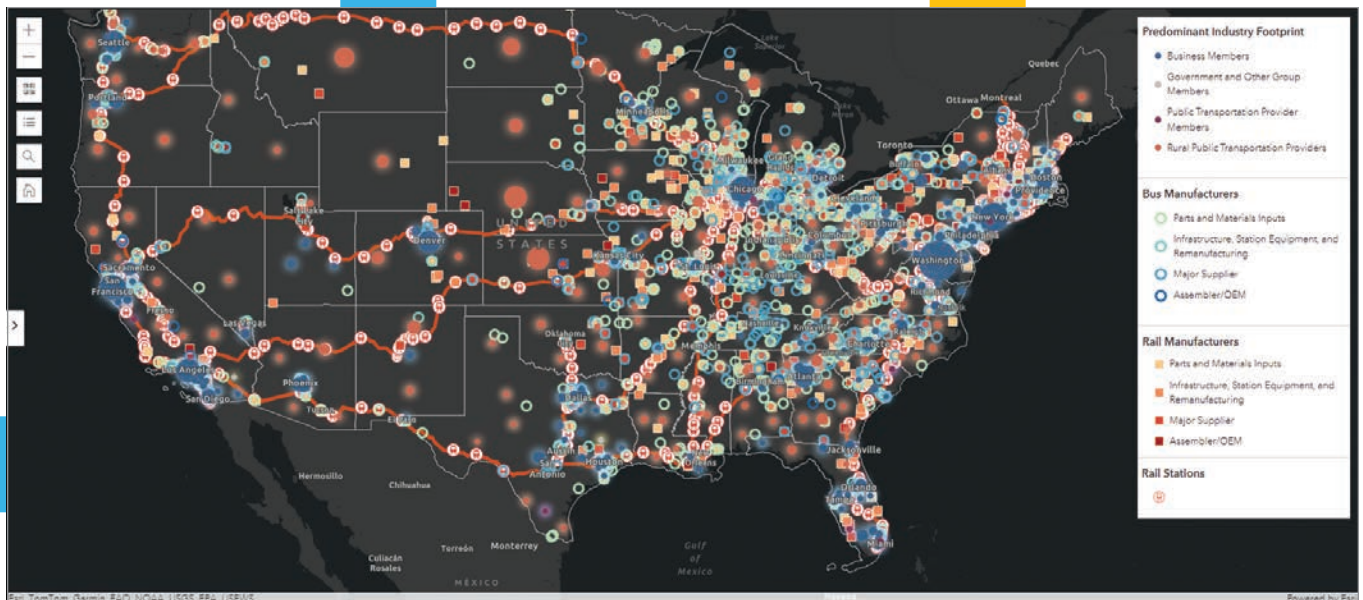
summaries of communities throughout the United States. The classifications are divided into 67 distinct markets.

“The Tapestry data helps us gain a deeper neighborhood understanding and develop an engagement strategy,” said Dickens. “Details include gender, race, ethnicity, income, worth, and typical occupations. Combining these market profiles with housing information and population-growth data provides a comprehensive view of a region or locale.”

Search capabilities in the app include a number of selection options—local legislator, state, APTA member, or committee name. Based on the specific search, the app provides detailed spatial data and aggregated statistics.



← The APTA Industry Footprint application main login screen features robust search capabilities. The app is also optimized for use on mobile devices.



The Road Ahead

The chief benefit of APTA's Industry Footprint app is that it streamlines the search for information necessary for public transportation advocates as well as the public to paint a clear, cohesive picture of the current state of public transportation in their communities and in the United States as a whole.

"What would have taken days of research and analysis just a short time ago can now be accomplished in seconds," said Dickens.

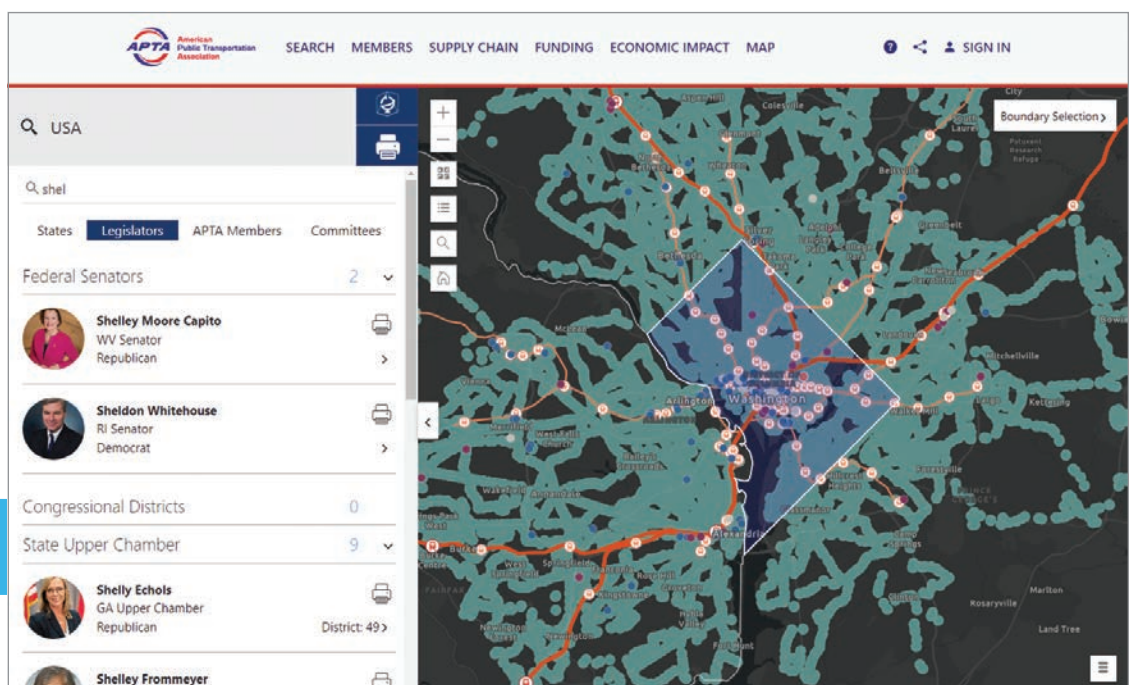
"[This leaves] more time to share, discuss, and act on the information presented by the application."

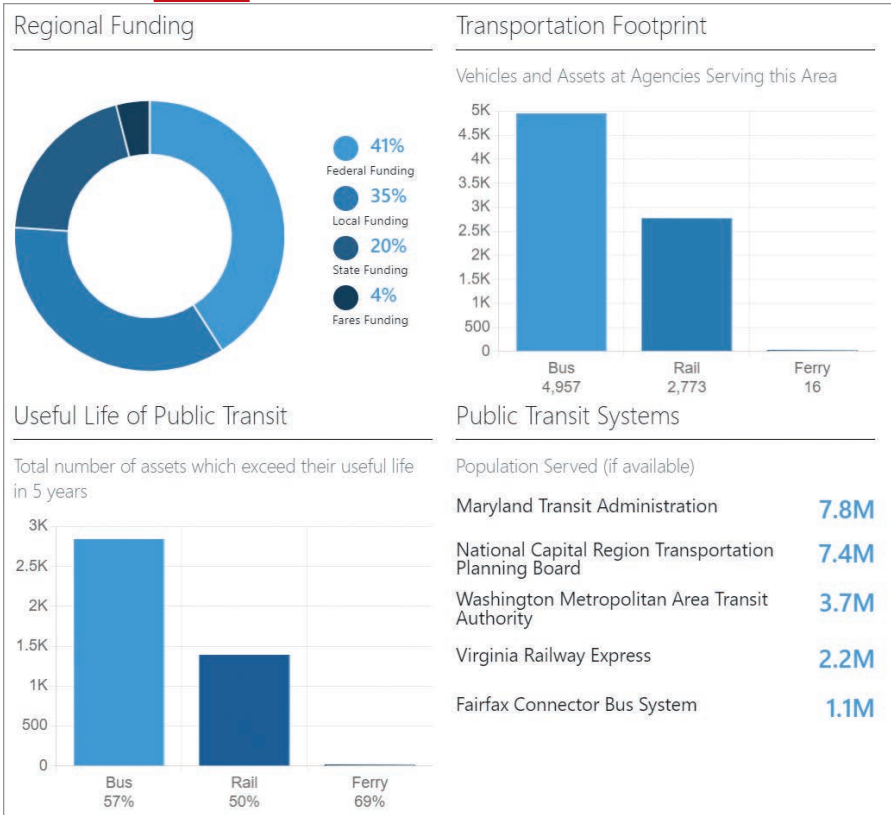
Of course, challenges arose during the process of app development. Nordling cited the volume of print requests that can occur during periods of heavy usage, for instance.

"Monitoring the requests and confirming their completion was a technical challenge solved using innovative cloud architecture," he said.

↑ This map illustrates the type and distribution of data powering the application.

→ Search functionality includes legislator names, geographic location, APTA membership, and committee focus.





results in a visually pleasing and compelling report format.”

Thus far, users of the application have lauded the extensive datasets available to them, which allow a wide range of analytical capabilities for the transportation industry.

“The Industry Footprint application provides a one-stop solution for public transportation policy advocates looking for information to present to legislative leaders and decision-makers,” said Dickens.

Explore APTA’s Industry Footprint app at footprint.apta.com.

About the Author

Jim Baumann is a longtime employee at Esri. He has written articles on GIS technology and the computer graphics industry for more than 30 years.

← Dynamic charts and summary statistics give insight into an area’s public transportation footprint.

Maintaining the linkage between legislator data and the Industry Footprint app using application programming interfaces (APIs) in the event of an API failure was also critical. To solve this problem, the periodic download of all API data to Amazon S3 storage made it available to the user at all times.

“We are continually adding capabilities and enhancing features of the Footprint application,” said Dickens. “Our current focus is on improving the search experience for APTA members, and providing summary statistics for each member in the districts in which they are located. Advances in charting libraries and enhancing the mobile experience will continue to make the application more accessible to a wider audience.”

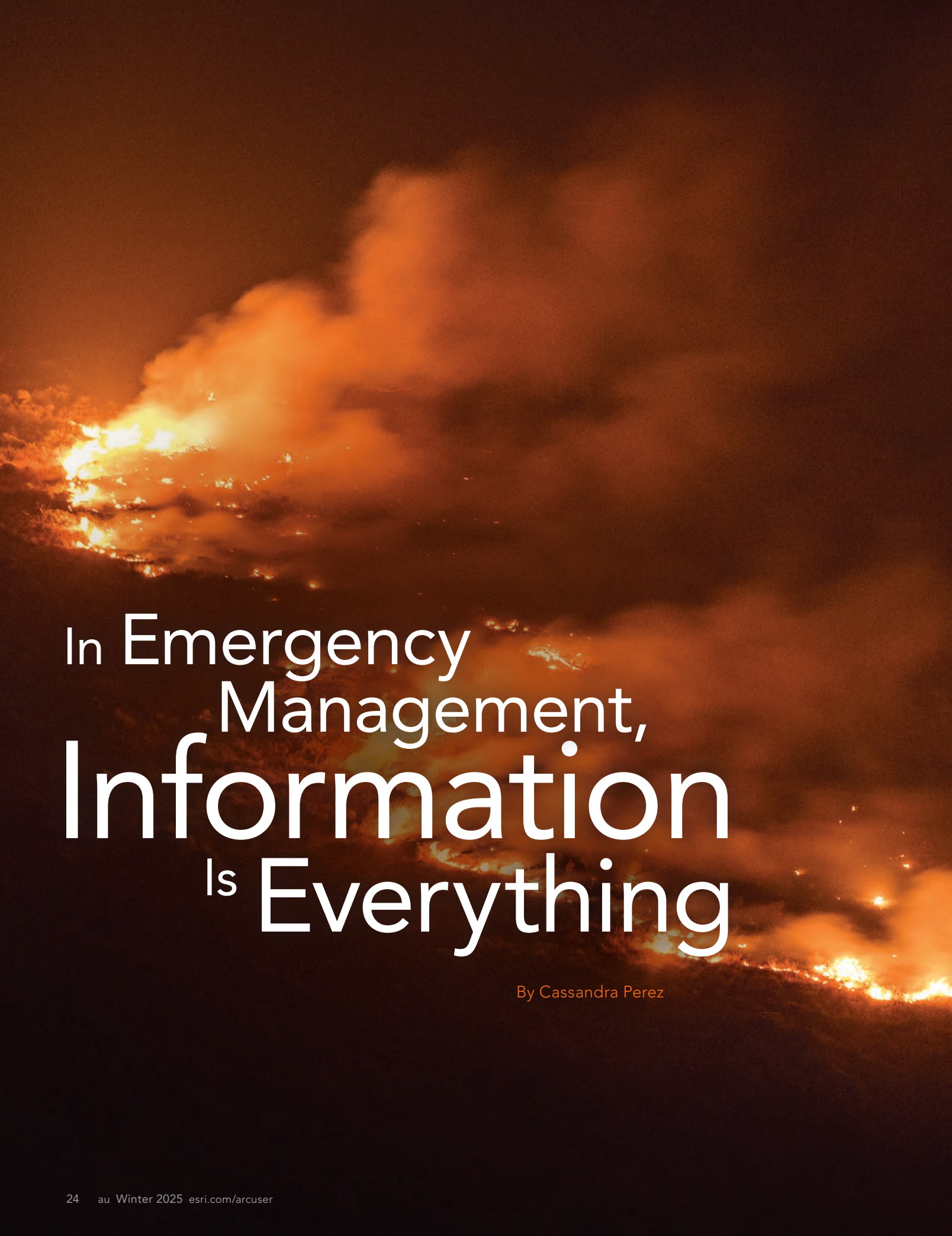
Dickens, too, emphasized that ease of access and accessibility were clear priorities for the app, noting that “the application brings best-available data from a wide variety of sources together, conducts detailed relevant analysis, and presents the

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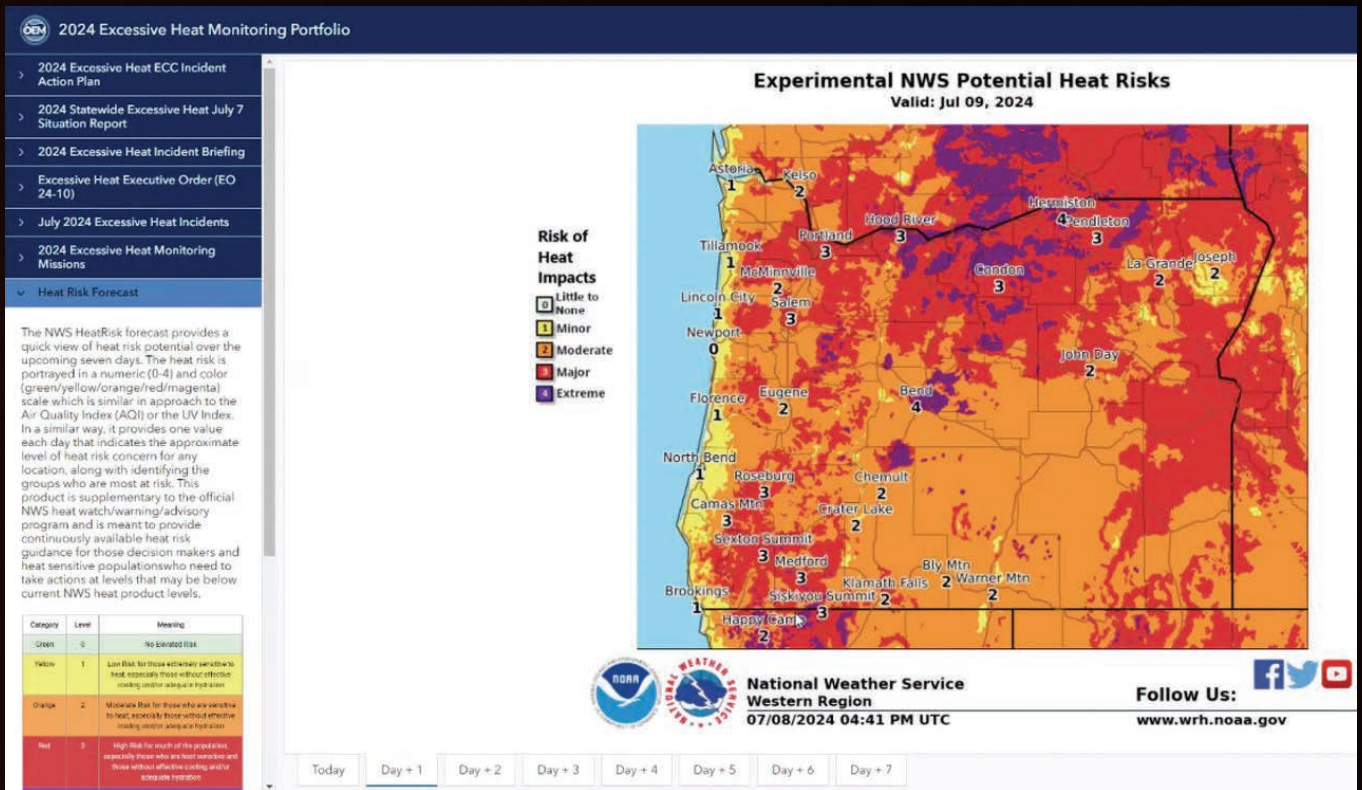
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In Emergency
Management,
Information
Is Everything

By Cassandra Perez



↑ An excessive-heat monitoring portfolio displays real-time heat risk information.

In recent years, the State of Oregon has faced a significant increase in the frequency and intensity of wildfires, making efficient and timely disaster management a top priority. The Oregon Department of Emergency Management (OEM) coordinates and maintains a statewide system for emergency and disaster communications.

Maintaining an accurate and accessible system of maps is a necessary part of responding to emergency situations across the state. However, according to Curtis Peetz, a response planner at OEM, the agency has faced multiple challenges in maintaining and updating its maps. These maps are crucial for providing clear and effective situational awareness about the status of various incidents and state agencies' responses to them.

The department needed to find a way to improve information-sharing and decision-making processes, particularly during emergency events. By leveraging ArcGIS Instant Apps, OEM has not only improved its partners' access to critical information but also enhanced the reliability of the data being reported.

Information Delay

In the past, OEM staff built a common operating picture by manually compiling information from various sources to create situation reports. These reports included photographs of maps, which were then inserted into a Microsoft Word document and published in the afternoon, showing data that was 8–12 hours old. The delay meant emergency response teams did not have the up-to-date information they needed.

The OEM information and planning team used an app template designed for presenting a related set of maps to show incident areas such as wildfire locations. With this system, any data required for daily situation reports had to be manually collected, a task that included processing requests for assistance and compiling statistics. This had to be repeated every 12 hours. Despite the maintenance and update challenges, maps served as a foundational element in OEM operations.

"It was extremely . . . time-consuming, and not always very accurate," explains Kelly Jo Craigmiles, OEM operations and emergency program coordinator.

When specific information was required, the team would put in a request for the GIS specialist to gather data. However, the team frequently found that the requested data wasn't what was needed, leading to additional requests for different information.

An Instant Solution

To address these challenges, OEM turned to ArcGIS Instant Apps. The small team had limited time to develop custom solutions, so the ArcGIS Instant Apps gallery—including preconfigured app templates as well as an express mode, which allows users to quickly configure and create an app—proved incredibly useful.

Daniel Stoelb, GIS program coordinator for OEM, used the Instant Apps Portfolio template, which is designed to present a series of maps, scenes, and apps as well as other content such as images, PDF files, and embedded web pages. This template allows maps and apps to be assembled in one place. The maps can also be shared on a new, publicly available website, giving the community better situational awareness after natural disasters.

According to Peetz, the flexibility and user-friendly nature of the apps has allowed nontechnical team members to contribute and update information, and enabled Stoelb to set up a replicable template for future events. In fact, OEM's entire setup and training on the solution took only 30 minutes, during a meeting of the Emergency Support Function Information and Planning (ESF 5) workgroup. ESF 5 aims to coordinate and support emergency management activities.

"It's about getting a baseline template set up and writing procedures. The steps to success were very easy because it's a repeatable process and people are familiar enough with the product," Stoelb said.

Everyone in the ESF 5 workgroup can help maintain the portfolio template. They are trained to create new sections in the template, attach and save PDF files, and share updates with the group and response partners, and all have ArcGIS Online accounts.

The training is straightforward and supported by visual aids like screenshots to

simplify navigation and make it easy for team members to upload and update information as needed. The flexibility of the system allows them to adjust what can be displayed and provide a situation report. When the National Weather Service or other partners send updates in the form of PDFs, these updates are easy to incorporate into the Portfolio template as new tabs within the incident portfolio.

The new site delivers a comprehensive report on any given emergency by providing links to real-time data on weather conditions, air quality, heat risks, and potential hazards. "The goal of our portfolio really is to be that comprehensive, common operating picture to point people to and say, 'Go here, and here's where you get the information about what's happening in this incident,'" said Peetz.

A Framework in Place

OEM's integration of ArcGIS Instant Apps has enhanced the department's situational awareness and information-sharing capabilities. The app compiled all relevant

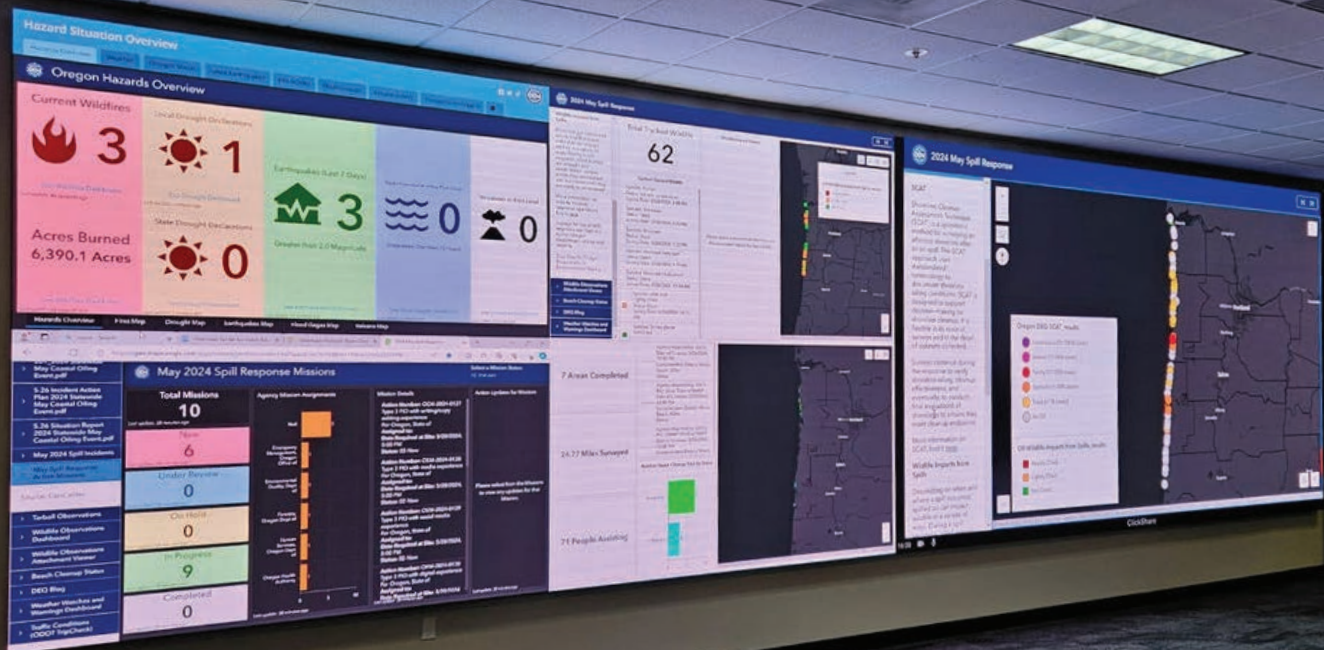
information in one place and improved situational awareness about potential and ongoing hazards. This helps partners like the Oregon State Fire Marshal and the Oregon Department of Forestry make informed decisions, fostering a more informed response community. The app also facilitates real-time updates and comprehensive documentation during an incident.

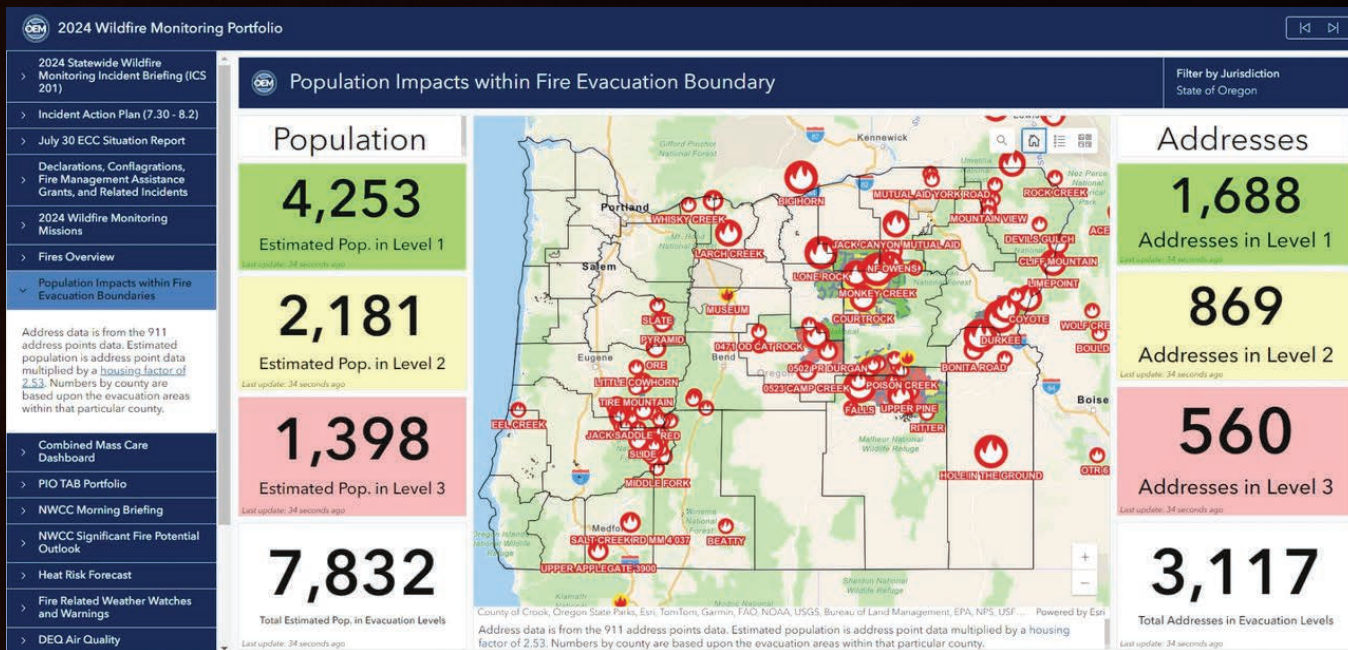
"It's a lot easier to initiate our response at the beginning of an incident when we already have expectations set," explains Stoelb. "Using templates, we prearrange all necessary tabs, streamlining the transfer of information to the Planning section with data from other authoritative sources."

According to Stoelb, setting up a portfolio based on a preexisting template took around 15 minutes, while creating a new application from scratch could take multiple hours. The template allowed the team to shift focus from the standard data they typically provided so that they could research what they were missing instead.

Stoelb keeps existing hazard templates in a folder in ArcGIS Online, which makes

↓ The State of Oregon Emergency Coordination Center's main screen displays dashboards and portfolio templates for tracking the response to a May 2024 oil spill in Oregon.





↑ The application depicts the populations within fire evacuation boundaries and the status of evacuations from wildfire throughout Oregon.

them easier to replicate for new events and allows for the preservation of standard formats like icons and color codes. This ensures consistency of information and saves OEM time when setting up a new app for emergency events.

“We all know what we’re going to get. There are no surprises. It’s wonderful. It saves so much time and it’s a known quantity, something we can expect every single time,” Craigmiles said.

Dynamic Results

ArcGIS Instant Apps facilitates information sharing through links, ensures that the information OEM provides is current with source updates, and enables access to real-time information from partners. Now, OEM staff can guide individuals directly to primary sources, which are also documented on each tab of the incident portfolio.

The app also allows users to clearly see areas where a wildfire may be encroaching on a population, as well as shelter locations. This offers a much clearer method of viewing information compared to traditional static paper documents.

Information is now accessible to local counties, tribal jurisdictions, and response partners, which often operate with minimal staff and resources. Providing these groups with the same information in near real time

allows data to guide their decision-making.

“[Elements] can change so very quickly during wildfires that we’re giving them that real-time data so that their elected officials can make determinations and decisions on what [they] need to do...to help protect [their] populace the best by being able to visualize that,” said Stoelb.

Combining static and dynamic information offers a clear and impactful visual representation of situations. The Federal Emergency Management Agency (FEMA) Regional Response Coordination Center (RRCC), which collaborates with OEM, has frequently said the app’s near real-time information and visuals are helpful for disaster declaration requests. This visual approach significantly enhances the agency’s understanding of an incident’s severity. FEMA now has data in one place, which streamlines the approval process and gets Oregon the funding needed to help residents recover.

With this app, “folks have consistent and timely information provided at the local level as well as up to our executive leadership to help us save lives,” said Peetz.

About the Author

Cassandra Perez joined Esri in 2018 as a content marketing writer. She received a master’s degree in mass communications

from California State University, Northridge, and has almost 10 years of experience in writing and producing content for digital and print channels.

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7 Signs You Need a (New) GIS Strategy

By Matthew Lewin

I was asked recently whether there are telltale signs that a new GIS strategy is in order. I've written plenty about the process behind strategy development, but I have yet to discuss the catalysts of the process in detail. So, it begs the question: What's the tip-off that you need to develop a new strategy, or at least refresh key elements of your strategy such as your solution portfolio, data architecture, or governance processes?

Like any other technology, the effectiveness of GIS is contingent on a well-crafted strategy. And as technology and business landscapes evolve, so do our strategies. Here are some signs that your GIS strategy most likely needs an update.

1 Your Technology Feels Outdated

One of the most glaring signs that you might need a new GIS strategy is when your technology feels like it belongs in a museum. If your software lags behind several versions or your hardware struggles with current demands, it's time to upgrade. Outdated tech not only hampers efficiency, but also prevents you from leveraging new capabilities, limiting your ability to compete and innovate.

For example, outdated desktop software might prevent you from connecting to real-time data streams or collaborating with other users via cloud-based collaboration capabilities. Or your mobile apps might not support disconnected operations or editing, preventing fieldwork staff in remote areas from realizing the benefits of tech-supported workflows.

In cases like these, a review of your overall strategy is probably in order. As you start to explore new technologies, you'll inevitably have questions regarding data requirements, system architecture, return on investment (ROI), user training, governance processes, and more. This indicates a need to think holistically about the overall investment you're making and the capability you're building—in other words, your GIS strategy.

GIS is a powerful technology, but only if your strategy is up-to-date.

2 No One's Using Your Tools

If you've invested in GIS-based tools that are relatively up-to-date, but no one's really using them, that's a problem. Maybe the tools are too complicated, or maybe people just don't see the value. Either way, it's a sign your current strategy isn't hitting the mark.

There could be many underlying reasons for this situation, but one common issue is that your current approach needs to pay more attention to change management. Effective change management is crucial to guide users through a significant transition, such as a new platform, revised workflows, or an organizational structure change. You need to address people's concerns, and ensure that they're equipped and motivated to embrace the latest systems. A strategy that fails to address the impact of change on the organization is likely doomed from the start. Take another look at your strategy, ensure that you understand the readiness of your people for change, and incorporate best practices into your road map.

3 You've Got Data Silos and Integration Issues

Data silos are a significant roadblock in any organization. If your spatial data is fragmented across different departments or systems, it creates inefficiencies and makes it challenging to get a comprehensive view of your data. This lack of integration is often a sign that you need to rethink how you deliver your GIS technologies and data.

An updated GIS strategy should prioritize breaking down these silos. Modernizing your data architecture, standardizing data formats, and formalizing data management workflows can enhance interoperability. Moreover, integrating GIS with other enterprise systems like customer relationship management, enterprise resource planning, and asset management can streamline operations and make data more accessible.

4 Your Data Quality Is Lacking

Data is the heart of GIS, so if your spatial data is outdated, incomplete, or inaccurate, it compromises the value of your investment. Poor data quality leads to flawed analyses and suboptimal decision-making. Not a good situation to be in! High-quality data should be a cornerstone of your new GIS strategy.

Let's say you're using GIS data for urban planning purposes, and the data you have regarding population density and infrastructure locations is outdated and incomplete. This could lead to errors in zoning decisions and the allocation of resources for public services. For example, inaccurate population density data could result in inadequate provision of essential services in areas with a higher population than what is reflected in the data. That means inefficiencies and taxpayer dissatisfaction. Revamp your strategy to focus more on data quality by implementing regular audits and utilizing real-time data collection tools, such as drones for aerial imagery or Internet of Things (IoT) devices for continuous monitoring.

5 Your System Can't Keep Up

As demand for geospatial tools and maps grows, the performance of your GIS needs to keep up. Poor system performance—characterized by frequent downtime, slow response times, and inefficiencies—indicates that your current strategy is failing to meet the demands of your organization. This underperformance can lead to decreased productivity and user dissatisfaction. It also suggests that your GIS infrastructure may be outdated, inadequately maintained, or misaligned with business needs. Addressing poor system performance often requires a strategy refresh that considers modernizing technology, enhancing system integration, and implementing proactive maintenance. These measures will help improve overall reliability; efficiency; and, ultimately, organizational performance.

6 You're Not Seeing the ROI

Poor return on investment means that your GIS investment is not delivering expected benefits, which can result from any of the issues mentioned throughout this article—including out-of-date technology or poor user adoption—but could also include misalignment with business goals, unrealistic expectations, or overall implementation challenges.

This underperformance could signify a need for a new strategy to realign technology investments with business objectives, enhance user adoption, improve implementation processes, and

optimize operational efficiency. A revised strategy ensures that technology investments provide value, support business growth, and drive long-term success.

7 The Business Landscape Is Changing

The business landscape is constantly changing, bringing new challenges and opportunities. If your GIS strategy hasn't evolved to keep up with these changes, you risk falling behind. Whether it's addressing new regulatory requirements, market trends, business strategy or structure shift, or technological advancements, your GIS approach needs to stay current.

All of this speaks to strategy setting as an ongoing process. It's something you do and revise continuously as conditions change. A proactive GIS strategy should anticipate and adapt to evolving business needs. Make sure you stay informed about industry trends, engage with GIS professionals, and continuously explore innovative applications of GIS technology. Regularly revisiting and updating your strategy ensures that it remains aligned with your business objectives and supports sustained growth.

For example, a logistics company faced new regulatory requirements for tracking and reporting on carbon emissions. The company's GIS environment, which focuses primarily on routing and logistics, didn't address these new needs. The system and data architecture weren't designed to support the necessary workflows or mapping requirements; users needed to be more adequately trained and knowledgeable in the new workflows, and governance processes needed to be revised. Essentially, what the company needed was a refresh of its whole approach to GIS.

Wrapping Up

GIS is a powerful technology, but only if your strategy is up-to-date. If you notice any of the signs mentioned in this article, it's time to rethink and refresh your approach. By staying agile, focusing on data quality, and aligning your GIS initiatives with your business goals, you'll be well-equipped to make the most of what GIS offers. Here's to a smarter, more efficient, and geospatial technology-driven future!

About the Author

Matthew Lewin is the director of management consulting for Esri Canada. His efforts are focused on helping management teams optimize and transform their businesses through GIS and location-based strategies. As a seasoned consultant, Lewin has provided organizations in the public and private sectors with practical strategies that enable GIS as an enterprise business capability. His interests lie at the intersection of business and technology, and he thrives on helping organizations bridge the gap between the two to achieve their most challenging GIS ambitions.



► Affordable Housing Policy Starts with Location

By Keith Cooke

For decades, the United States Census Bureau has published monthly reports about residential construction statistics. But this isn't the only metric that can capture the pulse of America's housing market. Since 1985, the National Association of Home Builders has published the Housing Market Index (HMI) on a monthly basis. This index is designed to reflect overall builder confidence in the housing market.

The HMI is derived from a monthly survey that asks single-family residential builders to evaluate three key aspects of the housing market: the current sales of new

single-family homes, the anticipated sales of these homes over the next six months, and the level of traffic from prospective buyers of new single-family homes. These components are rated on an index with a threshold of 50. A rating above 50 indicates that most builders express confidence the housing market, while a rating below 50 indicates less builder confidence.

In August 2024, builder confidence fell to a rating of 39, the lowest it had been in nine months. This also marked the fourth straight month that this rating has declined. Current sales conditions dipped to 44 and traffic

of prospective buyers fell to 25. For more than two years, these readings have been on a roller coaster, but the HMI has rarely exceeded 50, and has only maintained this level for a maximum of four consecutive months out of the last 26.

For perspective, during the six months leading up to April 2020 (the first month after the pandemic hit the United States), the HMI ranged from 71 to 76, indicating high market confidence. The HMI flourished in 2021 and the first half of 2022, peaking at 84. Since July 2022, it has never exceeded 56.



← Planners, community development directors, and municipal leaders can use a data-driven geographic approach to shape housing policy for their city or county.

It doesn't take a world-renowned economist to identify the key culprit of buyer (and developer) hesitation: the elevated interest rate. That isn't the only problem, though. Housing affordability was a critical issue even before interest rates rose a couple of years ago. Much of the problem was driven by lack of supply as well as supply chain issues brought about by the pandemic.

As a planner, community development director, or municipal leader, you cannot fall into the trap of believing that today's housing affordability crisis is strictly an interest rate issue and, therefore, out of your hands.

Location, Location, Location

Planners and municipal leaders are directly involved in housing policy for their city or county. Policies and zoning ordinances that were put in place prior to the 2010s are unlikely to meet the needs of current and prospective residents. Today's generation of homeowners typically do not want access to exclusively single-family homes on large lots. The appeal of middle housing alternatives, such as townhomes, duplexes, and cottage courts, is strong because of both lower cost and maintenance.

The first step in policy development is to gain an understanding of community needs.

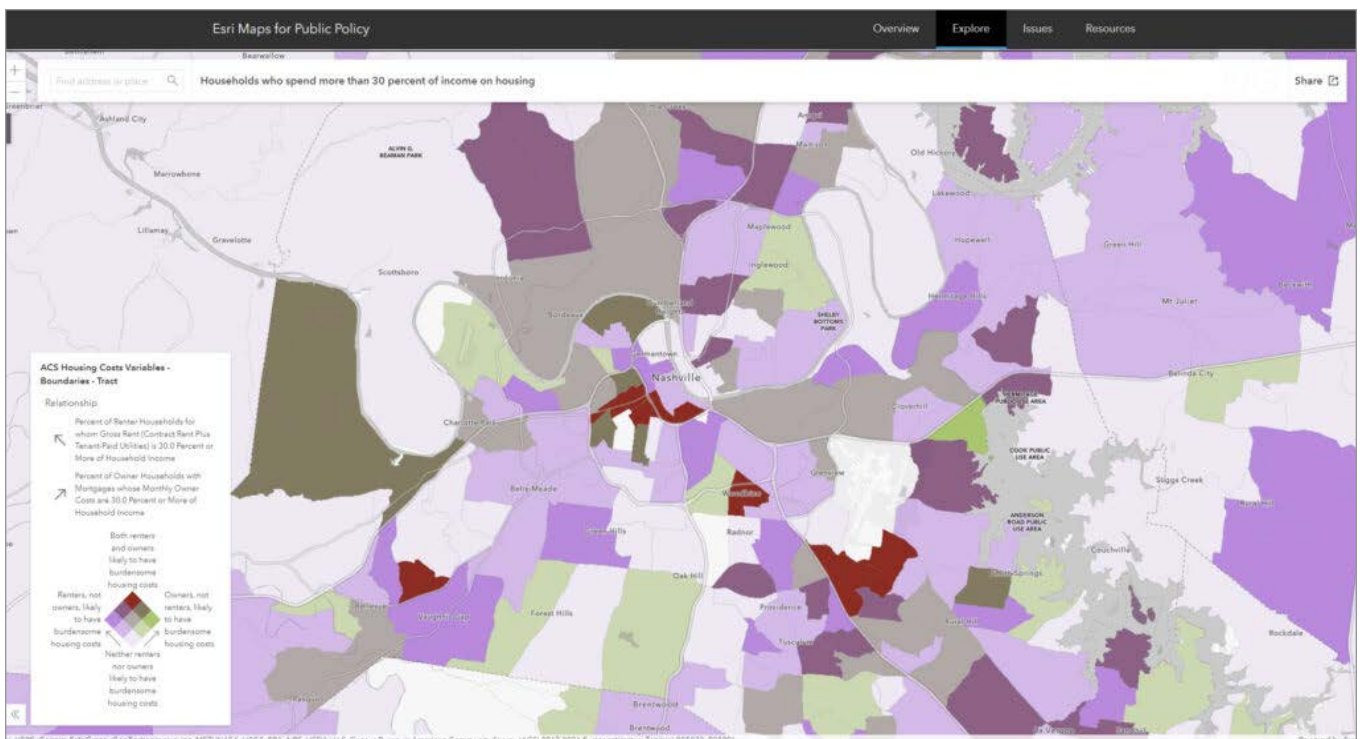
A free resource available to help determine this is the Esri Maps for Public Policy app in ArcGIS Living Atlas of the World. With over 800 curated maps, including 200 focused on housing, this app is an invaluable resource in taking a data-driven approach to policy development. Questions that these maps help answer include:

- What is the predominant number of units per housing structure, not including single-family detached homes?
- Where are the owned, rented, and vacant housing units in a specific neighborhood?
- What is the relationship between the median housing age and cost-burdened housing?
- Where are the households that spend 30 percent or more of their income on housing?

A Geographic Approach to Implementing Affordable Housing

With an understanding of residents' needs and struggles, planners can perform suitability analysis for affordable housing. Again, a data-driven approach is necessary because even the phrase "affordable housing" can trigger unhelpful political discourse. In

↓ This ArcGIS Living Atlas of the World map shows cost-burdened households, differentiated by renters and owners in the metro Nashville area.



other words, the specific sites for affordable housing cannot accurately be derived from anecdotal evidence or your feelings as a planner as to where it should be.

Tools within ArcGIS Urban allow planners to run parcel suitability analysis for a neighborhood or entire city. Determining which factors are involved and how suitability is measured is up to each municipality. Common suitability metrics include access to groceries, retail, education, and health services; transit options; ideal zoning regulations; parcel size and structure; and vacant lots with potential for purchase agreements.

This data-driven geographic approach changes the narrative in a municipality. The discussion becomes about the necessity of affordable housing units in certain locations, because of proximity to jobs and

transit options, neighborhood revitalization, and more.

What Will It Look Like?

Finally, the design work can begin. Using ArcGIS Urban, planners can collaborate with developers to design housing and mixed-use developments that meet the needs of residents, while also being feasible and profitable for developers. This iterative scenario planning is a quick and cost-effective approach for planners and developers alike. They can both rapidly view the results of subtle or large changes and answer questions such as:

- Do we have the zoning regulations in place to accommodate mixed-use or compact, walkable communities? If not, what parameters (e.g., FAR, parcel coverage, permitted uses, building height, etc.) would

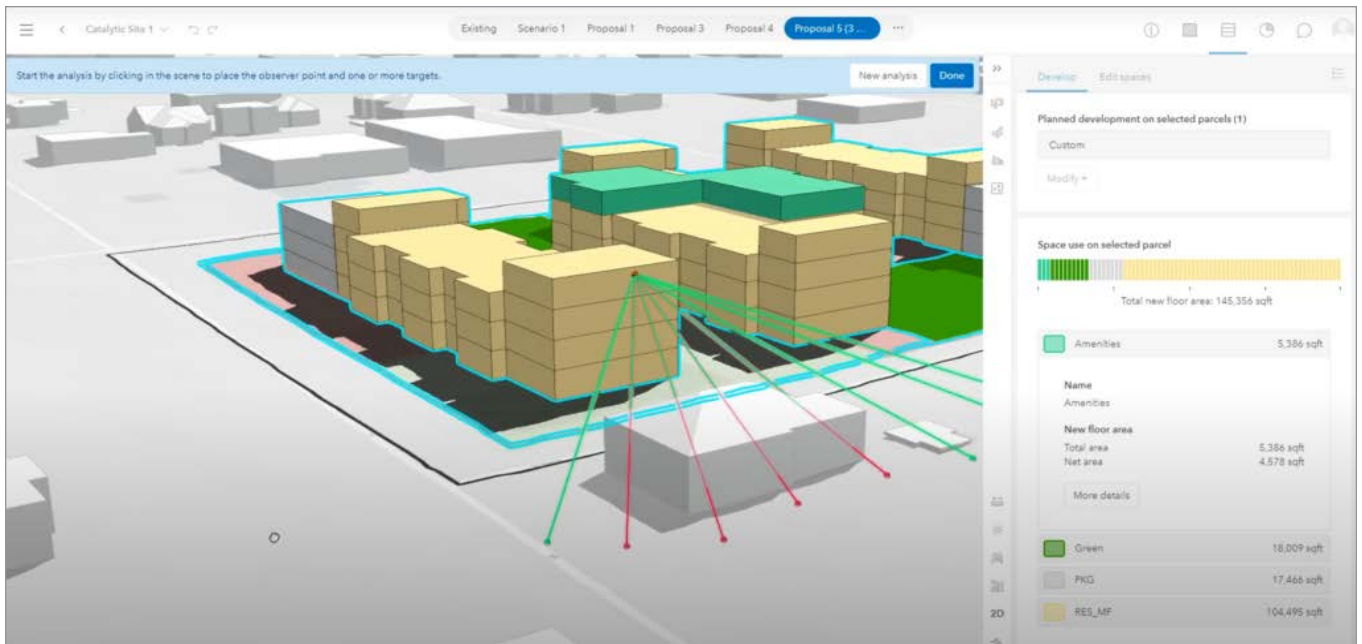
that zone need to have to accommodate developers' and residents' needs?

- If we add a single floor to a development, how many residents will this add? How many additional jobs will it create in office spaces? In commercial spaces?
- What is the impact for a proposed development regarding tax revenue, utilities, transit, etc.?
- Will the development have issues involving line of sight and/or shadow impact that will negatively affect resident sentiment?
- How many potential units can we create if we require 10 percent of new homes in a district to be designated as affordable units? What would the fiscal impact be on the developer?

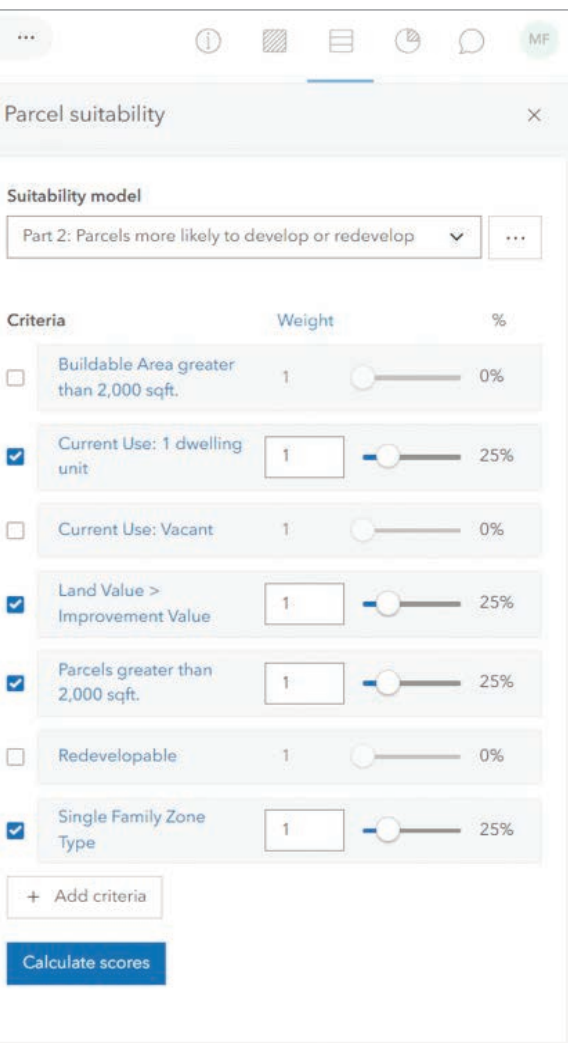
There is no simple fix for addressing affordable housing. There are also factors

↓ ArcGIS Urban can be used to identify and prioritize metrics for suitable locations for affordable housing.





↑ This scene shows a development with a designated percentage of units as affordable units. A line-of-sight tool is applied to reveal the obstruction from a proposed development.



outside the control of planners, city administrators, and elected and appointed officials. However, these same leaders must put policies in place now that motivate and incentivize developers to meet residents' needs. By leveraging GIS, planners and administrators can take a data-driven approach to identify suitable locations for affordable housing and work with developers to design developments that meet both community needs and market demands. This geographic approach not only helps planners make informed decisions but also changes the conversation around affordable housing from one of uncertainty to one backed by evidence and sustainable strategic planning. As the housing market continues to fluctuate, proactive, informed policymaking will be essential in ensuring that communities can thrive and remain accessible to all residents.

About the Author

Keith Cooke is the director of planning and community development markets at Esri. A graduate of Auburn University, he has been a GIS professional since 1994 and has worked for planning and community development agencies at the regional and municipal levels. Previously, he was an account executive at Esri for 15 years, working with over 100 local governments. He is a frequent speaker at GIS, community planning, and

economic development events. He is also an active member in the American Planning Association, where he has conducted nearly 100 hands-on GIS workshops for planners since 2004 at the National Planning Conference and state chapter conferences.

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Build a Strong Geospatial Foundation for Your Organization

By Tammy McCracken, Jim Pardue,
Deepti Kochhar, and Hamid Yunus

As organizations evolve and embrace digital transformation, digital and data strategies have become indispensable components of their success. And in this strategic planning landscape, the integration of geospatial elements has become critical. The central advantage of folding GIS into your business strategy is its ability to provide spatial context. This adds a new dimension to strategic initiatives, enabling businesses to gain deeper insights, delve into advanced analytics, optimize resources, and unlock opportunities for growth.

Building your organization's GIS program on a strong foundation is essential to the success of your geospatial operations. Enter the Path to Geospatial Excellence web page, an online resource designed to help organizations implement and maintain a successful enterprise-class GIS environment. This programmatic approach involves five key components on which organizations can build their geospatial technology capabilities and leverage location intelligence to drive innovation and informed decision-making. These components are business, governance, systems, engagement, and capacity.

1 Business

Business is the first and most critical component to building a strong foundation for an organization's GIS program. Aligning GIS with the organization's mission, vision, and priorities is essential. The core of geospatial operations success involves thorough understanding of how location intelligence impacts business operations and outcomes. Organizations must align their GIS initiatives with their overarching business objectives, vision, and priorities while identifying specific use cases and applications where geospatial insights can deliver tangible value.

By integrating geospatial considerations into strategic planning and decision-making, businesses can harness the power of location intelligence to optimize processes, mitigate risks, and gain a competitive edge. A core element of this component is developing a geospatial strategy with executive backing and support. That means building a strong team with all the right people involved, who represent key aspects of the organization.

2 Governance

Effective governance is crucial for managing a geospatial operations program and ensuring alignment, impact, capacity, quality, and security. This component involves establishing clear policies, standards, and procedures that govern an organization's geospatial operations program. This includes organization structure, GIS environment, data, applications, and tools. By implementing robust governance frameworks, organizations can maintain a comprehensive system, preserve data integrity, enforce compliance, and facilitate transparency and collaboration among stakeholders. Governance provides a decision-making structure, clear ownership, and organizational accountability needed to manage and allocate limited geospatial resources such as people, processes, and technology.

Organizations can struggle with various challenges when it comes to governing a geospatial operations program. Many of these problems stem from not having a clear understanding of policies and procedures or the capacity to address governance challenges. Knowing what challenges are most critical to your organization helps you optimize your resources and organizational structure.

The national Geospatial Data Act (GDA) of 2018 and the FAIR Principles, introduced in 2016, spurred many organizations to begin their governance journey of geospatial data and technology. Several federal, state, and local government agencies established effective geospatial governance frameworks, policies, procedures, standards, best practices, and tools to ensure that their geospatial systems and data adhered to their strategic plans. This allowed the organizations to:

- Lead the development and management of geospatial data infrastructure with executive committees that oversaw geospatial assets.
- Establish and maintain best practices and standards for their critical organization geospatial assets and data.
- Establish and operate their geospatial platform in accordance with best practices and guidelines.
- Foster communication and collaboration with their key stakeholders.
- Identify and meet the needs of the users of geospatial data assets.

3 Systems

The systems component focuses on the infrastructure, data, innovation, and analytics that are needed to underpin geospatial operations. This includes identifying and implementing appropriate GIS software, databases, and hardware systems to effectively capture, manage, analyze, and visualize geospatial data. By investing in scalable and interoperable systems, organizations can enhance their analytical capabilities, streamline workflows, and facilitate seamless integration with other enterprise systems. At the core of this approach lies the recognition that ArcGIS serves as a system of systems, composed of a robust framework that encompasses systems of record, engagement, and insight. Additionally, a well-architected framework forms the bedrock for fostering innovation and ensuring the sustainability of long-term enterprise geospatial operations.

users across the organization to make sure that user needs were met, and provided active continued support. The customer success managers were responsible for:

- Managing a portfolio of geospatial technology stakeholders.
- Understanding the business and technical requisites for bringing added value.
- Managing geospatial project/product enhancements, delivery, and operations.
- Engaging a community of practice with staff enablement workshops.
- Providing skills development and capabilities enhancement plans for teams.

In essence, these ambassadors were pivotal in bridging the gap between technological capabilities and user needs, ensuring that the organization was successful in achieving its desired outcomes. By fostering a culture of engagement in this way, organizations can create sustainable and long-term success of geospatial technology adoption and operations.

4 Engagement

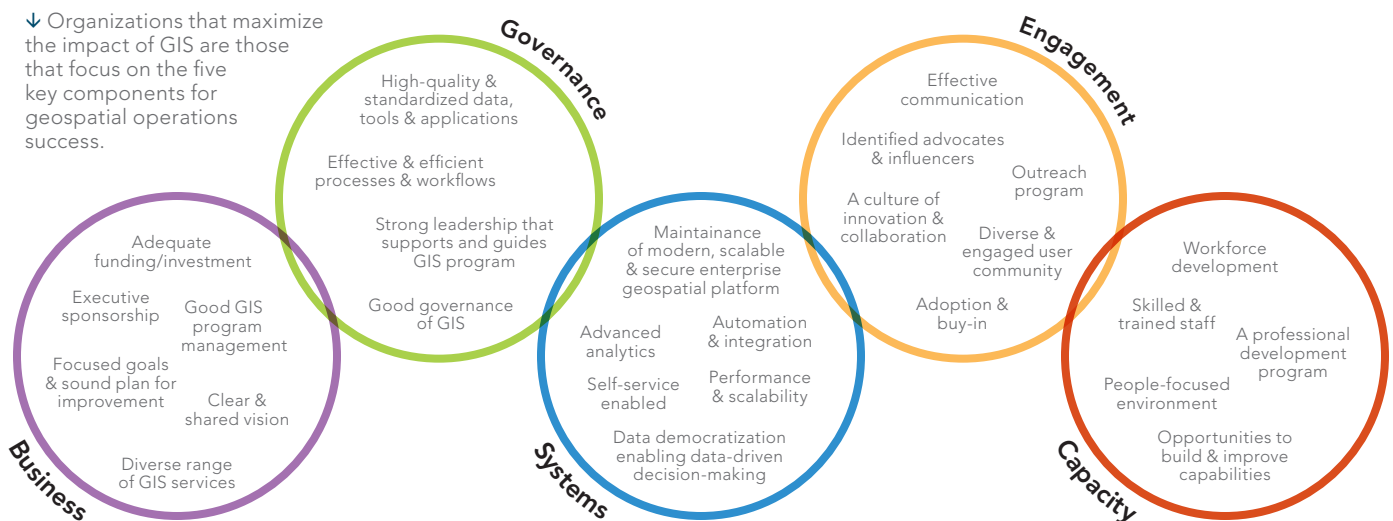
The engagement component is critical to the success of geospatial operations program for several reasons. For one thing, it ensures consistent communication and collaboration with stakeholders, which is essential for gaining buy-in for the successful adoption of a geographic approach and actively engaging end users, decision-makers, and external partners throughout the geospatial operations program. This kind of active communication is also necessary when soliciting feedback and providing support to ensure user proficiency and ownership among stakeholders. By fostering a culture of engagement, organizations can maximize the value derived from geospatial technology investments, prepare the workforce for change, and drive broader organizational transformation.

One organization took a customer-centric approach by designing its customer success managers to serve as geospatial technology ambassadors. These ambassadors proactively engaged

5 Capacity

The capacity component focuses on building and nurturing the skills, new capabilities, and expertise necessary to leverage geospatial technologies effectively. This includes providing training, professional development, and career advancement opportunities for GIS professionals, analysts, and end users. By investing in capacity building, organizations can be certain that their workforce possesses the requisite knowledge and competencies to drive innovation and harness the full potential of geospatial tools. Capacity building also gives individuals capabilities that can impact the entire organization and deliver a geographic advantage that will support the organization's mission. The continuous building of new capabilities and efficiencies throughout an organization is crucial to expanding capacity.

↓ Organizations that maximize the impact of GIS are those that focus on the five key components for geospatial operations success.



1 2 3 4 5

One success story involves an architecture, engineering, and construction (AEC) company that started with limited GIS capability. Staff built a workforce development plan that defined training for specific roles, then followed it up with certification attainment. This initiative generated new revenue for the AEC firm and got the attention of the CEO. Recognizing the value of new location capabilities, the CEO recommended that everyone attain Esri technical certification. Staff accomplished this within a year and saw their business grow. The company achieved that growth through persona-based training plans; validated knowledge via certification; and applied these concepts to employees' work, thereby building robust capacity for additional business.

Characteristics of Success

Together, the five components provide a core framework and foundation to build a successful GIS program. When it embraces and aligns with these components, the benefits can be transformative.

Success in geospatial operations hinges on a comprehensive approach that addresses each of these key components. Success also requires thinking holistically about your GIS investment, not as a point solution technology but as an organizational enterprise

capability. By prioritizing and reinforcing the interplay between business alignment, governance, systems integration, stakeholder engagement, and capacity building, organizations can unlock the transformative power of geospatial technology and drive sustainable growth and innovation. The Path to Geospatial Excellence web page is geared toward developing a mindset shift that can produce actionable strategies and build resilience.

The path to geospatial excellence is a continuous journey. Much like embracing a healthy lifestyle, building a successful geospatial operations program is a lifelong journey that provides numerous benefits along the way. Although there is no ultimate destination, you can continuously improve and strive to reach greater heights. As you and your organization navigate your own unique GIS journey, you can apply the path to geospatial excellence as a road map to assist you along the way.

Find the Path to Geospatial Excellence web page at links.esri.com/geo-excellence.

About the Authors

Tammy McCracken is a senior consultant on Esri's emerging technologies market team. With over 25 years of experience in geospatial projects, she has developed cutting-edge spatial solutions with artificial intelligence and machine learning as well as communicated with vast sensor networks in smart city efforts. McCracken holds a bachelor's degree in information management from the University of Maryland and is pursuing her MS in analytics from the Georgia Institute of Technology.

Jim Pardue is a principal consultant and the strategy consulting community lead at Esri. He has over 35 years of experience working in the geospatial technology industry and has spent 32 years working for the United States government. He has led and managed diverse, dynamic, and multidisciplinary geospatial intelligence teams and organizations across the globe, supporting complex operations in austere environments. He spends his free time gardening and cooking outdoors, and has a passion for mentoring people such as young GIS professionals.

Deepthi Kochhar is the practice lead and executive consultant at Esri. She has over 26 years of experience working in the geospatial technology industry. She specializes in enterprise system implementation, geospatial strategy, governance, and business analysis. She has supported a variety of governments, nonprofits, and global development organizations in implementing geospatial technology solutions.

Hamid Yunus is a strategy adviser and senior consultant at Esri with 19 years of strategy, governance, and business consulting experience. His recent projects include strategic geospatial envisioning, digital twin initiatives, BIM and GIS integration, bespoke urban planning platforms, digital indoor mapping and positioning, and AI and machine learning-based solutions.



Technical Sponsor

- Supports technology
- Enables change



Champion

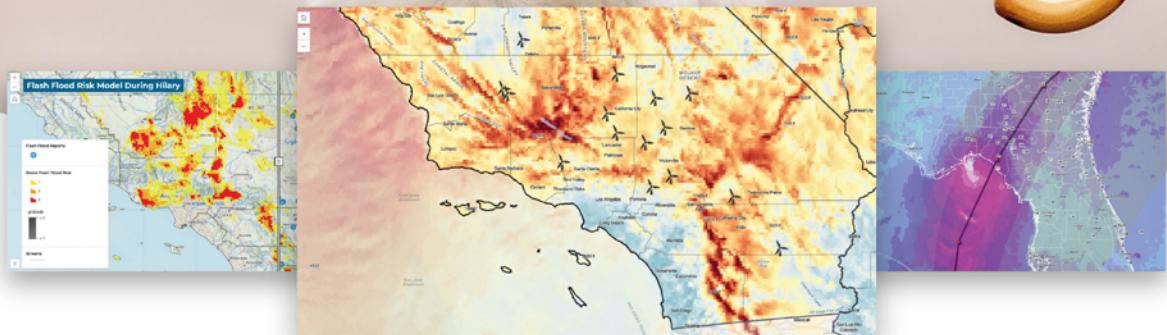
- Evangelizes GIS
- Sees potential



Executive Sponsor

- Assigns resources
- Engages stakeholders

← Key roles are needed to adopt and develop a geospatial strategy within an organization.



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Simplify Your Web App Development with Map Viewer

By Kristian Ekenes

There are often many different ways to develop a web application. Some are good. Others are better. In ArcGIS, starting with a web map built in Map Viewer is always best.

ArcGIS Maps SDK for JavaScript provides a wide range of APIs, components, and resources that enable you to build web mapping applications for a variety of workflows. Creating a map from scratch using the WebMap class is good, for instance, because it keeps you from having to do graphics development yourself.

But there is a better way. JavaScript Maps SDK boasts developer-friendly APIs and hundreds of samples that demonstrate how to build apps from the ground up using only JavaScript, CSS, and HTML.

However, there is an often-overlooked tool that can significantly improve your web app development—Map Viewer, available via ArcGIS Online or your ArcGIS Enterprise portal.

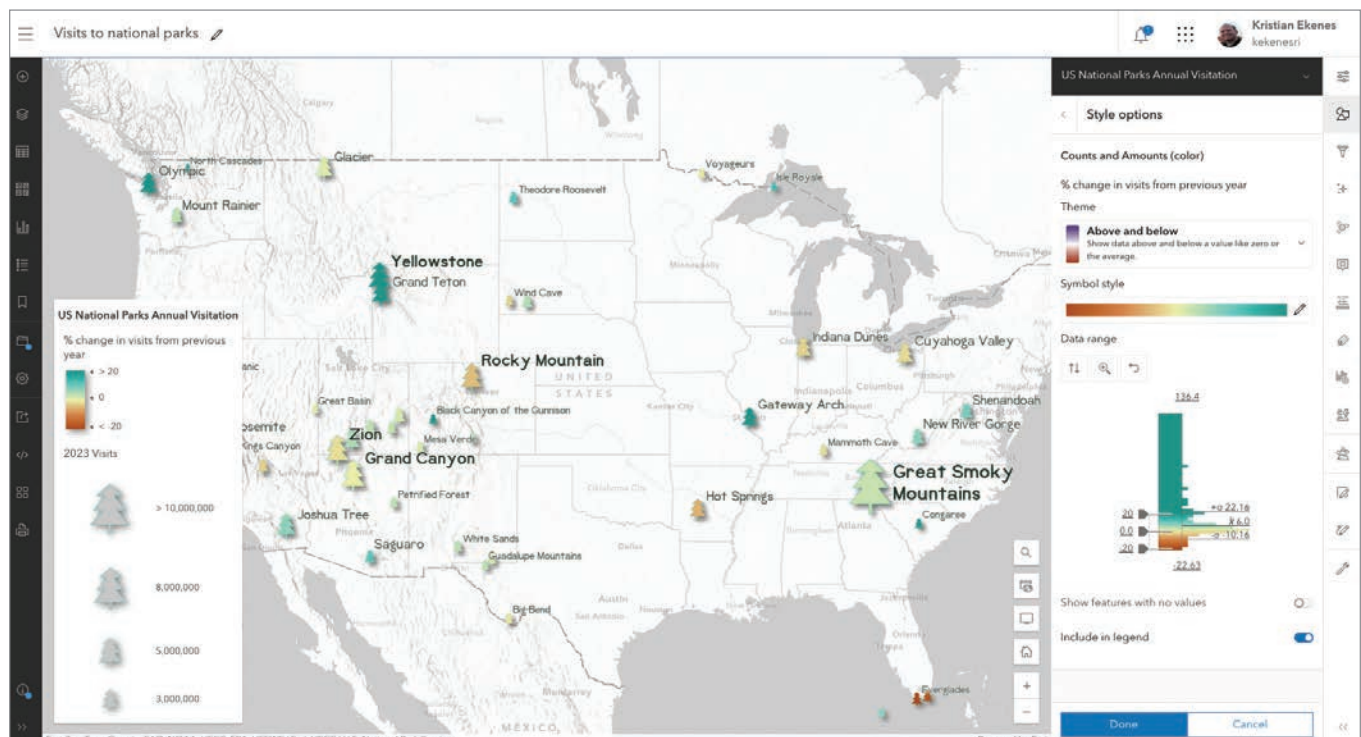
In this article, I'll demonstrate how using Map Viewer in your development workflow is actually the best approach to take when creating a web mapping application. As an example, I'll use an application that explores the number of people visiting United States national parks from year to year. I'll also compare using Map

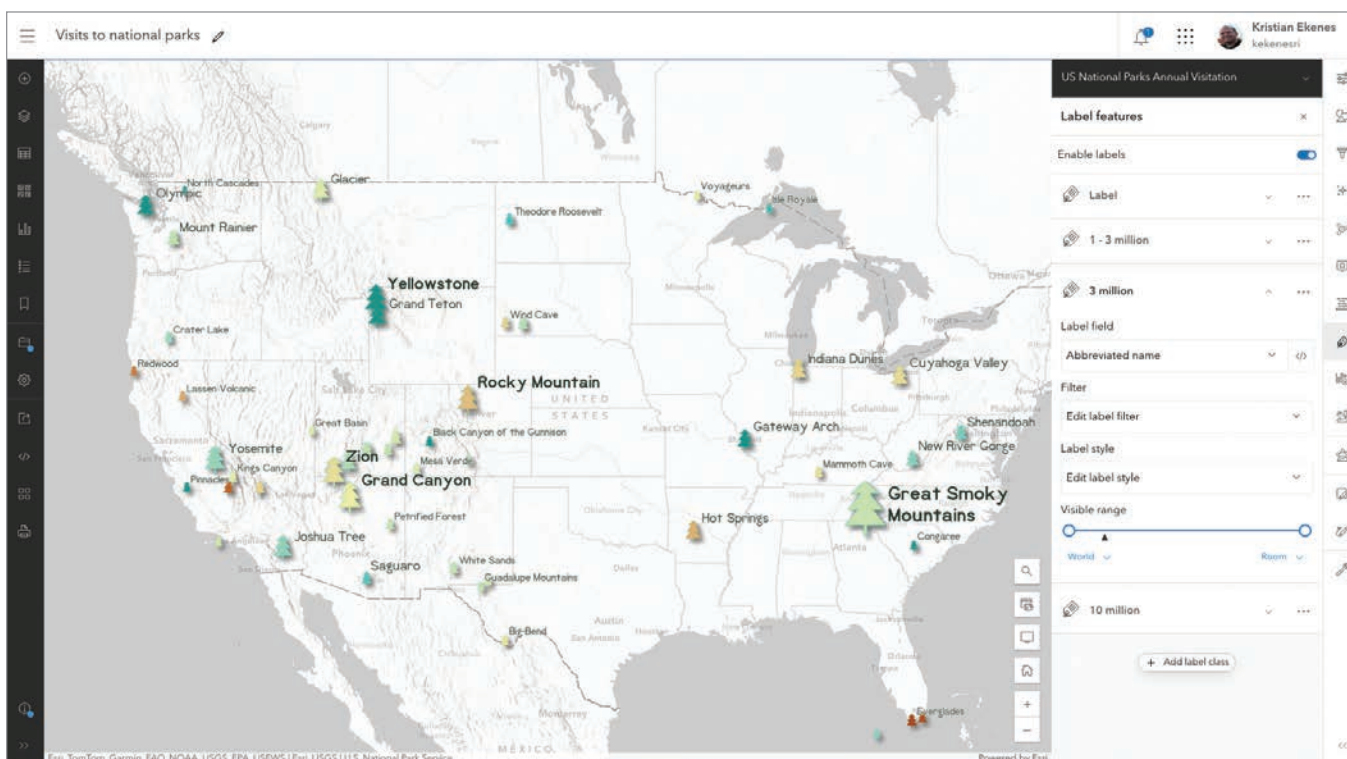
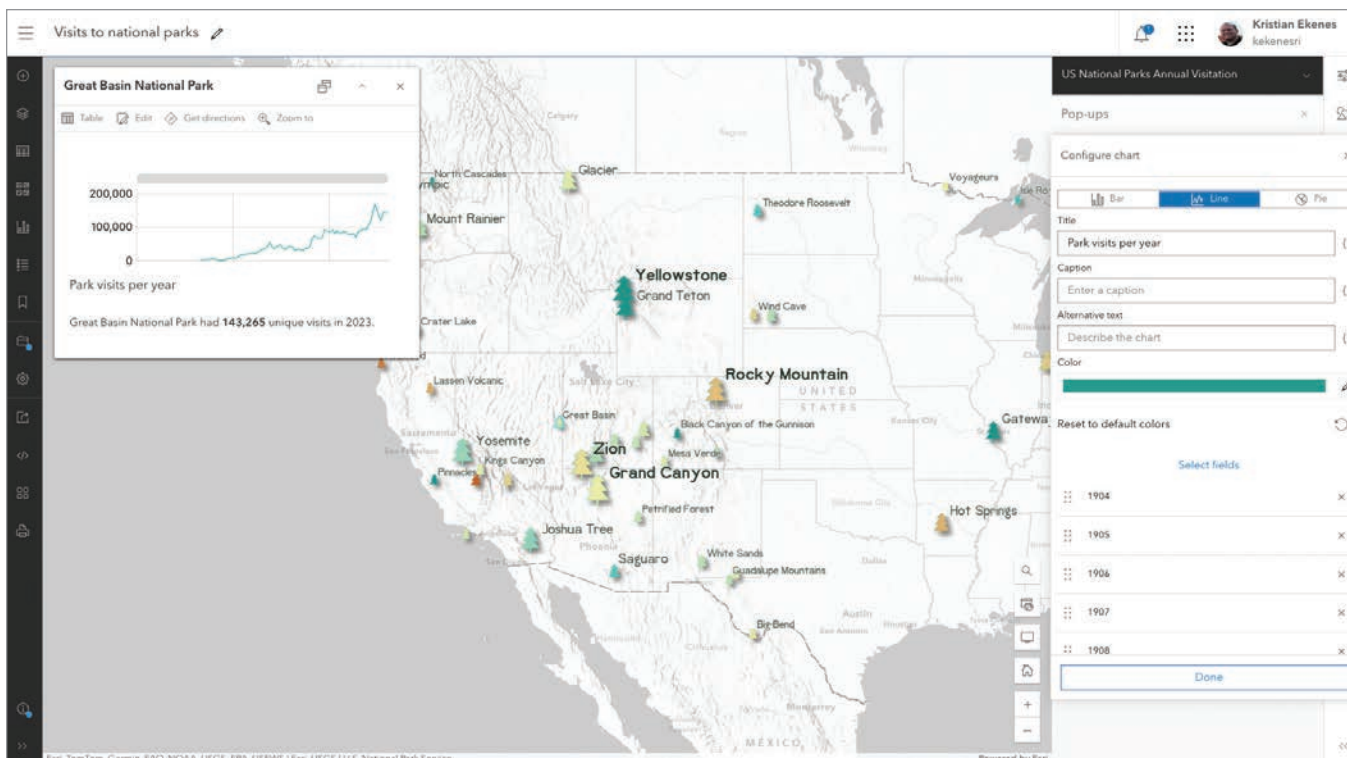
Viewer with other common approaches that can be effective but don't confer the same benefits.

The Benefits of Map Viewer for Developers

Map Viewer's name doesn't adequately convey the full power of its capabilities. In addition to allowing you to view web maps, Map Viewer gives you tools to configure a vast array of properties for web maps and layers with a simplified, intuitive UI. These configurable properties include renderers,

Map Viewer's configuration panel streamlines data exploration and styling. Using the panel provides a shortcut for what would otherwise be hours of programmatic trial and error.





↑↑ The pop-up configuration panel in Map Viewer allows you to configure a layer's pop-up content, such as text, charts, and images.

↑ The label configuration panel in Map Viewer allows you to configure one or more label classes for each layer.

pop-ups, labels, basemaps, tables, and charts, just to name a few.

I've created a web map that explores the number of visitors to US national parks in 2023. The size of each park's symbol corresponds to the number of visitors to

that park. The color indicates how the number of visitors changed from the previous year.

Each configuration panel in Map Viewer can be used to create the style (or renderer), labels, and pop-ups in this map.

```

<html lang="en">
<head>
<meta charset="utf-8" />
<meta name="viewport" content="initial-scale=1, maximum-scale=1, user-scalable=no" />
<title>National Park Visits</title>

<style>
html,
body {
padding: 0;
margin: 0;
height: 100%;
width: 100%;
}
</style>
<!-- Load Calcite components from CDN -->
<link rel="stylesheet" type="text/css" href="https://js.arcgis.com/calcite-components/2.13.2/calcite.css" />
<script type="module" src="https://js.arcgis.com/calcite-components/2.13.2/calcite.esm.js"></script>

<!-- Load the ArcGIS Maps SDK for JavaScript from CDN -->
<link rel="stylesheet" href="https://js.arcgis.com/4.31/esri/themes/light/main.css" />
<script src="https://js.arcgis.com/4.31/"></script>

<!-- Load Map components from CDN-->
<script type="module" src="https://js.arcgis.com/map-components/4.31/arcgis-map-components.esm.js">
</script>
</head>

<body>
<arcgis-map item-id="8aa8e543e8e0446e8e2937e2b743b9f0">
<arcgis-zoom position="top-left"></arcgis-zoom>
<arcgis-expand expanded position="top-left">
<arcgis-legend></arcgis-legend>
</arcgis-expand>
</arcgis-map>
</body>
</html>

```

↑ Listing 1

→ Open your browser's developer tools to view the portal item JSON for the current map in Map Viewer. Here you can clearly see the renderer properties and label classes that have been saved to the operational layer in the item.

Once configured, layers and maps can be saved as portal items. A portal item is a JSON-based file hosted on ArcGIS Online or your ArcGIS Enterprise portal instance. Portal items have a unique item ID that facilitates loading the corresponding web maps into any ArcGIS web application, and can be reused and shared with others.

Map Viewer may seem like just an app that lets you create a map. But leveraging Map Viewer to save web maps and layers as portal items has several benefits for development workflows.

No-Code App Development

In many cases, you don't need to write a single line of code to deploy a web app based on a map that you have configured in Map Viewer. Esri provides many configurable apps, covering a variety of common use cases, that allow you to load the map in a predefined layout that you can easily modify according to your needs.

Within Map Viewer, simply click Create app, then select one of the configurable app options: ArcGIS Instant Apps, ArcGIS Experience Builder, ArcGIS StoryMaps, or ArcGIS Dashboards.

This workflow doesn't require any app development experience and makes maintaining apps easy.

Low-Code App Development

You can also load maps created in Map Viewer in custom low-code applications built with JavaScript Maps SDK. Out-of-the-box apps are not always the right approach for all app designs and use cases. This is where you'll need to put on your developer hat and use JavaScript Maps SDK. Fortunately, configuring a web map in Map Viewer greatly simplifies the code required to render the map in a simple web app.

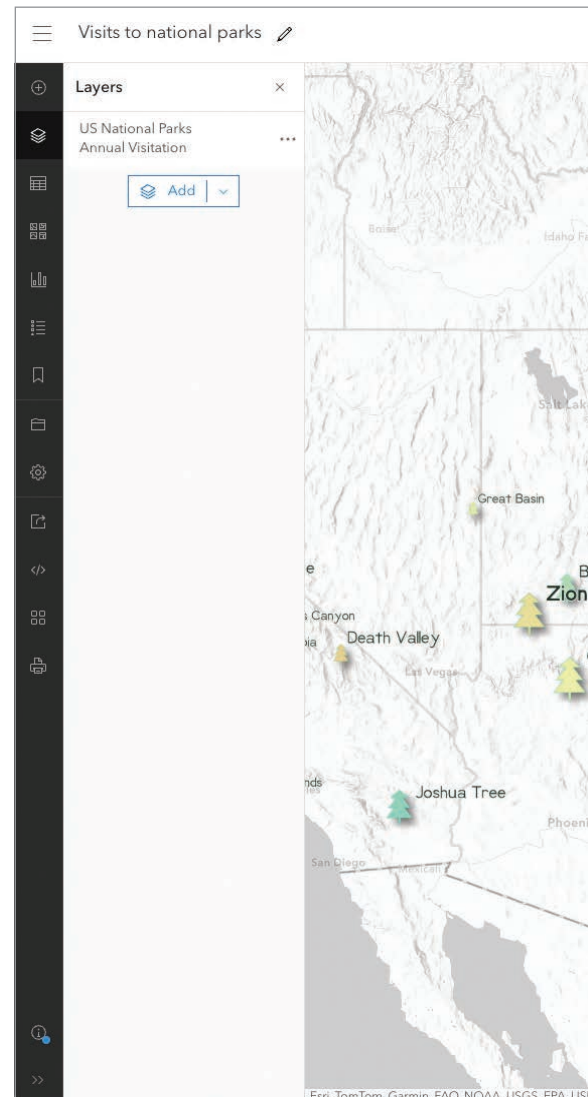
Using this method, Listing 1 shows the entirety of the code required for this app.

The app is a mere 38 lines long!

Also, note that by creating the app using map components and loading a web map configured in Map Viewer, I didn't have to write a single line of JavaScript. It is pure HTML and CSS, even for adding other map components, such as a legend.

In this case, the configuration of the map in Map Viewer takes the bulk of the time to create the app, whereas the time needed for actual app development was insignificant.

Building the same app without Map Viewer or map components involves using JavaScript to configure a layer with a pop-up containing a line chart, data-driven labels, renderer, and effects, and adding it to a map with a basemap containing a hillshade layer blended with three vector tile layers.



To create this, I needed to write 775 lines of JavaScript.

The APIs that were used to create this app are effective and have been carefully designed to be intuitive. However, setting this many configurations using only JavaScript can be a tedious and time-consuming game of trial and error.

How do I know which stops and break points to set in my renderer? What about picking suitable colors that go well with my basemap? How do I design good labels with an appropriate font size?

Map Viewer makes finding the answers to these questions easy. In fact, I find the process of exploring different visualizations and configurations enjoyable. Spending time guessing values in JavaScript, as well

as refreshing and rebuilding my app just to see the changes, would be tedious, prone to silly errors, and frustrating in comparison. Map Viewer's components are highly interactive and performant, giving you instantaneous feedback throughout the configuration process.

Once you're done with your map, simply save it and paste the item ID of the web map into the item-id property of the arcgis-map component in your custom application.

Efficient Teamwork

Because configuring a map in Map Viewer uses an intuitive user interface, you don't actually need development experience at all to be part of the web app creation process. Therefore, an app developer doesn't

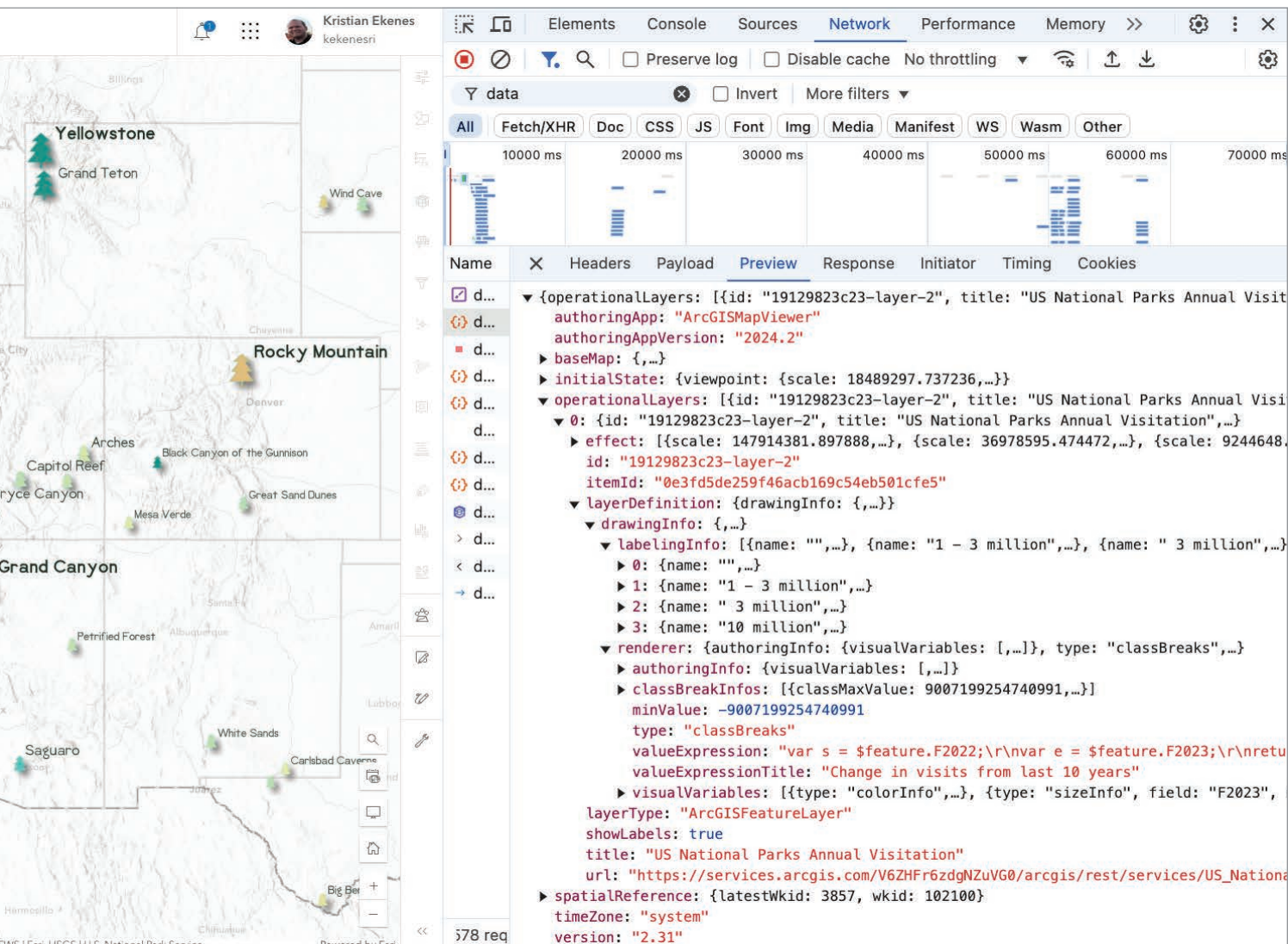
need to spend the bulk of the time in the app development cycle.

If you have an in-house GIS specialist, they can do the map configuration on their own and provide you—the developer—with the item ID, so you don't need to worry about any of the map configuration.

This also saves time when team dynamics involve a lot of change requests between developers and cartographic designers. The GIS specialist can maintain control of the cartography of the map while removing the extra burden on the developer.

Flexibility for Changes

Map Viewer also makes it easy to deploy changes to maps that are consumed by many web and mobile applications. Data



Visits to national parks

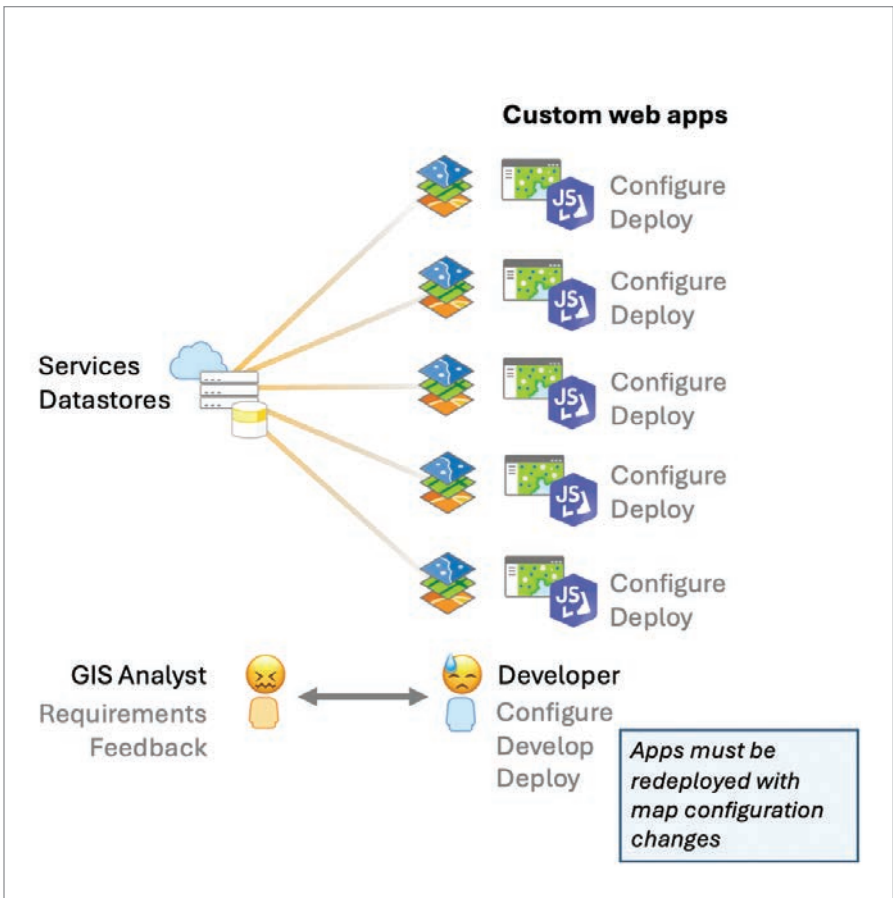


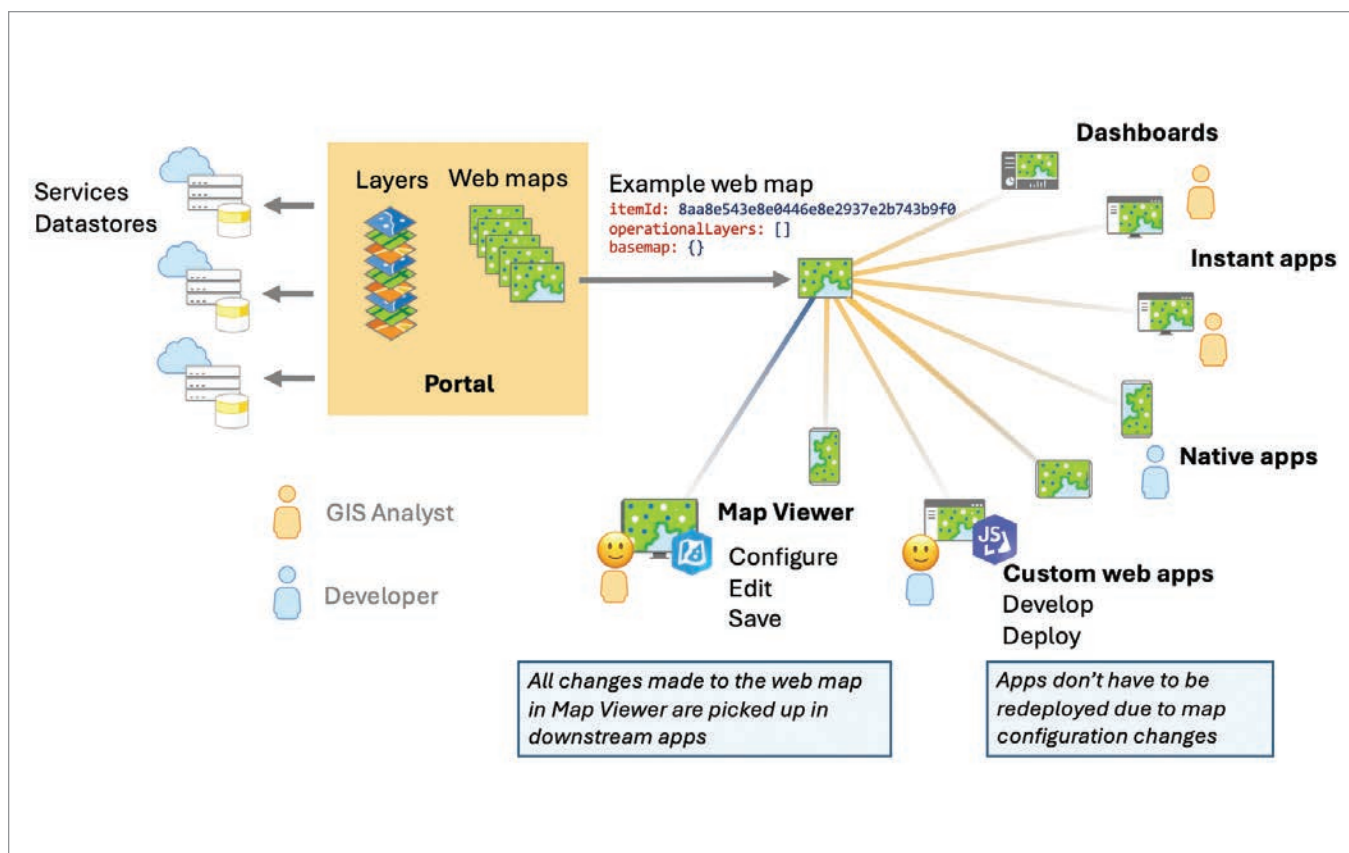
↑ This app visualizes the number of visitors to US national parks in 2023. It was created without writing a single line of code. The map itself was configured in Map Viewer. The layout, including the insets, was created using ArcGIS Instant Apps.

→ Building custom web apps without leveraging web maps can lead to maintenance problems when the number of apps grows in your organization.

changes, either due to edits or live feeds, may necessitate changes in a web map's configuration. For example, in the *Visits to national parks* map, the data will eventually be updated with more current numbers. When that happens, the web map pop-up, renderer, and labels will need to be updated to point to the field containing numbers for recent visits.

If all the configurations were done in JavaScript, the app code would need to be updated, rebuilt, and redeployed with even the most minor changes. Imagine building 10 apps, consuming the same data, that also had to have consistent layer configurations, and being forced to copy and paste layer configurations 10 times—all in JavaScript. Any change you





↑ Web maps saved to your portal or ArcGIS Online organization give GIS analysts the flexibility to make changes without having to touch the code.

make would have to be made in each of the apps.

If the configuration is done entirely in the portal, then the app code doesn't need to change because the associated item ID remains constant. A change to the portal item automatically gets picked up the next time the app is loaded. This makes the process for updating map and layer configurations more flexible and thus more efficient.

The Capacity to Do More

Because layer configurations can be saved to the portal, you can reuse items in multiple apps, saving you development time and maintenance. This increased efficiency and flexibility in creating web apps naturally leads to an increased capacity to do more. You will have the time and ability to create and maintain more web apps than you could without the portal.

Building a mapping application using the powerful APIs available in ArcGIS Maps SDK for JavaScript is good. Using the map components to reduce your JavaScript is

a better approach. But starting with Map Viewer and saving your configurations to portal items will save you time and maintenance and leave more time for focusing on core app functionality and interactivity.

Generally speaking, when building an app with the JavaScript Maps SDK, I always suggest striving to write as few lines of code as possible. If you can get away with no code using an app builder, do it!

About the Author

Kristian Ekenes is a principal product engineer at Esri specializing in data visualization. He works on ArcGIS Maps SDK for JavaScript, ArcGIS Arcade, and Map Viewer in ArcGIS Online. His goal is to help developers be successful, efficient, and confident in building web applications with JavaScript Maps SDK, especially when it comes to visualizing data. Before joining Esri, he worked as a GIS specialist for an environmental consulting company. He enjoys working with cartography, performing GIS analysis, and building GIS applications for genealogy.

Enhance Accessibility in Web Apps with Reduced Motion

By Anne Fitz and Kitty Hurley

Creating accessible web applications is not just about complying with legal standards; it's about creating an inclusive digital environment where all users can interact comfortably. One important aspect of this is honoring user preference for reduced motion, which prevents animations from being displayed.

In this article, we'll explore why supporting reduced-motion preference is important, how it is supported within ArcGIS Maps SDK for JavaScript, and how you can integrate reduced-motion support into your applications.

Why Supporting Reduced-Motion Preference Is Important

Animations aren't for everyone, and some users can experience discomfort or adverse health effects when presented with certain types of motion. Supporting user preference for reduced motion ensures that you are creating an environment where more users can have a pleasant experience.

Benefits of supporting reduced-motion preference include:

- **Minimizing motion sensitivity and seizure risk**—As mentioned, some users experience discomfort or adverse health effects, such as dizziness, nausea, or headaches, due to motion animations on web pages, such as a sliding panel. This is particularly prevalent among those with vestibular motion disorders or individuals prone to motion sickness. Other types of animations, like rapid flashes or high-contrast movements, can trigger seizures in people with photosensitive epilepsy.
- **Improving user experience**—Providing options for reduced motion ensures that more users, regardless of physical condition, can have a pleasant experience using your apps. Users will feel more comfortable and in control if they can adjust the settings to match their needs and preferences.
- **Adopting accessibility standards**—Various accessibility standards and guidelines, such as the Web Content Accessibility Guidelines (WCAG) Success Criterion 2.3.3: Animation from Interactions, advocate for reduced-motion preference to ensure that web content is accessible to a broader audience.

Reduced-Motion Support in 2D Maps

As of version 4.30, released in June 2024, ArcGIS Maps SDK for JavaScript supports reduced-motion preference in 2D MapView displays. When users have enabled reduced motion

or disabled animations in the operating system or browser, animations will be removed when navigating the map using `MapView.goTo()`, or with components or widgets such as Search and Bookmarks. Additionally, panning momentum will also be disabled.

Since June 2024, ArcGIS Online apps using JavaScript Maps SDK 4.30 also inherit reduced-motion support for 2D maps, which include Map Viewer, ArcGIS Instant Apps, ArcGIS Dashboards, ArcGIS StoryMaps, and ArcGIS Experience Builder.

App developers can decide whether their app honors reduced-motion preference with the `config.respectPrefersReducedMotion` setting. While this option is available, it is not recommended unless your application requires animation. The implied setting is `true`, meaning that the SDK, by default, will honor the user's reduced-motion preference (if any).

How to Build Reduced-Motion Support into Your Applications

While we have built support for reduced motion into JavaScript Maps SDK, you can take additional steps to support it in your apps:

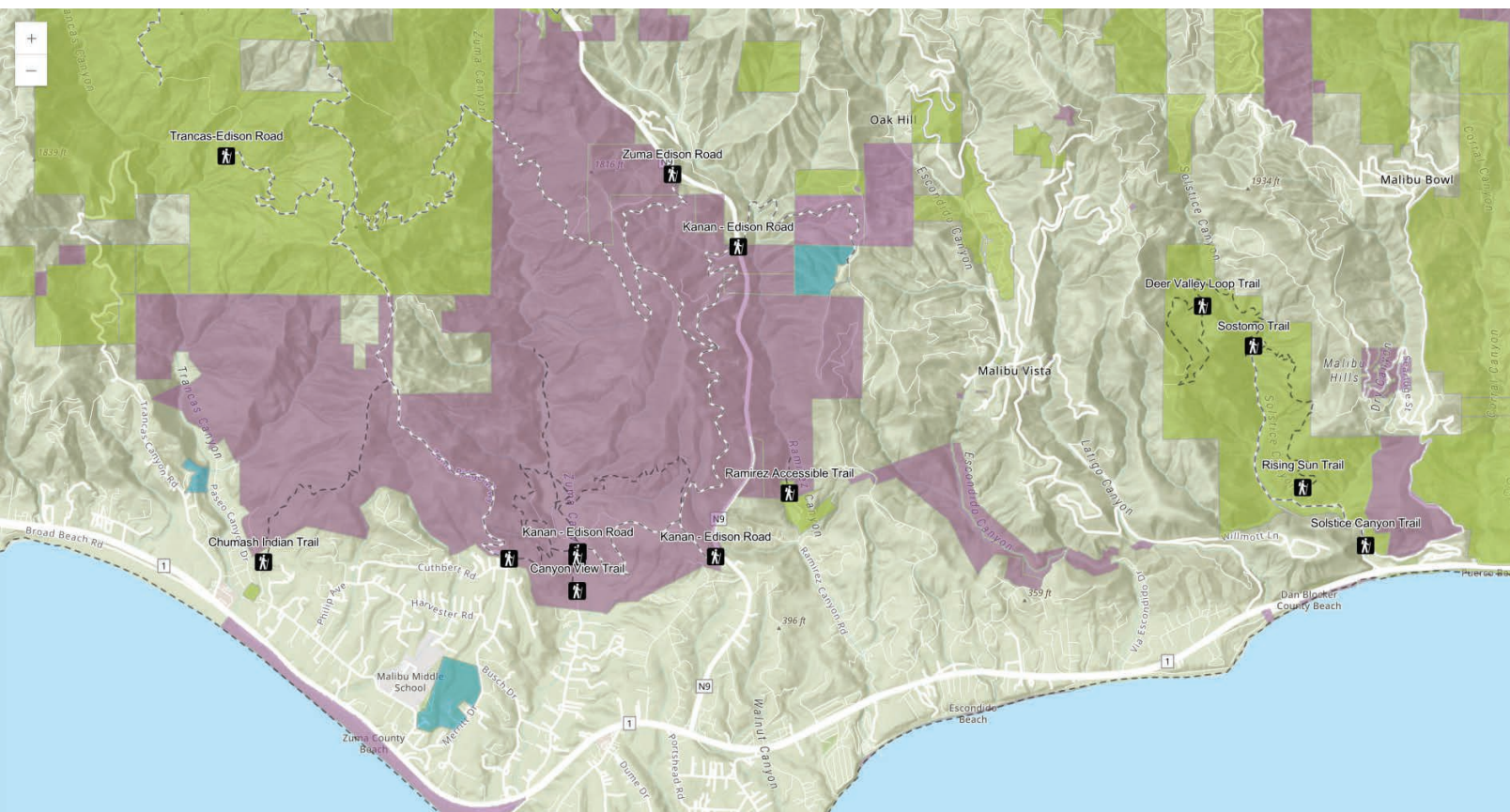
- Remove nonessential animations.
- Add a play/pause button to give users control over animations.
- For animations that add context or meaning, consider minimizing the motion using the `prefers-reduced-motion` media query.

Browsers support the `prefers-reduced-motion` media query, which allows you to detect if a user has requested reduced motion in their operating system settings.

The CSS `@media` query can be used to detect a preference for reduced motion, and allows you to apply specific CSS rules, as shown in Listing 1.

↓ Listing 1

```
@media (prefers-reduced-motion: reduce) {  
  /* CSS rules for reduced motion */  
}
```

```
const isReduced = window.matchMedia('(prefers-reduced-motion: reduce)').matches;
```

↑↑ Supporting user preference for reduced motion ensures that you are creating an accessible user experience.

↑ Listing 2

Similarly, the matchMedia method in JavaScript allows you to check for the prefers-reduced-motion media query and update your application accordingly, as shown in Listing 2.

Web accessibility is a consistently evolving topic and it can be challenging to know what the best solution is for your app. It is important to continually evaluate the accessibility of your content and find ways to improve experiences for users. For additional information on what you can do to improve accessibility, visit Esri's Accessibility Resources site at links.esri.com/accessibility.

About the Authors

Anne Fitz is a senior product engineer at Esri, working on ArcGIS Maps SDK for JavaScript and ArcGIS Arcade. She is an expert on dynamic vector symbology (CIM symbols), data visualization, animation, ArcGIS Arcade integration, and widgets. Her primary goal is to help developers succeed in building geospatial applications, providing them with the tools they need to bring their ideas to life. She has been with Esri for over five years.

Kitty Hurley is passionate about web map accessibility and bringing the web and maps to wider audiences. A senior product engineer on Esri's Calcite Design System team, Hurley enjoys exploring Minnesota's wilderness and intends to visit every Major League Baseball stadium across America.

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→ An Olive Farm
in Izmir, Turkey

How GIS Can Protect the World's Olive Legacy

By Deniz Karagulle and Sarmistha Chatterjee

For thousands of years, olive oil production has been central to many different agricultural practices, spanning diverse regions in primarily temperate climates around the world. The cultivation of olive trees and the creation of olive oil have become more than just agricultural activities; they are woven into the cultural identities and economies of the places where olives thrive. Nowhere is this more evident than in the Mediterranean, where the olive tree has stood as a symbol of peace for centuries.

Today, the changing climate affects us all, even threatening the crops that have sustained us for centuries. Atmospheric carbon dioxide levels are projected to nearly double by 2050, resulting in an average temperature increase of 4.4 degrees Celsius by the end of the 21st century. Over 53 percent of the olive-growing regions along Turkey's Aegean Coast—which accounts for 80 percent of the country's total olive production—could become unsuitable for cultivating olive trees by 2050. This is a significant concern, as Turkey ranked among the top three countries in the world for olive and olive oil production between 2023 and 2024.

With the help of GIS technology, including ArcGIS Living Atlas of the World layers, we can pinpoint these vulnerable regions and

assess the potential impacts of a changing climate on olive trees. GIS empowers us to take proactive measures to understand the cultivation of olives and other crops in those vulnerable regions and ensure the sustainability of this vital industry.

To address these challenges, we need to determine where to allocate resources and efforts by understanding the potential impact of climate change on terrestrial ecosystems by 2050 and how it will affect olive trees in those ecosystems. In order to gain a greater understanding of this impact, we decided to analyze the olive trees on Turkey's Aegean Coast using ArcGIS Living Atlas.

New Threats to Old Vintages

Thousands of years after the first olive trees appeared on the Greek Aegean Coast, the family of Deniz Karagulle's grandparents moved along the coast from Greece to Turkey in 1923 and established an olive farm in Izmir. Since then, the family has produced its own olive oil and olives from that farm—until 2023.

In October 2023, during the harvest season, Karagulle visited her grandparents and joined them on the farm to pick olives. As

they worked, Karagulle asked her grandfather how the farm was doing compared to previous years.

Things weren't going well. He explained that from 10 kg of olives, he used to extract 5 kg of olive oil, but now only gets 1 kg. He said the change is due to a lack of rain, as well as weather that's much hotter than previous years.

According to Nicolas Netien, an environmental engineer and organic farming expert who cofounded Atsas Organics, the heat isn't the issue. "The olives can withstand it," he said. "The real challenge now is the shifting [weather] patterns. Conditions are becoming increasingly unpredictable, which means we need systems that are more adaptable and resilient."

Each year, it is becoming harder to predict what will happen. Winter rains are not arriving, spring is experiencing unexpected snowfall during the flowering period, and intense heat comes a month early and lasts twice as long as it used to. All of this has placed significant stress on the olives, especially in 2024.

As the Food and Agriculture Organization of the United Nations noted, "Changes in temperature, precipitation, and extreme weather events due to climate change are already affecting crop yields and quality in many regions, threatening global food security." This highlights how shifts in climate variables like temperature and precipitation can impact agricultural productivity and quality.

When climate shifts affect the surrounding ecology, it signals the need for adaptation. Otherwise, people like Karagulle's

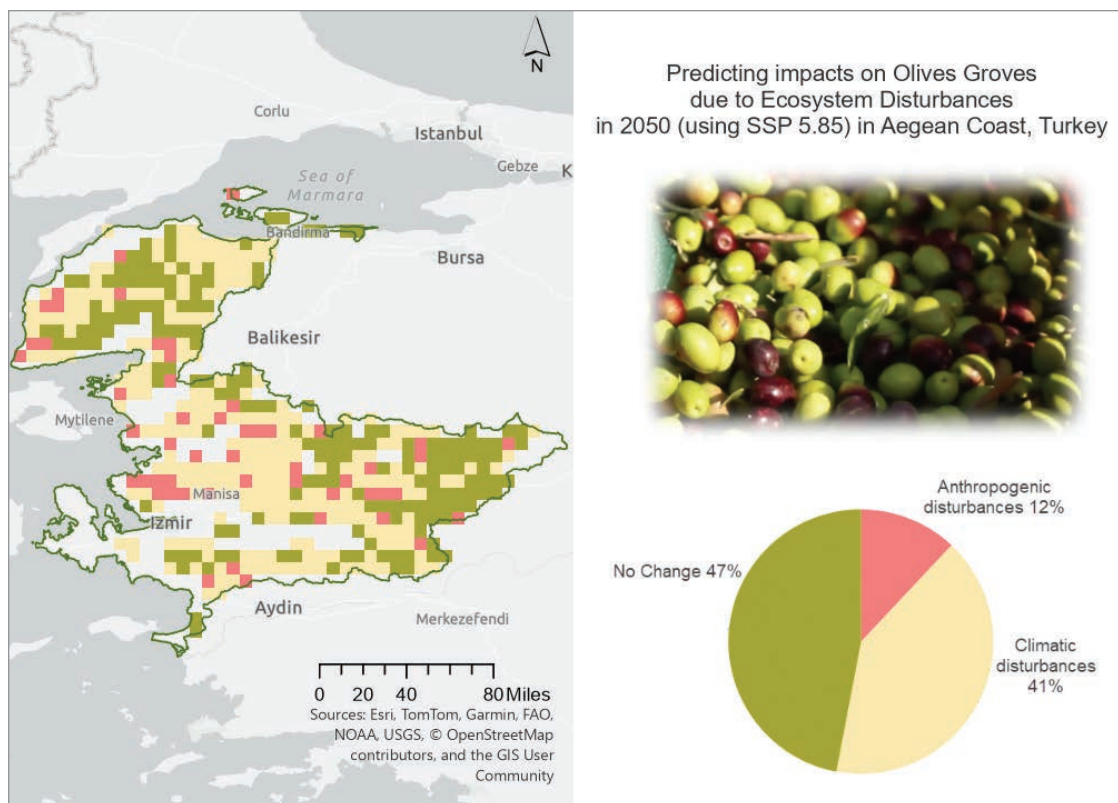
grandparents begin to lose both the volume and quality of their crops. Olive farmers in Greece, Spain, Italy, California, and many other areas face similar challenges.

To understand the percentage of olive trees that may be impacted by changing climate and ecosystems, we performed spatial analysis using data from ArcGIS Living Atlas. You can implement the same method for your own region with any type of crops.

The Analysis Workflow

In our analysis, we used the 1 km resolution Projected Change Types for World Terrestrial Ecosystems (WTEs) in 2050, under the SSP5-8.5 scenario available in ArcGIS Living Atlas. This layer is derived from the Projected World Terrestrial Ecosystems for 2050 (SSP5-8.5) and World Terrestrial Ecosystems 2015 datasets. These datasets are available in ArcGIS Living Atlas, alongside a 10 km resolution olive tree dataset from International Food Policy Research Institute's Spatial Production Allocation Model (SPAM).

By analyzing the 2015 and projected 2050 WTEs (see page 51), we observed potential global climate changes in ecosystem types. This analysis forms the basis of our study, using the Projected Change Types for WTEs in 2050 (SSP5-8.5) layer. This layer shows the types and combinations of modeled changes to WTEs from 2015 to 2050 under the SSP5-8.5 emissions scenario. We used this data to identify the drivers of ecosystem change in our model and to calculate the impact on olive trees within those drivers.



← Projected Impacts on Olive Groves Due to Ecosystem Disturbances in 2050

Ecosystem changes in our model are driven by climate-related disturbances and anthropogenic (human-caused) disturbances. Each WTE is defined as an area with a unique combination of the three inputs: climate setting, landform, and land cover. If any of the three input variable classes change, the ecosystem type itself changes.

To develop solutions for sustainable olive production and better land management planning, it's essential to first identify where these changes are occurring. We created a set of change layers that indicate whether a change occurs and, if so, what type of change occurs. We used these layers to determine the percentage of olive trees located within each of the different types of ecosystem disturbance areas in 2050.

The analysis workflow involved reclassifying the change layers to identify areas of no change, change by anthropogenic disturbances, and change by climate disturbances. We then calculated the percentages of olive trees within these disturbance zones.

You can apply similar workflows to other types of crops for any region in the world using the 2050 Projected Terrestrial Ecosystems

dataset from ArcGIS Living Atlas and the capabilities of ArcGIS Spatial Analyst in ArcGIS Pro.

Step 0: Set Up the Analysis Environment

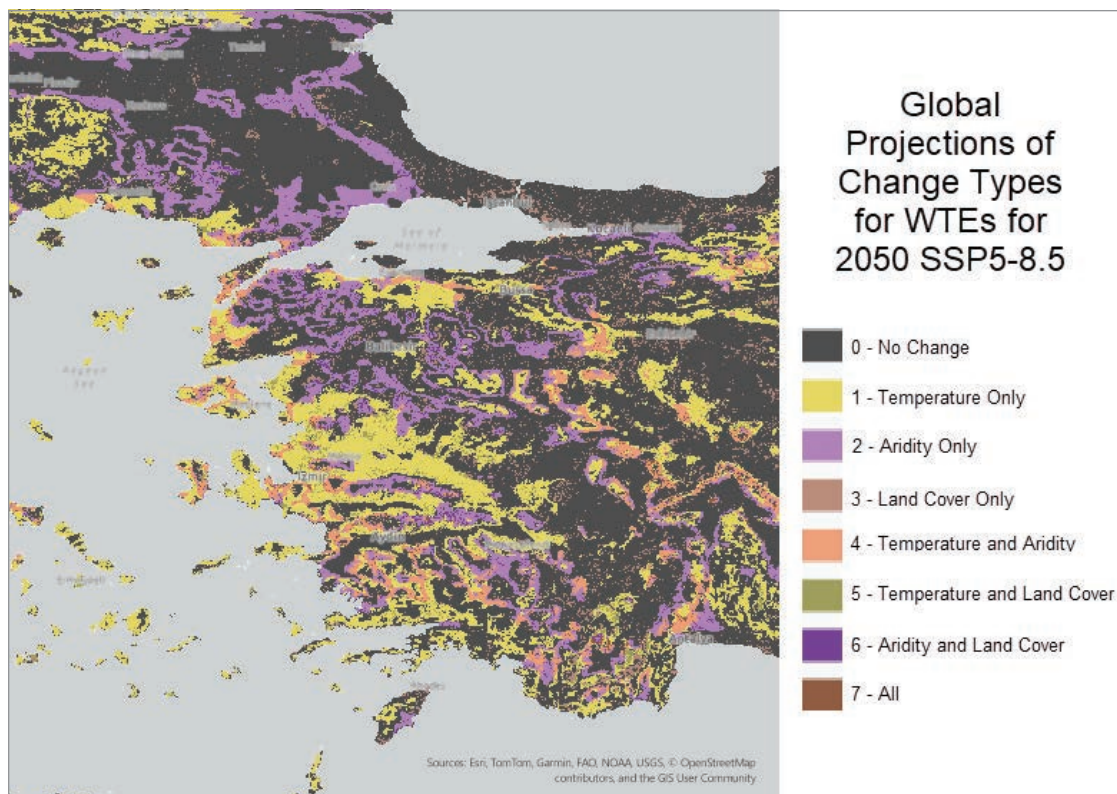
Prior to doing any analysis, it is recommended that you ensure that all the steps of the analysis are done in the same analysis environment. Since we had data of different resolutions, extents, and coordinate systems, we set the cell size and snap raster to the coarsest resolution of 10 km, the analysis extent to the Olive Tree Dataset (10 km native resolution), and output coordinate system to the Global Projections of Change Types for WTEs for 2050 SSP5-8.5 (1 km native resolution). This ensured that we processed the correct extent and did not create any data that does not exist, thus introducing bias into our analysis.

Step 1: Reclassify Data

First, we reclassified the Global Projections of Change Types for WTEs for 2050 SSP5-8.5 data, decreasing the number of classes



→ An ancient olive tree grows in Acropolis, Athens.



from seven to three, to differentiate between anthropogenic and climate change disturbances to create the Ecosystem Disturbance raster. Here, we assumed that any temperature or aridity change is classified as climate disturbance, and any land-cover change is anthropogenic disturbance. Classes that combine temperature or aridity with land cover are classified as anthropogenic, as the area has already changed and cannot be used for crop cultivation anymore. We used the Reclassify tool in the Spatial Analyst extension in ArcGIS Pro.

Step 2: View Overlap

Next, we combined the olive trees with the ecosystems disturbance raster to see the overlap of the disturbances with the olive tree distribution. Using the Combine tool, we assigned a unique combination to each overlap of ecosystem disturbance to olive tree distribution. There were 327 such unique combinations.

Step 3: Calculate Change

Now, using the Summary Statistics tool, we calculated the sum of the percentages of olive farms within each of these ecosystem disturbance zones as well as the zones that see no change over time.

Step 4: Create a Chart

To visualize our findings, we created a chart from the attribute table of the summary statistics. We clicked Create chart, chose Pie chart, and matched the colors of the chart with the map.

A Future for Olives

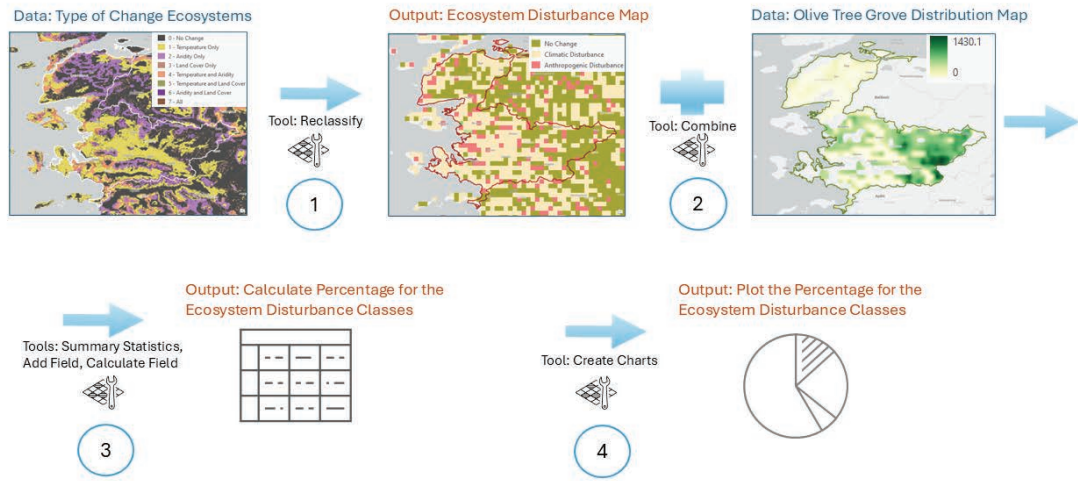
The projected terrestrial ecosystem changes are informed by models of future climate scenarios and the demands of expanding populations for settlement and agriculture. Models like ours do not prescribe what will happen but rather what may happen. The results are subject to change. However, according to our model, significant climate alterations that impact surrounding ecosystems underscore the necessity for adaptation.

The good news is that just because a region becomes less suitable for olive tree agriculture doesn't mean it's impossible to grow olive trees there. A loss of suitability means that more effort and resources are needed to grow viable and productive olive trees. Adapting to climate change in olive production could involve introducing or expanding irrigation systems or terracing hillsides to optimize growing conditions in milder temperatures. Farmers might use modular shades to protect olive trees from peak UV radiation, or apply treatments to ward off pests and diseases. Adjustments in orchard management could maximize water efficiency, improve soil nutrients, or utilize cover crops to enhance soil carbon retention.

In response to changing climates, olive cultivation may also shift to newly suitable areas, or farmers could explore different olive varieties that are more resilient under future conditions.

If we make the right decisions in managing the land with the future techniques of sustainable farming, regardless of potential climate and land-cover changes by 2050, we could save up to 88 percent of the olive trees on Turkey's Aegean Coast. However, if we don't, we risk losing 53 percent of these trees. (This is a projection based on our model, not a prediction. It describes what may happen, and

Calculate the Percentage of Olive Groves that are at risk of Ecosystems Change in 2050 in Aegean Coast of Turkey



→ The analysis workflow involved reclassifying the change layers to identify areas of no change, change by anthropogenic disturbances, and change by climate disturbances.

the results are subject to change.) The Aegean Coast accounts for 80 percent of Turkey’s olive production, and since the country is one of the top three olive producers in the world, a failure to act will affect people far beyond just this region. Similar outcomes are likely in other olive-growing countries around the world.

As a result, we advocate for the integration of maps depicting potential ecosystem shifts into the planning of strategies meant to help us adapt to the effects of a changing climate, with a focus on the needs of local populations. In this analysis, we assessed areas where existing olive trees may be affected by these ecosystem changes, based on anticipated shifts in climate and the growing land requirements for human activities.

There is an urgent need for sustainable transformation in global food systems to support farmers, especially those who lack access to advanced agricultural technologies, in preparing for and adapting to changing climate and weather patterns. The world can no longer afford to delay these critical innovations.

For more information, see links.esri.com/olive-legacy-references.

About the Authors

Deniz Karagulle is a technical lead for the global community engagement team at Esri and has been with the ArcGIS Living Atlas of the World team since 2010. She specializes in GIS engineering and is one of the lead authors for global scientific and thematic data layers, covering topics such as terrestrial ecosystems, landforms, and live feeds.

Sarmistha Chatterjee is a senior product engineer in the raster analysis group at Esri, and works on raster and scientific multidimensional data analysis.



← Deniz Karagulle visits her grandparents' olive groves in Izmir, Turkey, in October 2023.

World Terrestrial Ecosystems

Before you start using the Projected Change Types for the World Terrestrial Ecosystems (WTE) layer in your analysis, it is helpful to first understand the concept of WTEs. This will help you grasp what you are aiming to achieve and why.

In 2020, The Nature Conservancy (TNC), the United States Geological Survey (USGS), and Esri collaboratively developed a 250-meter-resolution WTE 2015 dataset. Terrestrial ecosystems are land-based environments where plants, animals, and microorganisms interact with each other and their physical surroundings. The WTEs are a set of 431 ecosystems conceptualized and mapped as distinct combinations of World Climate Region, generalized Hammond landform types, and European Space Agency (ESA) Global Land Cover for the year 2015.

Temperature and aridity data from WorldClim 2 were used to produce 18 climate regions, following Intergovernmental Panel on Climate Change (IPCC) guidelines. Land cover was reclassified into eight classes, and landform data was derived from the 2010 digital elevation model (DEM), reclassifying the Hammond model landforms into four classes. This is the foundational layer that allows us to understand changes in terrestrial ecosystems when compared to the projected 2050 terrestrial ecosystems.

Last year, Esri collaborated with USGS, Conservation International, Wildlife Conservation Society, TNC, NatureServe, and Clark University. This collaboration extended the projections for WTE 2015 work by incorporating climate and shared socioeconomic pathway scenarios for 2050, and identifying the types, magnitude, and locations of changes in the distributions of Earth's terrestrial ecosystems.

By leveraging global climate models, climate regions and land cover can be projected into the future. The latest global climate models, part of the Coupled Model Intercomparison Project Phase 6 (CMIP6), use a range of developmental and emissions scenarios known as Shared Socioeconomic Pathways (SSPs). SSPs represent narratives

describing broad socioeconomic trends that could shape future society.

Three CMIP6 SSPs were selected to model three projected 2050 WTEs. The SSPs selected for the global ecosystem modeling were the emissions reductions pathway (SSP 1-2.6), the continued emissions pathway (SSP 3-7.0), and high emissions pathway (SSP 5-8.5).

The dataset used CHELSA 2.1 (1 km) climate models from CMIP6 instead of World Clim 2, following IPCC guidelines incorporated with three SSPs described above. For each SSP, modeled climate data was selected from five CHELSA-compiled CMIP6 GCMs: UKESM1-0-LL, MPI-ESM1-2-HR, MRI-ESM2-0, GFDL-ESM4, and IPSL-CM6A-LR. The combination of the five GCMs and three SSPs produced 15 bioclimate combinations with 19 classes of climate regions.

For the projected land-cover dataset, the existing models from Chen et al. (2022) were used. The Chen et al. models are 1 km spatial resolution global projections at five-year intervals from 2015 to 2100 for eight SSPs, including the three described above. The Chen et al. models harmonized global land-use data from the Land-Use Harmonization 2 (LUH2) model (Hurtt et al., 2020) and the ESA/CCI GLC data based on reclassifying the LUH2 outputs into 17 plant functional types (PFTs). They were then reclassified into eight classes.

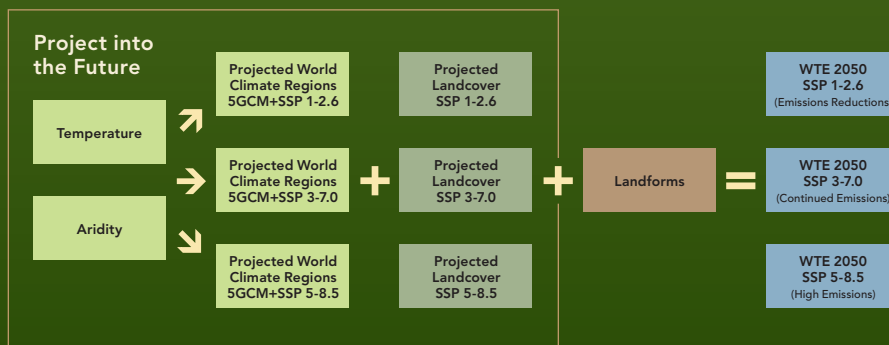
The same landform dataset from 2015 WTE was used as the third parameter. In

the case of the 2015 WTEs, the model combined three input layers to produce one ecosystem map. For the 2050 WTEs, however, the use of five GCMs each with three SSPs produced 15 climate region outputs, and the single model vegetation and land cover projections produced a total of three landcover outputs based on three SSPs. For the case of 2050 WTEs, the landform, landcover and the climate regions datasets included resolutions of 231, 927, 1157 meters respectively. These datasets were resampled to their lowest common denominator, and then aligned and combined. Finally, the dataset was re-sampled to approximately 1.25km cell size output to ensure a very small resampling error propagation.

The climate region, global vegetation and land cover, and landforms inputs were then combined to assign a WTE classification per SSP following the original WTE typology described in Sayre et al. (2020). The five 2050 WTEs for each SSP. To simplify outputs and derive one final, predominant WTE for each SSP, a majority rule was applied across all five 2050 WTEs per SSP to identify that which occurred most frequently. This produced three projected WTEs based on three SSPs and GCMs.

Using this data, the ecosystem type of every 1 km² land pixel on Earth was compared in 2015 to its projected type in 2050 under three scenarios, each representing varying trajectories of human behavior and the changing climate.

↓ Below is the projected 2050 WTE workflow used for this analysis.



Customize a Basemap for ArcGIS Business Analyst

By Helen Thompson

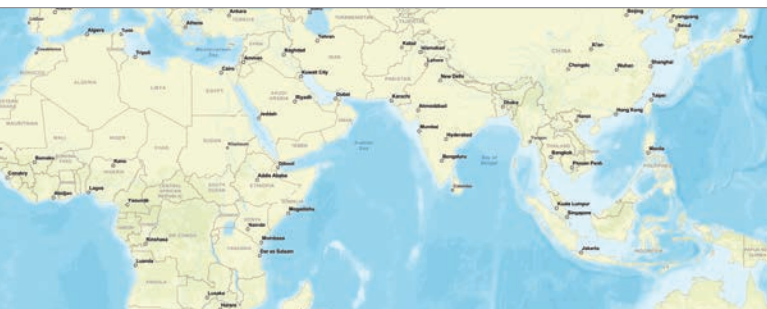
ArcGIS Business Analyst users have many options when it comes to basemaps for use in ArcGIS Pro and ArcGIS Business Analyst Web App. Both applications come with a standard set of basemaps that allow for informative and aesthetically pleasing cartographic display. Any of the 30-plus basemaps offered in ArcGIS Online can be curated into your organization to expand on the set of cartographic styles and display options.

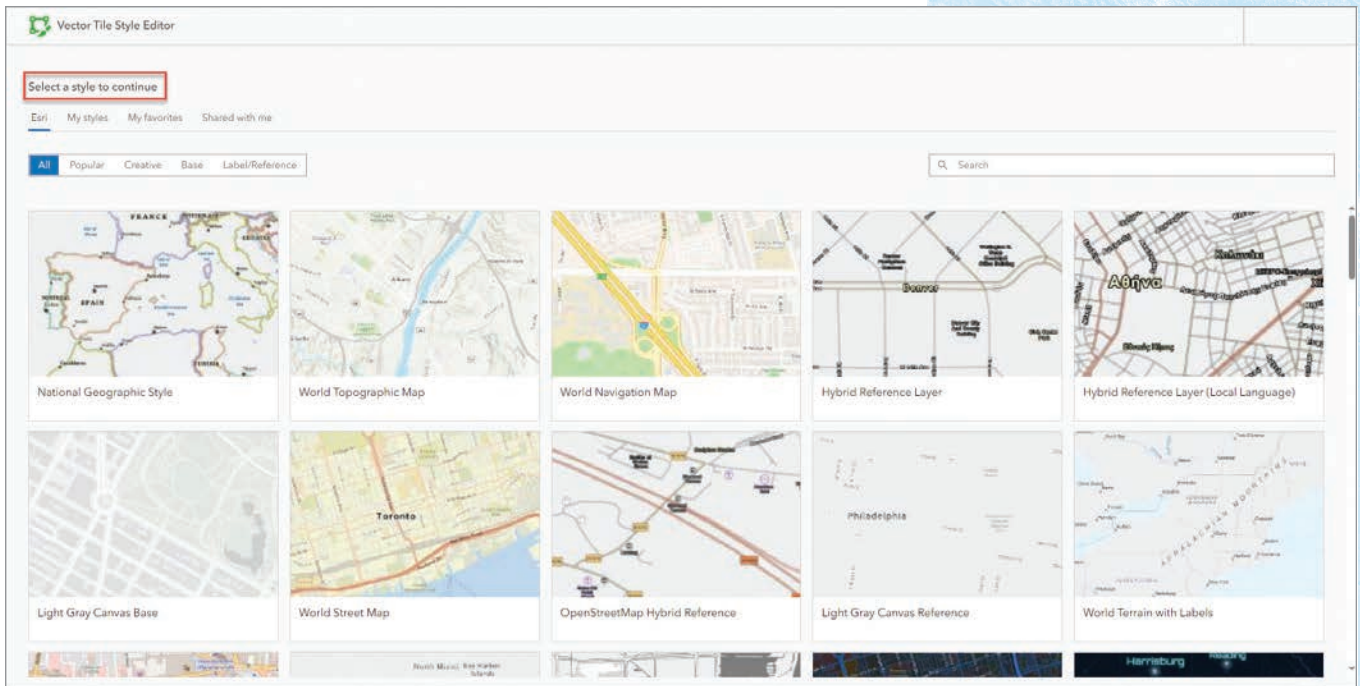
Many users want the ability to create and customize their basemaps. For example, you may want to change the color of the roads, modify symbol sizes and shapes, or remove certain types of map detail at different scales. This allows market, site, or customer data to stand out against the basemap or create a more visually pleasing aesthetic when working with data. I frequently swap basemaps when using different workflows. I might use color-coded maps as opposed to suitability analysis, for example, because of the color ramps I use in my analysis. Additionally, I often want to tone down the background detail so that I can better discern and understand the variations and patterns in my data.

Historically, users could edit the background mapping data supplied in the local data package using the file geodatabase (FGDB) format. With the file geodatabase format, ArcGIS Business Analyst Pro users could customize every detail of their maps and not rely on the ArcGIS Online basemaps. While extremely flexible, it was also time-consuming, and with each new data release, users needed to re-create their maps.



↓ Top, Streets, National Geographic Style Map in ArcGIS Business Analyst Web App; bottom, Human Geography Dark Map, Charted Territory Map in ArcGIS Pro





In 2024, Business Analyst adopted the modern Mobile Map Package (.mmpk) format for map layers, which greatly improves performance that is also aligned with the whole ArcGIS platform. The downside is that this format cannot be customized. So how does a user get the same ability to create and customize base-maps and use them in Business Analyst applications?

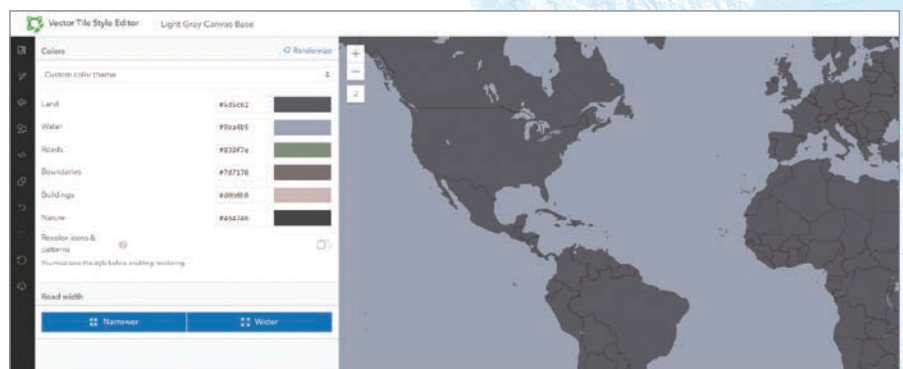
The answer is to use ArcGIS Vector Tile Style Editor (VTSE) to design a map background, which will form a new basemap that shows features of interest to you, in the way you want to view them.

Why Create a Custom Basemap?

Aside from the fun of learning a new mapping skill, VTSE allows you to create basemaps that are specific to and supportive of the workflows and needs of your organization. For example, users sometimes want to specifically configure and layer businesses, roads, parks, and other points of interest in their maps and visualizations.

VTSE provides flexibility and customization opportunities not only in ArcGIS Business Analyst Pro but also anywhere you use Business Analyst, including on mobile devices, on the web, or in applications you develop. This includes reports and infographics, ArcGIS Experience Builder apps, ArcGIS StoryMaps stories, and dashboards created with ArcGIS Dashboards. The basemaps allow infinite customization, and you can easily save and modify your styles. This allows one basemap to act as a template for a later style, an innovative new design, or even a combination of elements from different sources—such as using imagery at the regional scale, adding roads at the city scale, and including streets and topography at the block level.

Many organizations use VTSE to support brand and design guidelines in conjunction with results created using Business Analyst. It's also a fast track to consistent, boardroom-ready information products that you can share with your organization, allowing anyone in your organization to leverage your investment in basemap creation.



↑↑ Step 1: Select a default basemap style.

↑ Step 2: Style the layers individually or as a group.

The process for creating a custom basemap in VTSE is composed of three overarching steps.

Step 1: Select a default basemap style.

You can choose from the familiar defaults, such as World Topographic, World Navigation, and Light Gray Canvas.

Step 2: Style the layers individually or as a group.

Optionally, adjust the colors in the Colors pane. You can assign colors to features such as land, water, roads, boundaries, and buildings.

You can also expand layers, such as roads or buildings, and style them individually.

Step 3: Save your custom basemap.

Once you have created your basemap, save the style in your ArcGIS content portal to use and share with others in your organization. You can save and export what you create as a file that you can customize further or share with others.

Bring Your Custom Basemap into Business Analyst

Once you have customized and saved your basemap, you can open the item in Business Analyst. To curate basemaps in your ArcGIS organization, you must be an organizational administrator.

To access your custom basemap in ArcGIS Business Analyst, open ArcGIS Online and go to Organization > Settings > Map. Then, in the Basemap gallery section, under Group, click Edit on the Basemaps group.

On the Basemaps group page, click Curate featured content.

Select the basemap you created to add it to the group. Once you have added it to the group, it is available in both ArcGIS Business Analyst Pro and ArcGIS Business Analyst Web App to all organization members.

VTSE can add a huge number of possibilities to your basemaps. I've created many different styles by blending imagery and vector layers, as well as by mixing color styles and components from one basemap with elements from another. VTSE and Map Viewer in ArcGIS Online provide extraordinary control in creating maps that mix elements and items—you can even take reference text from one basemap and add elements from another. When you experience what the VTSE and ArcGIS Online map compilation tools can do, you'll wonder why you spent any time editing your own vector layers.

About the Author

Helen Thompson is the distinguished product engineer for ArcGIS Business Analyst and ArcGIS GeoEnrichment at Esri. She has spent 30 years helping clients apply spatial methods and analysis to enable their organizations to thrive. She is passionate about the opportunities to solve challenges big and small.

↓ Step 3: Save your custom basemap.

Save style as

Title
Neutral Streets Basemap

Required
Tags
Tags

Folder
Select folder

Share with:
My organization

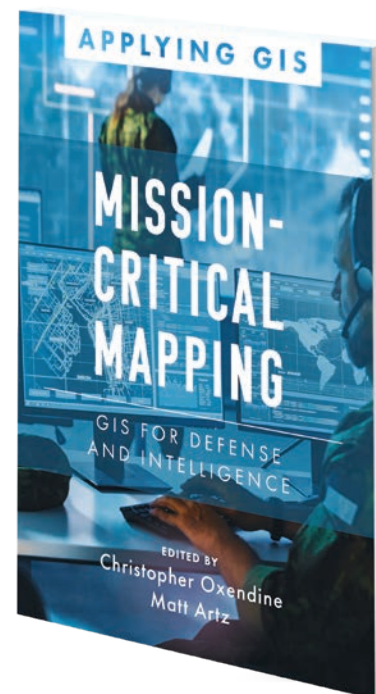
Save style

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Edited by Christopher Oxendine and Matt Artz

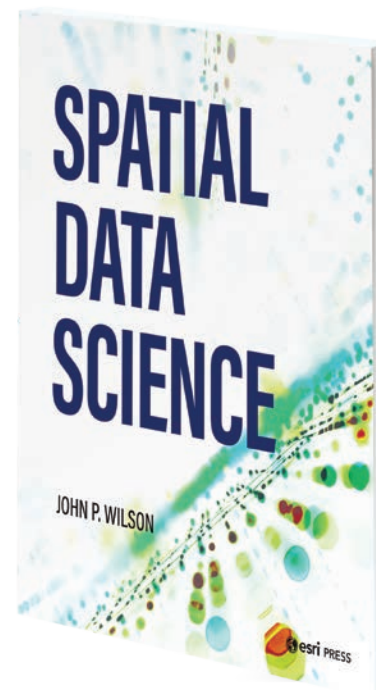
Mission-Critical Mapping: GIS for Defense and Intelligence is a collection of real-life stories that demonstrate how defense and intelligence organizations use GIS to improve operations and readiness, collect intelligence, collaborate, and provide humanitarian assistance. By using ArcGIS technology,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



Spatial Data Science

By John P. Wilson

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



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Taking Initiative Is Vital to Launching a GIS Career

By Rosemary Boone and Logan Stevens

Catherine DuBreck, a change management consultant for Esri partner Locana, provides crucial information to organizations about how to most effectively use and manage their GIS infrastructure. During her undergraduate studies, her initiative and tenacity to seek out internships enabled her to launch a career in GIS. All her undergraduate internships stemmed from sending a personalized outreach email to the leaders of the companies she was interested in, asking about internship opportunities—even in the absence of job openings. Using that tactic, she secured three internships that led to her being what she is today—a successful and thriving GIS professional.

In this interview, DuBreck shares how she took initiative and capitalized on networking opportunities to build a career as a GIS professional.

Q: How did you get your start in GIS?

A: In college, I was undecided on my major. I thought I was going to do physics and biology, and neither worked out. I needed to declare a major, and I happened to take an intro to urban planning course, which was in the geography department—and it fit my environmental minor. At the end of the semester, I declared my major as geography. And the following semester, I took my first GIS course and loved it! It was fun and cool to map my own maps.

Q: Did you do any internships in college?

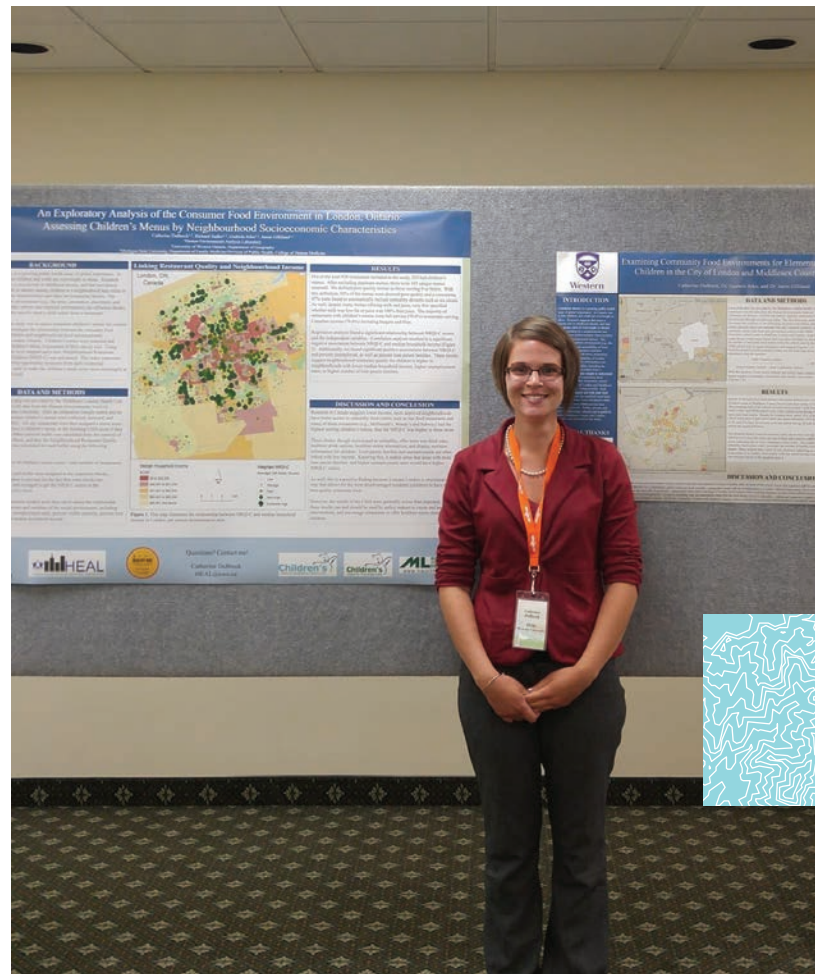
A: During my time in college, I completed three internships, all of which I secured through reaching out to various organizations. My focus was on planning-related internships, inspired by urban planning classes I took. I began by researching organizations in cities I was interested in, and ultimately chose Boston, Massachusetts, for my summer internship. I discovered a transportation planning organization and identified the executive director’s email from their website. I reached out, introducing myself and expressing my interest in learning more about their work and seeking internship

opportunities. The executive director responded promptly, leading to a phone interview with other members of the organization.

As a result, I was hired as a summer intern! Although I didn’t work extensively with GIS during this internship, I had the chance to interact with transportation planners who used GIS and learn from them.

As the summer internship concluded, I used the same approach to secure a fall semester internship with a county planning department where my college was located. By sending a similar email with some minor changes, I was hired as an intern in my college town. This internship offered more GIS-related work compared to the one in Boston.

The experience and skills I gained from these internships led to a third opportunity, with the same county planning organization, as a GIS intern for the spring semester. In this role, I updated county maps and created new maps for public use, further enhancing my expertise in GIS and planning.



Q: What did you get from your internships to prepare you for the workforce?

A: Communication and taking initiative are big ones. How I landed all my internships was an exercise in communication. I gained a sense of confidence in my approach to asking executive leaders for an opportunity at an internship.

I also learned about general office skills and dynamics. Working in an office is a lot different than listening to your professor in class or working in a group with classmates. In an internship, you are working with a group of people in the field, learning from them, and observing how they interact, which I found to be incredibly valuable.

Q: How do you use GIS in your current role?

A: In my current role, I primarily serve as a GIS change management consultant. My main responsibility is to inform and train clients about the changes between different GIS products and versions. For instance, I document information about custom tools used by developers on specific projects. Many of our clients are transitioning from ArcMap and the geometric network to ArcGIS Pro and ArcGIS Utility Network. To facilitate this, I use ArcGIS Pro to take screenshots of custom tools and parameters and create documentation to guide clients in using these new tools, which may differ slightly from what they're accustomed to.

I also create dashboards with ArcGIS Dashboards that utilize new Utility Network data for our clients. While building these dashboards, I often use Arcade expressions to extract information from a specific feature service hosted on their ArcGIS Enterprise portal, enabling the creation of custom widgets. Discovering the possibility of creating custom widgets has been particularly exciting, as it allows me to continuously expand my knowledge of various GIS applications and uses.

Apart from my full-time job, I also teach Introduction to GIS as a part-time instructor for undergraduate students, where I use GIS applications to demonstrate the fundamentals of GIS.

Q: What is your best advice for someone just starting a GIS career?

A: Don't be afraid! Put yourself out there. Send that email to ask about an internship even if nothing is posted to a website. Don't be afraid to say "I don't know" and ask for help. Take a few steps outside of your comfort zone, and often good things will happen as a result.

Go to conferences. I used to not like public speaking and would get very shaky; it just wasn't fun. I stepped out of my comfort zone and decided to submit abstracts for conferences or apply to be part of a poster competition. Those experiences have made me a better public speaker, and now I feel more comfortable because I've gotten more practice. You can also step out of your comfort zone by leaving home for a long time. This can look like taking an internship in another city, like [how I took] one in Boston. The point is, be OK with being uncomfortable.

Q: What's your advice for people attending conferences for the first time?

A: My advice for first-time conference goers is to remember that everyone started out being new to something. It can be overwhelming, especially if you're attending alone, but initiating a conversation with a random attendee can make a significant difference.

For larger conferences, do not pressure yourself to attend every session. With so many great talks and sessions overlapping, it's impossible to see everything. If you miss a session, connect with the speaker afterwards, and I am sure they will be more than happy to share their presentation with you. Prioritize your schedule ahead of time, and intentionally plan out each day to include not only sessions but networking activities as well.

Most people are happy to share their knowledge and chat with you, so take advantage of these opportunities to learn and network.





Q: How do you stay motivated to keep up with training?

A: Understanding the rapid pace of change in GIS technology keeps me motivated to stay updated. Continuous updates in GIS tools, applications, and software keep me interested. For instance, I once took a course on ArcGIS Collector, which has since been replaced by ArcGIS Field Maps—this illustrates the importance of staying informed about GIS.

As an instructor, it's crucial for me to be up-to-date so I can effectively answer student questions about GIS. Additionally, when working with clients or end users on new tools we're developing, I need to provide accurate and current information. Ultimately, my motivation comes from the ability to help others by staying knowledgeable and informed.



Q: What are some GIS career resources you recommend?

A: Use GIS job boards to get an idea of the types of GIS roles that are out there, including internships. In a blog post I wrote, I list various job boards that I recommend bookmarking (links.esri.com/dubreck-blog).

Also, keep up with training, even if you are still in college. Esri has a ton of free training, like the MOOCs [massive open online courses] and Esri Academy courses. If you're a student, it's highly likely that your university or college has an organization license that includes training, so I recommend taking advantage of that.

Be involved with Esri YPN [Young Professionals Network] and become an active participant in the GIS community. You can do this through Esri Community.

About the Authors

Rosemary Boone is a senior industry marketing manager for Esri, concentrating on executing marketing strategies for K–12 schools and higher education institutions. She holds a master's degree in education technology with an emphasis on multimedia. Prior to her career in marketing, she taught elementary school and was a teacher overseas. In her free time, she likes to listen to music, exercise, and spend time with her two dachshunds.

Logan Stevens is an ArcGIS Enterprise release engineer at Esri. He works with numerous ArcGIS Enterprise product teams to gather release requirements for new and existing products. Previously, he was an ArcGIS Enterprise support analyst, where he troubleshooted issues related to various ArcGIS Enterprise technologies. He has a BA and MS in geography from Virginia Tech, where he focused on GIS.



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▶ Connecting Past and Present in an Ohio Cemetery

By Brian Cooke

A city cemetery was established in Oxford, Ohio, in 1817, but burials didn't begin in Oxford Cemetery until 1855. In 2023, the city took over management of this cemetery, and quickly realized that the cemetery records were incomplete. The Oxford Cemetery Association, which ceased operations in 2022, had left only partial records of who was buried there and where their graves could be found.

"The records that the city got from the cemetery association were stacks of interment cards," said Robbyn Abbitt, GIS coordinator for Miami University of Ohio and associate director of the school's Geospatial Analysis Center. "[The city] also had big paper maps

with a grid system that showed ownership. But there were no maps or comprehensive lists showing where people were actually buried. This was a problem, because sometimes the lot owner is not the person interred. There was no way to look up and find who was there and how to find them."

In addition, the paper maps were not drawn to scale, and they showed roads and pathways that have since changed.

To help preserve this site's historical relevance, city staff turned to Abbitt, who guided 54 GIS students—using tools such as ArcGIS Pro, ArcGIS Online, ArcGIS Field Maps, and ArcGIS Hub—to gather cemetery data and then map and share the results.



Putting the Pieces Together with GIS Technology

“The city now has to manage this property,” Abbitt said, “and managing something is hard without knowing what’s there. You had to wander around and hope that the lot owner is the same person or [has the same last] name as the person who is interred.”

On the other hand, the students had a useful resource: notes taken in the 1960s by a local historian named Hazel.

“Hazel had cataloged everyone’s name up to the mid-sixties,” Abbitt said. “That was helpful for headstones that we can no longer read.”

Abbitt listed several desired data categories: veteran plaque placements, empty lot locations, and places where only one partner is buried but both are named on the headstone.

Working for more than 500 hours combined during the university’s fall 2023 and spring 2024 semesters, the students defined locations for more than 6,300 headstones and processed more than 4,300 interment cards.

The project began with data collection. Students used ArcGIS Field Maps, drone imagery

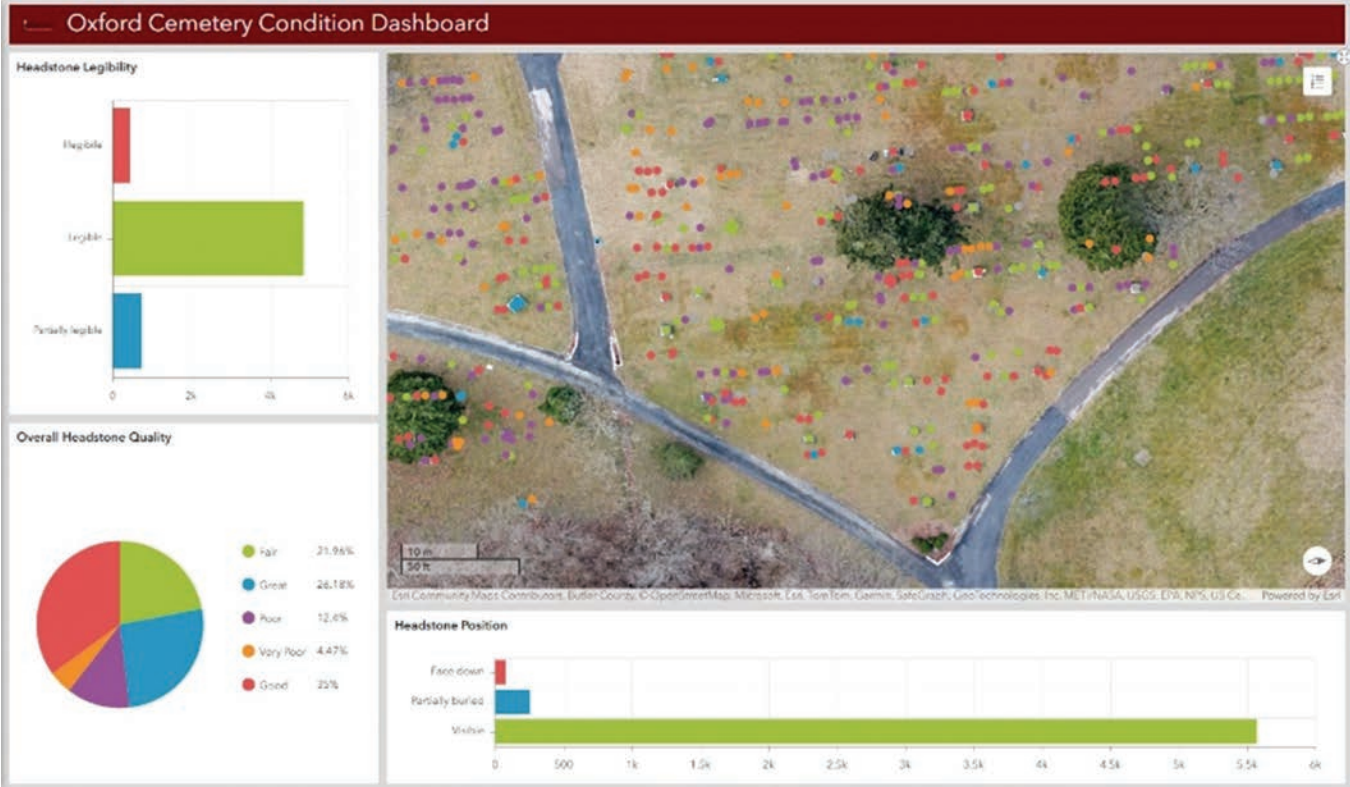
shared by the city, and digitized historical maps to collect features throughout the 31.4-acre property. Using the Create Fishnet geoprocessing tool in ArcGIS Pro to designate sections and individual grave sites, each student could conduct individualized research and build a web map with their own data layer—all while sharing results as they were entered. For their final projects, students were put into teams to create web maps, web apps, and dashboards using this data.

“From a teaching perspective, the ability of multiple people to edit in a single feature class was amazing because it was like an enterprise system. The ability to group edit was a game changer,” Abbitt said.

Using ArcGIS Pro, students could combine their results in a database that included headstone attributes linked with information from hard-copy interment cards from the cemetery files. Data was then stored as feature classes in ArcGIS Online, so the students could easily continue working on and access the data for future visualization needs.

Newly available drone imagery provided a level of detail that Abbitt said was unavailable for her previous GIS classes’ projects.

▼ Newly created Oxford Cemetery dashboards display information such as whether headstones are legible, upright, partially buried, cracked, or missing.





“With drone imagery, we only missed maybe 10 headstones out of more than 6,000.”

Robbyn Abbitt
Miami University

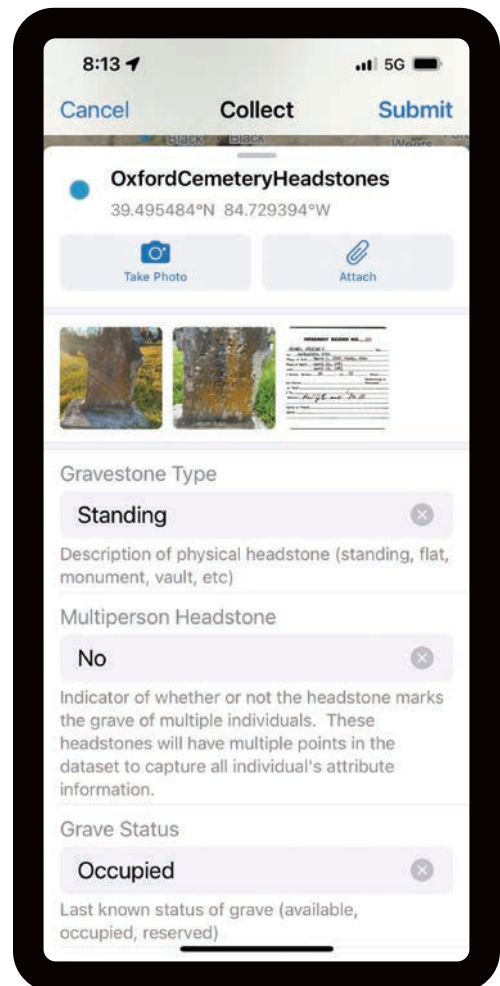
“With drone imagery, we only missed maybe 10 headstones out of more than 6,000,” she said. “We loaded the drone imagery into ArcGIS Online and created a feature service that anyone in the group could edit, and it was built to go into Field Maps when needed. The drone imagery was so good that we could lay down points for everything that looked like a headstone, with no GPS adjusting needed.”

After gathering and integrating this data, the students used various methods to visualize and present information about the cemetery. Tools such as ArcGIS Pro and ArcGIS Online enabled data creation and integration. ArcGIS Field Maps facilitated adding photo attachments and updating data the students collected in the cemetery. ArcGIS Dashboards and ArcGIS StoryMaps helped students tell stories and provide context beyond what was found on the headstones.

Linking Lives and Locations

The results—collected on a website created with ArcGIS Hub—include the students’ maps, apps, and stories created with ArcGIS StoryMaps, providing details such as headstone conditions, notable gravesites, and stories of former town residents interred in the cemetery.

One such story, titled “The Unsung Heroes of Oxford Cemetery,” describes the childhood





friendship and 52-year marriage of Shirley and Robert Younts—including their daily crossword puzzle competition; Shirley’s work at the university’s zoology department; and Robert’s experiences as a university flight instructor, including piloting flights for Martin Luther King Jr. and astronauts Alan Shepard and Neil Armstrong.

After the students completed the project, city staff spent some time determining what to do next with the data for long-term management of the cemetery. Now, the City of Oxford and Miami University have collaborated using ArcGIS Online so that the city can use the data collected by Abbitt and her students to actively manage and update records.

With all this information plus online access to student-made digital maps, associated details, and personal stories related to Oxford Cemetery grave sites, visitors can better understand the cemetery and how it provides connections with the past.

Read about Esri’s latest cemetery management

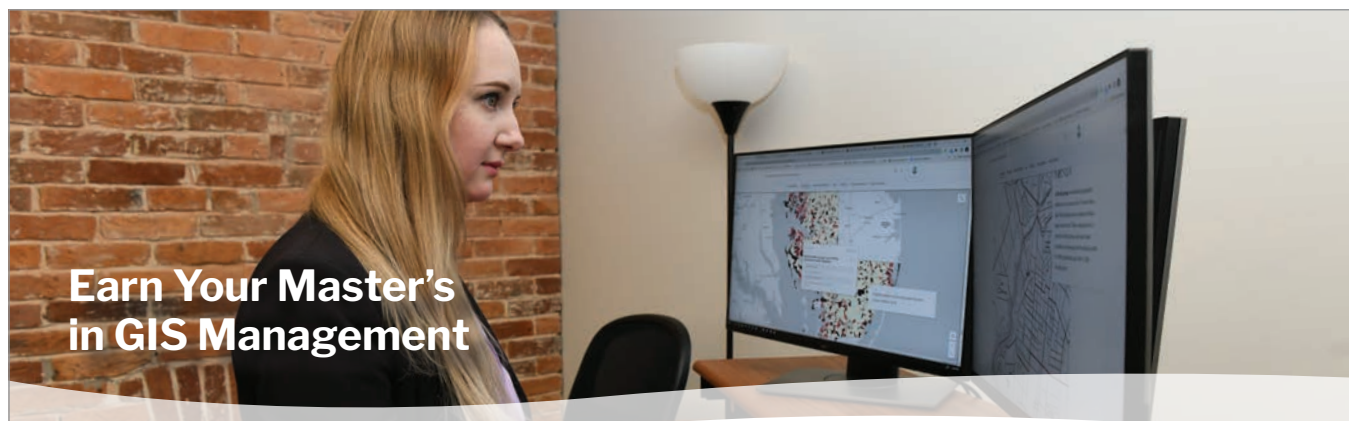
solutions for ArcGIS Online and ArcGIS Enterprise at links.esri.com/cm-s.

Learn more about Miami University’s online GIS certificate program at links.esri.com/ox-gis.

About the Author

Brian Cooke is the editor of Esri’s *ArcWatch* publication and a writer and contributing editor for *ArcNews* and *ArcUser*. He helps readers stay informed about ArcGIS technology and tells compelling stories about how Esri partners and GIS users apply Esri technology. Cooke has worked as a marketplace researcher, an enterprise technology analyst, a technical writer and editor, and an environmental science writer for clients such as the US National Park Service and the US Forest Service. He has a degree in science writing from Lehigh University and a certificate in conservation communications from Colorado State University, where he is seeking a master’s degree in natural resource stewardship.

← Students used an ArcGIS Field Maps app to collect and link data on headstone and grave characteristics.



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Austin Community College Students Find Their Way with Indoor GIS

By Holly Wiese

↑ FIS has installed 46 kiosks with access to the wayfinding map across all ACC campuses.

Navigating the sprawling Austin Community College (ACC) District, with its 11 campuses, 76 buildings, and nearly 4.5 million square feet of interior space, has always been a challenge. Every semester, volunteers are stationed to assist students in finding their way, yet many students still struggle to locate the right room, especially on larger campuses. Until now, there was no way for students to look up locations ahead of time, leading to frustration, stress, and often arriving late to their first classes.

To address this issue, the ACC Facilities Information Systems (FIS) team in Austin, Texas, developed and deployed ACC's first district-wide digital wayfinding map using ArcGIS Indoors.

In 2021, when ACC started integrating CAD floor plans into GIS, the FIS team used a trial version of ArcGIS Indoors and then transitioned to a basic ArcGIS Indoors Pro license. The first success was a 360-degree photo viewer for internal use, which allowed ACC employees to select any space, view the floor plan, see a 360-degree image, and take measurements—all without leaving their desks.

By January 2024, FIS had demonstrated the value of indoor GIS, and with a new mandate from the chancellor to remove barriers for students, the team secured the necessary support and funding to develop a public wayfinding solution. The goal was ambitious: deploy a fully operational system across all 11 campuses by the fall 2024 semester—giving the team just six months to get it done.

Testing and Deployment

In January, FIS upgraded its ArcGIS Indoors license to include the Indoor Viewer and focused on refining CAD and GIS data. Given

ACC's 50-year history, inconsistencies in CAD layers and room names across campuses were expected. FIS meticulously reviewed all 6,569 rooms in the district, renaming them if necessary, and designating each room as either public or private. This ensured that only the appropriate information was visible on the map.

The next challenge was to decide how to symbolize and present the searchable data in the viewer. Should it be district-wide, categorized by campus, or both? The team needed a structure that would be intuitive for users, ensuring they could easily find what they were looking for. The team also needed a point layer showing public-entry doors, welcome centers, and other high-traffic areas.

In April 2024, FIS rolled out a prototype of the viewer to 150 testers, including both ACC students and employees. The feedback was overwhelmingly positive, with excitement about the project tempered by useful suggestions for improvement. While some users found the system intuitive, others requested detailed instructions. They also wanted data to be searchable by campus, and for parking lots and other outdoor spaces to be labeled.

In response to this feedback, FIS spent the following summer refining the viewer and preparing for deployment. By August 2024, just weeks before the semester began, the team had installed 46 kiosks and nine large touch screen TVs across all ACC campuses—ensuring that at least one touch screen device was installed at every location. All the touch screen devices were existing college assets that were repurposed to save the college money and reduce waste.

To further support students, FIS provided 80 iPads for volunteers to borrow on Welcome Day and trained them on using the map. Printed instructions were placed around campus, and the wayfinding map was added to the ACC website and campus brochures.

On the first day of the semester, the new wayfinding map was accessed nearly 4,000 times, a testament to its immediate impact.

The Solution

ACC's new digital wayfinding map revolutionizes how visitors and students navigate the district's campuses. The easy-to-use interface allows users to search for a specific room by number or name, explore district resources, and browse floor plans at any campus within the ACC district. This tool allows anyone planning a visit to ACC to explore parking options and find their destination before stepping on campus.

FIS plans to improve and expand the wayfinding map with routing and ArcGIS IPS. But even now, by bringing floor plans into GIS and leveraging ArcGIS Indoors, ACC has transformed campus navigation, making it easier than ever for students, staff, and visitors to find their way around, and improving the overall campus experience.

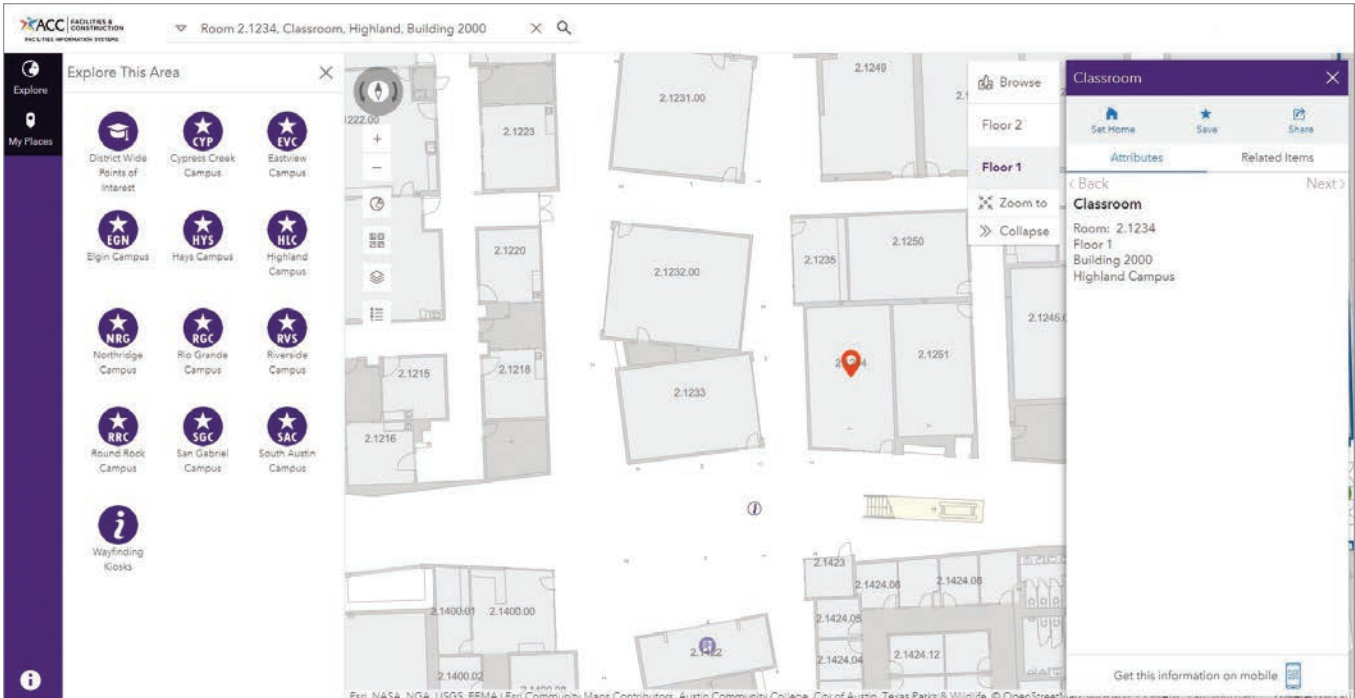
About the Author


Holly Wiese is the GIS coordinator for Austin Community College District's Facilities Information Systems team. Since joining ACC in 2018, she has held various GIS roles. Currently, her efforts focus on developing and implementing cross-departmental GIS solutions to address complex challenges in indoor GIS, wayfinding, and asset management.

→ An ACC volunteer uses an FIS-provided iPad to help a student navigate the wayfinding map on Welcome Day.

↓ ACC's digital wayfinding map empowers users to navigate district resources and search for rooms from kiosks on campus or from their homes.

↓ Led by Deborah Massaro, the FIS team includes two GIS professionals, five GIS interns, and three CAD interns—all of whom are alumni of Austin Community College's GIS or CAD programs and have firsthand experience with the wayfinding challenges at ACC.





Nature-Based Solutions Aim to Fortify Point Hope

By Kimberly Hartley

On a narrow peninsula in northwest Alaska, about 800 people, predominantly Iñupiat, have made Point Hope one of the longest continuously inhabited settlements in North America.

It's a “little point with a lot of history,” said Lauren Bosche of the US Army Corps of Engineers (USACE) Cold Regions Research and Engineering Laboratory. Yet the coastal land where Point Hope was first settled about 2,500 years ago could soon succumb to history itself.

For decades, waves have slowly carved away the northern coast of this narrow piece of land that juts into the Chukchi Sea in the Arctic Ocean. Now, as the region faces a tipping point, Point Hope is increasingly threatened by coastal erosion, thawing permafrost, and rising sea levels.



← Whale bones frame the landscape of Point Hope, Alaska.

Point Hope is increasingly threatened by coastal erosion, thawing permafrost, and rising sea levels.

residents inland since the 1970s. Recently, erosion has accelerated along parts of the coastline. The ice that normally shelters Point Hope's shores is not forming early enough in the year to protect the community from violent fall storms.

These changes have also disrupted the Iñupiat people's ability to hunt wildlife for survival and threatened their cultural heritage.

"There's an incredible amount of archaeological history that's already been taken by the ocean," Bosche said.

Unfortunately, Point Hope's circumstances aren't unique. According to the Woodwell Climate Research Center, the last 20 years have seen a seven percent loss of near-surface permafrost due to a warming climate.

The center's Permafrost Pathways project maps and monitors Arctic warming. Scientists with the center note that permafrost underlies 15 percent of the land in the Northern Hemisphere, and 3.6 million people are at risk if it thaws. Up to 150 billion tons of carbon emissions stored in permafrost could be released into the atmosphere by 2100 as a result. The thaw is also exposing rivers and streams to once-stored minerals that make waterways in parts of Alaska more acidic.

For the Iñupiat people of Point Hope—a place also known as Tikiġaq—the thawing land also

↓ An old, abandoned house illustrates the changing landscape and conditions around Point Hope.

In early 2020, a three-person team from the public benefit corporation and Esri partner EA Engineering, Science, and Technology, Inc., met with members of the trilateral committee that runs the city—the tribal Village of Point Hope, the municipal government of the City of Point Hope, and the Indigenous-owned Tikiġaq Corporation. The team aimed to use GIS technology—including drone imagery and ArcGIS Pro—to get a clearer picture of how the changing climate impacts Point Hope, and what can be done to mitigate the effects of these changes on the environment and the community.

Disappearing Permafrost Threatens the Arctic Region

Erosion now consumes 1–2 meters of coastline annually, which has forced Point Hope's Indigenous

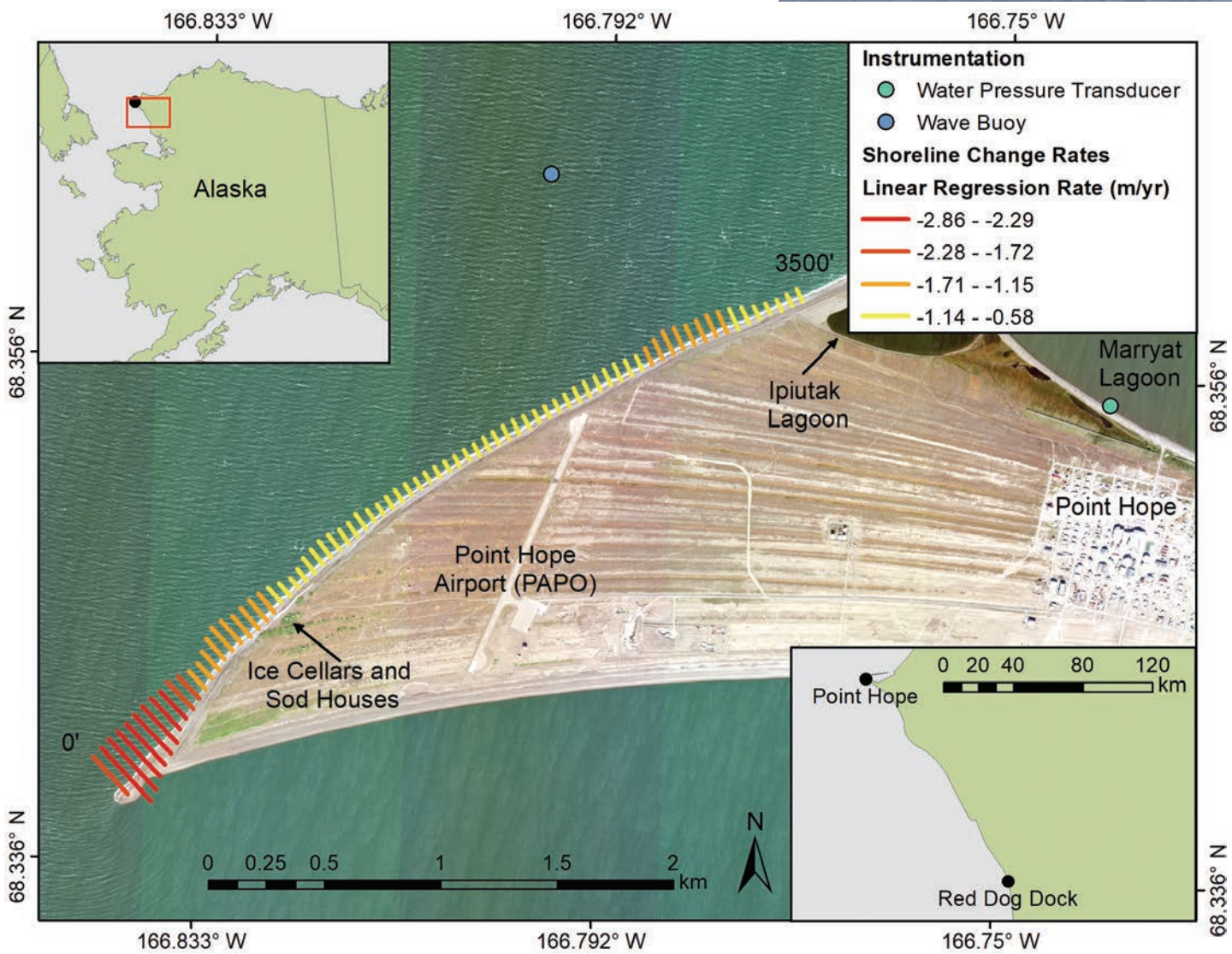



threatens their traditional way of life by making it more difficult to store the meat from their hunts of caribou, whales, and seals. "You can't put a bowhead whale in a chest freezer," said Ellen Jessup McDermott of EA. And people can't simply run to the grocery store. "Point Hope is very isolated. It's very expensive to fly anything in there," she said.

Native residents rely on sigluuqs—large ice cellars carved into the ground that, for generations, have kept meat cold. The community has recently been losing these cellars to erosion and may have fewer than 10 left. In the few that remain, mold or water has crept inside.



↓ This map shows the rate of erosion along the northern coastline of Point Hope, with the most significant changes seen at the western tip of the peninsula.





The maps helped us understand what we saw at the sites and develop a nonverbal intuitive sense of what's happening there.

Ellen Jessup McDermott
EA Engineering, Science,
and Technology, Inc.

Preserving traditional structures is among several priorities that the community of Point Hope outlined in the North Slope Borough's 2017 comprehensive plan.

To tackle the many challenges faced by Point Hope residents, the collaborators needed to fill data gaps. They first collected traditional ecological knowledge—learning from the people who not only live there but also survive on what's there for food.

"They know better than anybody what's going on where they live," Jessup McDermott said. "That data is crucial." She arranged meetings, paying people to participate in formal interviews. Meeting in person was key. And at those meetings, community members were often encouraged to draw what they knew on maps.

One of EA's certified GIS professionals, Jessica Morrissey, used ArcGIS Pro to help the team view

existing conditions, plan fieldwork, and perform spatial analysis. "The maps helped us understand what we saw at the sites and develop a nonverbal, intuitive sense of what's happening there," Jessup McDermott said.

As part of the field effort, EA flew drones to capture up-to-date aerial imagery to accurately study the Point Hope shoreline. With ArcGIS Pro, the images were stitched together and geographically tied to spatial analysis results. This allowed the team to visualize the degree of change over time by comparing historical imagery to the new drone imagery.

Engineering with Nature

Bosche's first site visit was indicative of the challenges that come with living in Point Hope. The journey from Fairbanks, Alaska, where she's based, involved three flights in a small plane that

↑ A project team member uses ground-penetrating radar along the Point Hope shoreline to assess permafrost and groundwater below the surface.

“Indigenous people have been working with nature for thousands of years. Having a safe community that meets your needs is nothing new.”

Lauren Bosche
US Army Corps
of Engineers

could carry 12 people at most. There is no road access—just a seven-mile evacuation route to higher ground if needed.

To get a more up-to-date understanding of Point Hope’s coastal erosion, the team used the US Geological Survey’s Digital Shoreline Analysis System, an ArcGIS-created tool designed to calculate shoreline or boundary changes over time. Bosche and USACE Cold Regions Research and Engineering Laboratory staff added new satellite imagery as well as archive satellite images to detect a wider range of change. EA also used photogrammetry to calculate the shoreline change by depicting areas of accretion, areas of erosion, and areas that remain unchanged.

Spatial analysis models revealed that steeper slopes on the beach exacerbated the erosion because of how the shoreline reacted to higher waves.

Ultimately, the community and the collaborators decided to focus on two priorities. To help slow coastal erosion, they plan to build a dynamic revetment—a gravel or cobblestone wall that reshapes the beach face with larger rocks—and a strengthened sand dune built over an armored core.

Progress on the revetment’s design was about 10 percent complete as of mid-2024. To safeguard the subsistence-hunting lifestyle of the Iñupiat, the team members also plan to repair and enhance the traditional underground cold-storage sites. Traditional ecological knowledge informs the careful selection of a sigluaq site based on the size of sediment grains, which determines its success.

“Indigenous people have been working with nature for thousands of years,” Bosche said. “Having a safe community that meets your needs is nothing new.”

Learn more about how GIS informs climate action strategies for adaptation and mitigation at links.esri.com/climate-action.

About the Author

Kimberly Hartley had been a journalist for 15 years before joining Esri’s writing team in early 2021. She worked as a reporter for *The Virginian-Pilot* in Virginia, the Associated Press in Las Vegas, and both *The Orange County Register* and *The Press-Enterprise* in Southern California under her byline Kimberly Pierceall.

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

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

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

Graduate Degrees

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

Undergraduate Degrees*

- Bachelor of Arts in GIS (BAGIS)
- Bachelor of Science in GIS (BSGIS)

**Offered in person*

Certificates

- Certificates in multiple GIS focus areas

Certificates and graduate degrees are available through in-person, online, and hybrid modalities.

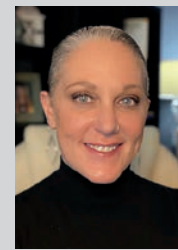


www.redlands.edu/igi

**TOP 10 BEST VALUE
IN THE WEST**

U.S. News and World Report 2025

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



As a graduate student working full-time, Liz not only excelled in her MBA coursework at Redlands, but she also worked alongside faculty members James

Pick and Avijit Sarkar on research projects studying digital divides in Latin America and the U.S. She has co-authored peer-reviewed publications and has returned to Redlands as an adjunct professor, keynote speaker, and mentor to students.

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

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

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

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



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Hats off to you, Monica Pratt!

It is with deep gratitude and a hint of sadness that we celebrate your retirement as Esri's treasured executive editor, publications manager, and editor of *ArcUser*.

For nearly three decades, your contributions to Esri have shaped and elevated our publications. By the time you bid farewell as an employee, you had produced 108 quarterly issues of *ArcUser* magazine and 521 issues of the weekly *Esri Globe* newsletter—all while overseeing the hard work that goes into producing *ArcNews* and *ArcWatch*. Monica, your unwavering work ethic, commitment to excellence, and passion for journalism have not only propelled Esri's mission but also left an enduring impact on each one of us.

From the bottom of our hearts, thank you. We will miss you tremendously and are forever grateful for your dedication and the legacy you've created.

Here's to a wonderful retirement filled with joy and new adventures!

